Appendix E-2: Supplementary Documentation to the 2015 DGAC Report

The 2015 DGAC used a variety of scientifically rigorous approaches to address its science-based questions. These approaches are described in ***Part C. Methodology***. Slightly more than one-third of the questions were answered using a state-of-the-art systematic review process, and these reviews are publically available in the Nutrition Evidence Library (NEL) at www.NEL.gov.

The remaining questions were answered using existing sources of evidence (including systematic reviews, meta-analyses, or reports), data analyses, and food pattern modeling analyses. These three approaches allowed the Committee to ask and answer its questions in a systematic, transparent, and evidence-based way.

Appendix E-2 provides a list of supplementary documentation related to the existing sources of evidence and data analyses used by the Committee in evidence reviews (see ***Appendix E-3*** for ***USDA Food Patterns for Special Analyses***). These sources are publically available online through active links within this document at www.DietaryGuidelines.gov.

CHAPTER 1: FOOD AND NUTRIENT INTAKES AND HEALTH: CURRENT STATUS AND TRENDS

NUTRIENTS OF CONCERN

Appendix E-2.1	Usual intake distributions, 2007-2010, by age/gender groups
Appendix E-2.2	Usual intake distributions as a percent of energy for fatty acids and macronutrients, 2007-2010, by age/gender groups
Appendix E-2.3	Usual intake distributions for individuals age 71 and older, 2007-2010
Appendix E-2.4	Usual intake distributions, 2007-2010, for pregnant and non-pregnant women in the U.S. ages 19-50 years
Appendix E-2.5	Usual intake distributions for supplement users for folate, folic acid, vitamin D, calcium, and iron, 2007-2010, by age/gender groups
Appendix E-2.6	Usual intake distributions for non-supplement users for folate, folic acid, vitamin D, calcium, and iron, 2007-2010, by age/gender groups

FOOD CATEGORIES

Appendix E-2.7	Major categories and subcategories used in DGAC analyses of WWEIA Food Categories
Appendix E-2.8	Percent of total food group intake, 2009-2010, for U.S. population ages 2 years and

EATING BEHAVIORS

HEALTH CONDITIONS

Appendix E-2.24	Prevalence of high and borderline high blood pressure (BP), children and adolescents ages 8-17 years, NHANES 2009-2012

DIETARY PATTERNS

Appendix E-2.25	Average Healthy Eating Index-2010 scores for Americans ages 2 years and older (National Health and Nutrition Examination Survey 2009-2010)

CHAPTER 2: DIETARY PATTERNS, FOODS AND NUTRIENTS, AND HEALTH OUTCOMES

DIETARY PATTERNS AND RISK OF CARDIOVASCULAR DISEASE

Appendix E-2.26	Evidence Portfolio

DIETARY PATTERNS AND MEASURES OF BODY WEIGHT

Appendix E-2.27	Evidence Portfolio

DIETARY PATTERNS AND RISK OF TYPE 2 DIABETES

Appendix E-2.28	Evidence Portfolio

CHAPTER 4: FOOD ENVIRONMENT AND SETTINGS

SCHOOL-BASED APPROACHES AND DIETARY INTAKE

Appendix E-2.29a	Evidence Portfolio
Appendix E-2.29b	Search and Sort Plan

SCHOOL-BASED POLICIES AND DIETARY INTAKE

Appendix E-2.30	Evidence Portfolio
Appendix E-2.29b	Search and Sort Plan

SCHOOL-BASED APPROACHES AND WEIGHT STATUS

Appendix E-2.31	Evidence Portfolio

CHAPTER 5: FOOD SUSTAINABILITY AND SAFETY

Appendix E-2.1: Usual Intake Distributions, 2007-2010, by Age/Gender Groups

Usual Intakes from Food and Beverages 2007-2010 Compared To Dietary Reference Intakes

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

7/2013

Energy (kcal/day)

Energy (kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	1427	(26.5)	931	1026	1202	1408	1629	1844	1975
Males: 4-8	1001	1758	(22.1)	1255	1352	1528	1742	1978	2211	2359
Males: 9-13	850	2137	(42.1)	1479	1604	1831	2103	2397	2682	2864
Males: 14-18	808	2530	(52.5)	1719	1867	2145	2481	2860	3243	3483
Males: 19-30	1113	2695	(49.6)	1621	1822	2187	2640	3144	3637	3948
Males: 31-50	1825	2695	(39.4)	1649	1847	2208	2651	3146	3639	3944
Males: 19-50	2938	2695	(33.9)	1634	1834	2202	2650	3142	3626	3943
Males: 51-70	1773	2337	(30.1)	1413	1584	1900	2291	2726	3166	3437
Males: 71 and over	912	1861	(36.5)	1228	1347	1569	1836	2130	2420	2602
Males: 50 and over	2685	2222	(27.6)	1328	1494	1801	2181	2599	3015	3281
Males: 19 and over	5623	2514	(23.0)	1478	1674	2027	2468	2955	3434	3739
Females: 1-3	712	1364	(24.7)	899	981	1140	1332	1548	1770	1911
Females: 4-8	894	1694	(26.4)	1165	1262	1443	1667	1915	2164	2317
Females: 9-13	867	1865	(33.9)	1261	1373	1584	1839	2113	2385	2551
Females: 14-18	706	1826	(46.8)	1253	1362	1565	1805	2059	2311	2473
Females: 19-30	1039	1855	(34.1)	1206	1329	1554	1830	2137	2443	2631
Females: 31-50	1918	1844	(28.0)	1129	1264	1510	1809	2140	2469	2668
Females: 19-50	2957	1848	(19.6)	1153	1284	1526	1816	2138	2455	2654
Females: 51-70	1738	1716	(23.4)	1111	1223	1432	1688	1971	2259	2440
Females: 71 and over	964	1502	(24.1)	941	1046	1240	1476	1735	1991	2152
Females: 50 and over	2702	1654	(17.7)	1044	1157	1366	1624	1907	2193	2376
Females: 19 and over	5659	1765	(14.7)	1100	1227	1453	1734	2045	2352	2551
All individuals 1 and over	17892	2065	(13.4)	1161	1313	1605	1992	2452	2919	3213

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Protein (g/day)

Protein (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	52.4	(1.39)	31.1	35.1	42.5	51.5	61.2	70.8	76.8
Males: 4-8	1001	60.2	(0.82)	41.0	44.6	51.2	59.3	68.4	77.6	83.4
Males: 9-13	850	77.7	(2.03)	60.3	63.6	69.7	76.8	84.3	91.4	95.9
Males: 14-18	808	95.3	(2.42)	60.2	66.6	78.7	93.3	109.6	126.0	136.2
Males: 19-30	1113	103.4	(2.27)	65.9	73.0	85.8	101.7	119.2	136.3	147.0
Males: 31-50	1825	105.2	(1.69)	67.1	74.5	87.7	103.8	121.6	139.1	149.9
Males: 19-50	2938	104.5	(1.51)	66.3	73.7	87.0	103.1	120.6	137.7	148.8
Males: 51-70	1773	93.5	(1.46)	55.7	62.6	75.5	91.5	109.4	127.7	139.0
Males: 71 and over	912	72.9	(1.65)	47.7	52.4	61.2	71.9	84.0	96.0	103.8
Males: 50 and over	2685	88.5	(1.34)	51.7	58.4	71.0	86.7	104.1	121.4	132.6
Males: 19 and over	5623	98.4	(1.00)	59.2	66.7	80.2	96.8	115.1	132.9	144.3
Females: 1-3	712	51.1	(1.14)	31.9	35.2	41.6	49.6	58.7	68.3	74.4
Females: 4-8	894	58.6	(1.14)	37.2	41.1	48.5	57.5	67.5	77.4	83.5
Females: 9-13	867	64.7	(1.36)	46.1	49.5	56.0	63.8	71.9	79.9	84.7
Females: 14-18	706	63.6	(1.60)	41.9	46.0	53.7	63.0	73.0	83.0	89.5
Females: 19-30	1039	68.3	(1.23)	45.3	49.7	57.7	67.5	78.1	88.5	94.8
Females: 31-50	1918	70.0	(1.01)	43.6	48.7	57.8	68.8	80.9	92.8	100.1
Females: 19-50	2957	69.4	(0.74)	44.1	49.0	57.8	68.3	79.9	91.2	98.3
Females: 51-70	1738	66.4	(1.21)	42.5	46.9	55.2	65.4	76.5	87.8	94.8
Females: 71 and over	964	58.2	(1.03)	35.3	39.6	47.4	57.0	67.7	78.3	85.0
Females: 50 and over	2702	64.0	(0.84)	39.6	44.1	52.5	62.8	74.2	85.5	92.9
Females: 19 and over	5659	67.1	(0.67)	42.0	46.8	55.4	66.0	77.6	89.0	96.4
All individuals 1 and over	17892	78.4	(0.63)	43.2	49.0	60.2	75.4	93.7	112.1	123.4

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Protein (g/day/kg body weight)

Protein (g/day/kg body weight): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	4.37	(0.116)	2.59	2.92	3.54	4.29	5.10	5.90	6.40	0.87	<3	
Males: 4-8	995	2.69	(0.051)	1.65	1.83	2.18	2.63	3.14	3.68	4.03	0.76	<3	
Males: 9-13	847	1.88	(0.053)	1.20	1.33	1.56	1.84	2.15	2.46	2.66	0.76	<3	
Males: 14-18	804	1.46	(0.038)	0.81	0.92	1.13	1.41	1.73	2.06	2.28	0.73	<3	
Males: 19-30	1107	1.41	(0.029)	0.89	0.99	1.17	1.39	1.64	1.88	2.03	0.66	<3	
Males: 31-50	1814	1.39	(0.022)	0.86	0.96	1.14	1.36	1.61	1.85	2.01	0.66	<3	
Males: 19-50	2921	1.40	(0.019)	0.87	0.97	1.15	1.37	1.62	1.86	2.02	0.66	<3	
Males: 51-70	1757	1.23	(0.019)	0.74	0.83	1.00	1.21	1.44	1.69	1.84	0.66	<3	
Males: 71 and over	881	1.01	(0.022)	0.67	0.73	0.85	0.99	1.15	1.32	1.42	0.66	4	(1.4)
Males: 50 and over	2638	1.18	(0.017)	0.70	0.79	0.95	1.16	1.38	1.61	1.76	0.66	3	(0.6)
Males: 19 and over	5559	1.31	(0.012)	0.79	0.89	1.07	1.29	1.54	1.78	1.94	0.66	<3	
Females: 1-3	712	4.26	(0.095)	2.66	2.93	3.47	4.13	4.89	5.69	6.20	0.87	<3	
Females: 4-8	891	2.60	(0.056)	1.55	1.74	2.10	2.54	3.04	3.55	3.86	0.76	<3	
Females: 9-13	865	1.57	(0.035)	0.89	1.01	1.24	1.53	1.85	2.18	2.39	0.76	<3	
Females: 14-18	704	1.11	(0.031)	0.66	0.74	0.90	1.09	1.30	1.51	1.65	0.71	8	(3.5)
Females: 19-30	1034	1.11	(0.020)	0.69	0.77	0.92	1.09	1.29	1.49	1.61	0.66	4	(1.4)
Females: 31-50	1909	1.11	(0.017)	0.67	0.76	0.91	1.09	1.29	1.49	1.61	0.66	4	(1.4)
Females: 19-50	2943	1.11	(0.013)	0.68	0.76	0.91	1.09	1.29	1.49	1.61	0.66	4	(1.1)
Females: 51-70	1722	1.05	(0.019)	0.66	0.73	0.87	1.04	1.22	1.42	1.54	0.66	5	(1.4)
Females: 71 and over	941	0.98	(0.018)	0.57	0.65	0.78	0.96	1.15	1.35	1.47	0.66	11	(1.7)
Females: 50 and over	2663	1.03	(0.013)	0.63	0.70	0.84	1.01	1.20	1.40	1.52	0.66	7	(1.3)
Females: 19 and over	5606	1.08	(0.011)	0.66	0.73	0.88	1.06	1.26	1.45	1.58	0.66	5	(1.0)
All individuals 1 and over	17755	1.47	(0.010)	0.71	0.81	0.99	1.26	1.62	2.35	3.24		3	(0.5)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR. Excludes individuals 4 and over without height and weight data. Body weights outside of normal range are set to the normal weight boundary fitting their height and age/sex for individuals 4-19 and to Body Mass Index cutoffs for individuals 19 and over. Reference weights assumed for children 1-3.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Carbohydrate (g/day)

Carbohydrate (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	195	(3.7)	121	135	161	191	225	258	278	100	<3	
Males: 4-8	1001	241	(3.7)	168	182	208	239	273	306	328	100	<3	
Males: 9-13	850	285	(5.5)	187	206	240	281	326	368	395	100	<3	
Males: 14-18	808	331	(7.2)	214	235	275	323	378	434	469	100	<3	
Males: 19-30	1113	332	(7.3)	186	213	262	324	394	465	510	100	<3	
Males: 31-50	1825	315	(4.3)	174	200	248	307	375	444	487	100	<3	
Males: 19-50	2938	321	(4.0)	178	205	253	314	382	450	495	100	<3	
Males: 51-70	1773	267	(4.1)	153	174	213	261	317	373	408	100	<3	
Males: 71 and over	912	228	(3.6)	142	158	188	224	265	305	331	100	<3	
Males: 50 and over	2685	258	(3.3)	148	168	206	253	305	358	392	100	<3	
Males: 19 and over	5623	297	(2.8)	163	187	232	290	355	420	462	100	<3	
Females: 1-3	712	182	(3.4)	113	125	148	177	209	244	265	100	<3	
Females: 4-8	894	231	(4.0)	155	169	195	228	263	298	320	100	<3	
Females: 9-13	867	253	(5.1)	166	182	212	249	289	329	353	100	<3	
Females: 14-18	706	243	(6.9)	159	175	205	240	277	314	337	100	<3	
Females: 19-30	1039	237	(4.3)	145	162	193	232	277	322	351	100	<3	
Females: 31-50	1918	230	(3.0)	131	149	183	225	272	320	349	100	<3	
Females: 19-50	2957	233	(2.5)	135	153	186	227	274	320	350	100	<3	
Females: 51-70	1738	210	(2.8)	124	140	169	206	246	287	313	100	<3	
Females: 71 and over	964	193	(3.3)	115	129	155	188	225	261	285	100	<3	
Females: 50 and over	2702	205	(2.2)	121	136	165	200	240	280	306	100	<3	
Females: 19 and over	5659	221	(1.7)	128	145	176	216	260	305	334	100	<3	
All individuals 1 and over	17892	256	(1.4)	140	160	198	248	306	365	403	100	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Total sugars (g/day)

Total sugars (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	107	(2.4)	62	70	85	104	125	147	160
Males: 4-8	1001	122	(2.4)	78	86	101	120	141	162	175
Males: 9-13	850	139	(2.7)	85	95	113	135	160	183	198
Males: 14-18	808	163	(4.2)	86	99	124	156	192	230	254
Males: 19-30	1113	152	(4.6)	63	77	105	143	189	238	271
Males: 31-50	1825	140	(2.9)	51	65	92	130	178	229	263
Males: 19-50	2938	145	(2.9)	55	69	97	135	182	232	266
Males: 51-70	1773	117	(3.5)	45	56	78	109	147	190	218
Males: 71 and over	912	102	(2.5)	49	57	75	98	124	151	169
Males: 50 and over	2685	113	(2.6)	45	56	77	106	142	181	207
Males: 19 and over	5623	133	(2.2)	51	63	88	124	167	215	246
Females: 1-3	712	100	(1.8)	59	66	80	97	117	138	152
Females: 4-8	894	116	(2.1)	68	77	93	113	136	159	173
Females: 9-13	867	121	(2.9)	72	81	97	118	141	164	179
Females: 14-18	706	116	(4.2)	72	80	96	114	134	153	166
Females: 19-30	1039	112	(2.9)	50	60	80	106	139	173	195
Females: 31-50	1918	108	(1.9)	46	56	76	102	134	167	189
Females: 19-50	2957	109	(1.8)	47	57	77	104	135	169	191
Females: 51-70	1738	96	(1.8)	45	54	70	92	118	145	163
Females: 71 and over	964	87	(1.7)	42	49	64	83	106	129	144
Females: 50 and over	2702	94	(1.4)	44	52	68	89	114	141	158
Females: 19 and over	5659	103	(1.1)	46	55	73	97	127	157	178
All individuals 1 and over	17892	119	(1.1)	51	62	83	112	147	185	210

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Dietary fiber (g/day)

Dietary fiber (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	10.3	(0.26)	4.9	5.8	7.6	9.9	12.5	15.3	17.0	19	<3	
Males: 4-8	1001	12.8	(0.29)	7.6	8.5	10.3	12.6	15.1	17.7	19.3	25	<3	
Males: 9-13	850	14.5	(0.45)	8.0	9.1	11.3	14.1	17.2	20.5	22.7	31	<3	
Males: 14-18	808	15.5	(0.48)	9.2	10.3	12.4	15.0	18.1	21.3	23.3	38	<3	
Males: 19-30	1113	17.3	(0.53)	8.2	9.8	12.8	16.7	21.3	26.0	29.0	38	<3	
Males: 31-50	1825	19.0	(0.54)	8.5	10.2	13.5	18.0	23.4	29.2	32.9	38	<3	
Males: 19-50	2938	18.3	(0.42)	8.3	10.0	13.2	17.5	22.6	27.9	31.5	38	<3	
Males: 51-70	1773	18.3	(0.50)	8.9	10.5	13.5	17.5	22.2	27.1	30.3	30	5	(1.3)
Males: 71 and over	912	17.0	(0.43)	7.9	9.4	12.3	16.1	20.7	25.6	28.9	30	4	(0.9)
Males: 50 and over	2685	18.0	(0.43)	8.6	10.2	13.2	17.2	21.9	26.7	30.0	30	5	(1.0)
Males: 19 and over	5623	18.2	(0.35)	8.5	10.1	13.2	17.4	22.4	27.5	31.0		<3	
Females: 1-3	712	9.6	(0.23)	4.6	5.4	7.1	9.2	11.6	14.1	15.7	19	<3	
Females: 4-8	894	12.2	(0.31)	7.9	8.7	10.2	12.0	14.1	16.2	17.5	25	<3	
Females: 9-13	867	13.5	(0.45)	8.4	9.2	10.9	13.1	15.6	18.1	19.7	26	<3	
Females: 14-18	706	12.6	(0.40)	6.6	7.6	9.7	12.2	15.1	18.2	20.2	26	<3	
Females: 19-30	1039	13.4	(0.47)	6.4	7.6	9.9	12.8	16.3	19.8	22.1	25	<3	
Females: 31-50	1918	14.9	(0.41)	6.5	7.9	10.6	14.1	18.4	23.0	25.9	25	6	(1.0)
Females: 19-50	2957	14.4	(0.34)	6.4	7.7	10.3	13.7	17.7	21.9	24.7	25	5	(0.8)
Females: 51-70	1738	15.8	(0.37)	8.0	9.3	11.9	15.3	19.2	23.3	25.9	21	17	(2.3)
Females: 71 and over	964	14.5	(0.28)	7.2	8.4	10.7	13.9	17.6	21.4	24.0	21	11	(1.6)
Females: 50 and over	2702	15.4	(0.29)	7.7	9.0	11.5	14.8	18.7	22.8	25.4	21	15	(1.8)
Females: 19 and over	5659	14.8	(0.26)	6.9	8.2	10.8	14.2	18.2	22.4	25.1		9	(0.8)
All individuals 1 and over	17892	15.6	(0.23)	7.1	8.4	11.2	14.8	19.2	23.7	26.7		5	(0.5)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Total fat (g/day)

Total fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	50.9	(1.35)	31.0	34.7	41.6	49.9	58.9	67.8	73.3
Males: 4-8	1001	63.8	(0.99)	43.4	47.3	54.5	63.2	72.9	82.7	88.9
Males: 9-13	850	78.6	(2.10)	51.6	56.5	65.5	76.6	88.8	101.0	108.9
Males: 14-18	808	93.1	(2.61)	61.6	67.4	78.3	91.6	106.6	122.0	131.6
Males: 19-30	1113	95.3	(2.07)	50.8	58.6	73.4	92.3	113.9	135.7	149.6
Males: 31-50	1825	102.1	(2.15)	55.5	63.9	79.5	99.3	122.1	145.4	160.0
Males: 19-50	2938	99.6	(1.72)	53.3	61.7	77.2	96.8	118.9	141.3	156.1
Males: 51-70	1773	91.2	(1.38)	47.1	54.7	69.3	88.1	109.8	132.4	146.6
Males: 71 and over	912	70.6	(1.75)	40.6	45.8	56.0	68.7	83.2	98.1	107.7
Males: 50 and over	2685	86.2	(1.26)	44.2	51.4	65.5	83.4	103.9	125.1	138.9
Males: 19 and over	5623	94.5	(1.17)	49.2	57.3	72.2	91.5	113.7	136.1	150.8
Females: 1-3	712	50.0	(1.03)	31.0	34.3	40.6	48.5	57.5	66.8	72.8
Females: 4-8	894	61.9	(1.22)	41.0	44.9	52.1	61.0	70.7	80.5	86.5
Females: 9-13	867	68.7	(1.54)	41.9	46.6	55.8	67.2	79.9	92.8	100.7
Females: 14-18	706	67.8	(1.99)	45.4	49.6	57.5	67.1	77.5	87.9	94.7
Females: 19-30	1039	67.9	(1.73)	38.1	43.6	53.8	66.5	80.9	95.2	104.1
Females: 31-50	1918	69.0	(1.37)	37.9	43.4	53.8	66.8	81.6	96.6	105.9
Females: 19-50	2957	68.6	(0.92)	38.0	43.5	53.9	66.7	81.3	95.8	105.2
Females: 51-70	1738	66.5	(1.15)	38.2	43.1	52.6	64.8	78.7	93.5	102.9
Females: 71 and over	964	56.5	(1.04)	32.2	36.5	44.7	55.0	66.7	78.6	86.2
Females: 50 and over	2702	63.6	(0.86)	35.7	40.5	49.9	61.8	75.4	89.7	99.1
Females: 19 and over	5659	66.4	(0.69)	37.0	42.3	52.2	64.7	78.9	93.3	102.7
All individuals 1 and over	17892	77.2	(0.70)	39.3	45.6	57.8	74.0	93.2	113.2	126.1

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Saturated fat (g/day)

Saturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	19.4	(0.63)	11.3	12.8	15.5	18.9	22.6	26.3	28.6
Males: 4-8	1001	22.7	(0.43)	14.2	15.8	18.7	22.3	26.4	30.6	33.3
Males: 9-13	850	27.7	(0.89)	17.4	19.2	22.6	26.8	31.4	36.1	39.1
Males: 14-18	808	32.2	(0.96)	19.7	21.9	26.2	31.4	37.4	43.6	47.5
Males: 19-30	1113	31.7	(0.82)	15.4	18.1	23.4	30.3	38.4	46.7	52.1
Males: 31-50	1825	33.8	(0.82)	17.0	19.9	25.4	32.6	41.0	49.7	55.3
Males: 19-50	2938	33.0	(0.69)	16.2	19.2	24.7	31.8	40.0	48.4	54.0
Males: 51-70	1773	29.9	(0.57)	13.7	16.3	21.5	28.4	36.7	45.6	51.3
Males: 71 and over	912	22.7	(0.64)	12.6	14.3	17.7	22.0	27.0	32.2	35.5
Males: 50 and over	2685	28.1	(0.51)	13.0	15.5	20.4	26.8	34.5	42.5	47.9
Males: 19 and over	5623	31.2	(0.47)	14.8	17.6	22.8	29.8	38.1	46.5	52.2
Females: 1-3	712	19.3	(0.43)	11.5	12.8	15.4	18.6	22.3	26.2	28.7
Females: 4-8	894	22.0	(0.56)	14.3	15.7	18.3	21.6	25.2	28.9	31.1
Females: 9-13	867	24.0	(0.60)	14.3	16.0	19.2	23.3	27.9	32.6	35.5
Females: 14-18	706	22.9	(0.65)	14.6	16.1	19.0	22.6	26.4	30.4	33.0
Females: 19-30	1039	22.7	(0.65)	12.0	13.9	17.5	22.1	27.4	32.8	36.2
Females: 31-50	1918	22.8	(0.46)	11.5	13.4	17.1	21.8	27.3	33.1	36.7
Females: 19-50	2957	22.7	(0.31)	11.7	13.6	17.3	21.9	27.3	32.9	36.5
Females: 51-70	1738	21.6	(0.45)	11.3	13.0	16.4	20.8	26.0	31.6	35.2
Females: 71 and over	964	18.6	(0.36)	9.9	11.4	14.2	17.9	22.2	26.7	29.6
Females: 50 and over	2702	20.7	(0.34)	10.7	12.4	15.6	19.9	24.9	30.3	33.8
Females: 19 and over	5659	21.9	(0.27)	11.3	13.1	16.6	21.1	26.4	31.8	35.5
All individuals 1 and over	17892	25.8	(0.27)	12.4	14.6	18.9	24.6	31.5	38.7	43.5

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Monounsaturated fat (g/day)

Monounsaturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	18.0	(0.49)	10.3	11.7	14.3	17.5	21.0	24.6	26.8
Males: 4-8	1001	23.2	(0.39)	15.9	17.3	19.8	22.9	26.4	29.9	32.1
Males: 9-13	850	28.5	(0.74)	19.0	20.7	23.9	27.8	32.1	36.3	39.1
Males: 14-18	808	34.0	(1.03)	22.3	24.5	28.5	33.5	39.2	45.0	48.6
Males: 19-30	1113	34.7	(0.79)	18.3	21.2	26.6	33.6	41.6	49.6	54.8
Males: 31-50	1825	38.1	(0.80)	20.6	23.7	29.6	37.0	45.5	54.3	59.8
Males: 19-50	2938	36.8	(0.63)	19.6	22.6	28.4	35.7	44.0	52.4	58.0
Males: 51-70	1773	33.8	(0.49)	17.5	20.3	25.7	32.6	40.7	49.1	54.4
Males: 71 and over	912	26.4	(0.65)	14.4	16.4	20.4	25.5	31.4	37.6	41.7
Males: 50 and over	2685	32.0	(0.47)	16.3	19.0	24.2	30.9	38.6	46.6	51.9
Males: 19 and over	5623	35.0	(0.42)	18.1	21.1	26.6	33.8	42.2	50.6	56.1
Females: 1-3	712	17.5	(0.32)	10.5	11.7	14.0	16.8	20.2	23.7	25.9
Females: 4-8	894	22.3	(0.47)	14.2	15.7	18.4	21.9	25.7	29.5	31.9
Females: 9-13	867	24.8	(0.56)	14.9	16.7	20.0	24.2	28.9	33.7	36.6
Females: 14-18	706	24.6	(0.95)	16.0	17.5	20.5	24.2	28.1	32.2	34.8
Females: 19-30	1039	24.3	(0.64)	13.2	15.2	19.0	23.8	29.2	34.7	38.1
Females: 31-50	1918	25.0	(0.54)	13.2	15.3	19.2	24.1	29.7	35.5	39.1
Females: 19-50	2957	24.7	(0.36)	13.2	15.3	19.2	24.0	29.5	35.1	38.8
Females: 51-70	1738	24.0	(0.47)	13.6	15.4	18.9	23.4	28.5	33.9	37.3
Females: 71 and over	964	20.2	(0.40)	11.6	13.2	16.0	19.7	23.8	28.0	30.7
Females: 50 and over	2702	22.9	(0.34)	12.7	14.5	17.9	22.2	27.2	32.4	35.8
Females: 19 and over	5659	23.9	(0.26)	13.0	15.0	18.6	23.2	28.6	34.0	37.6
All individuals 1 and over	17892	28.2	(0.26)	13.9	16.3	20.8	26.9	34.2	41.8	46.7

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Polyunsaturated fat (g/day)

Polyunsaturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	9.3	(0.25)	5.0	5.7	7.1	9.0	11.1	13.3	14.8
Males: 4-8	1001	12.7	(0.21)	8.5	9.3	10.7	12.5	14.6	16.6	17.9
Males: 9-13	850	15.8	(0.63)	9.3	10.5	12.6	15.3	18.4	21.5	23.7
Males: 14-18	808	18.9	(0.62)	12.6	13.7	15.9	18.5	21.5	24.6	26.6
Males: 19-30	1113	20.5	(0.50)	11.3	12.9	16.0	19.9	24.5	29.1	32.1
Males: 31-50	1825	21.2	(0.45)	11.5	13.2	16.4	20.6	25.6	30.8	34.2
Males: 19-50	2938	20.9	(0.37)	11.4	13.1	16.3	20.4	25.1	30.0	33.3
Males: 51-70	1773	19.7	(0.35)	10.6	12.1	15.1	19.0	23.6	28.4	31.5
Males: 71 and over	912	15.5	(0.42)	8.1	9.3	11.7	14.8	18.6	22.6	25.3
Males: 50 and over	2685	18.7	(0.29)	9.7	11.2	14.2	18.0	22.5	27.2	30.3
Males: 19 and over	5623	20.1	(0.28)	10.7	12.3	15.4	19.5	24.2	29.1	32.4
Females: 1-3	712	9.1	(0.30)	4.9	5.6	7.0	8.7	10.8	13.1	14.6
Females: 4-8	894	12.6	(0.29)	7.8	8.7	10.3	12.3	14.6	16.8	18.3
Females: 9-13	867	14.3	(0.37)	8.4	9.4	11.4	13.9	16.8	19.8	21.8
Females: 14-18	706	14.8	(0.53)	9.0	10.1	12.1	14.6	17.4	20.2	22.2
Females: 19-30	1039	14.9	(0.44)	8.5	9.6	11.8	14.6	17.7	21.0	23.0
Females: 31-50	1918	15.3	(0.34)	8.6	9.8	12.0	14.8	18.1	21.5	23.6
Females: 19-50	2957	15.2	(0.27)	8.5	9.7	12.0	14.7	18.0	21.2	23.4
Females: 51-70	1738	15.3	(0.27)	8.5	9.7	11.9	14.8	18.2	21.8	24.2
Females: 71 and over	964	12.9	(0.27)	6.4	7.5	9.6	12.3	15.6	19.1	21.4
Females: 50 and over	2702	14.6	(0.21)	7.7	8.9	11.1	14.0	17.5	21.2	23.6
Females: 19 and over	5659	14.9	(0.19)	8.2	9.4	11.6	14.4	17.8	21.2	23.5
All individuals 1 and over	17892	16.5	(0.18)	8.3	9.7	12.3	15.9	20.1	24.4	27.4

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

PFA 18:2 (g/day)

PFA 18:2 (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	8.2	(0.23)	4.2	4.9	6.2	7.9	9.8	11.9	13.3	7	63	(3.1)
Males: 4-8	1001	11.3	(0.19)	7.5	8.2	9.5	11.2	13.1	15.0	16.2	10	68	(3.8)
Males: 9-13	850	14.1	(0.59)	8.1	9.1	11.1	13.6	16.5	19.5	21.5	12	66	(4.3)
Males: 14-18	808	16.8	(0.56)	11.2	12.2	14.1	16.5	19.2	22.0	23.8	16	55	(6.5)
Males: 19-30	1113	18.0	(0.45)	10.0	11.4	14.1	17.5	21.6	25.7	28.4	17	54	(3.3)
Males: 31-50	1825	18.7	(0.41)	10.0	11.5	14.4	18.2	22.7	27.5	30.5	17	58	(2.6)
Males: 19-50	2938	18.5	(0.33)	9.9	11.5	14.3	18.0	22.3	26.7	29.7	17	57	(2.4)
Males: 51-70	1773	17.3	(0.31)	9.0	10.5	13.2	16.7	20.9	25.3	28.1	14	69	(1.9)
Males: 71 and over	912	13.6	(0.38)	6.9	8.0	10.2	13.0	16.4	20.0	22.4	14	42	(3.1)
Males: 50 and over	2685	16.4	(0.26)	8.3	9.7	12.3	15.8	19.9	24.2	27.0	14	63	(1.7)
Males: 19 and over	5623	17.7	(0.25)	9.3	10.7	13.5	17.1	21.4	25.9	28.8		59	(1.8)
Females: 1-3	712	8.0	(0.27)	4.2	4.8	6.0	7.6	9.5	11.7	13.1	7	60	(3.4)
Females: 4-8	894	11.2	(0.27)	6.9	7.7	9.1	11.0	13.1	15.2	16.5	10	64	(3.3)
Females: 9-13	867	12.7	(0.34)	7.3	8.2	10.0	12.4	15.1	17.9	19.7	10	75	(4.3)
Females: 14-18	706	13.2	(0.50)	8.0	8.9	10.8	13.0	15.6	18.2	19.9	11	73	(7.1)
Females: 19-30	1039	13.2	(0.40)	7.4	8.4	10.4	12.9	15.7	18.6	20.5	12	59	(3.8)
Females: 31-50	1918	13.6	(0.31)	7.5	8.5	10.6	13.1	16.1	19.1	21.1	12	61	(3.5)
Females: 19-50	2957	13.4	(0.24)	7.4	8.5	10.5	13.0	15.9	18.9	20.9	12	60	(3.0)
Females: 51-70	1738	13.4	(0.24)	7.3	8.4	10.4	13.0	16.1	19.4	21.5	11	69	(1.6)
Females: 71 and over	964	11.3	(0.24)	5.6	6.5	8.4	10.8	13.7	16.8	18.8	11	48	(2.4)
Females: 50 and over	2702	12.8	(0.18)	6.7	7.7	9.7	12.3	15.4	18.7	21.0	11	63	(1.3)
Females: 19 and over	5659	13.2	(0.17)	7.1	8.2	10.1	12.7	15.7	18.9	20.9		61	(1.9)
All individuals 1 and over	17892	14.6	(0.16)	7.2	8.4	10.8	14.0	17.8	21.7	24.4		62	(1.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

PFA 18:3 (g/day)

PFA 18:3 (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	0.83	(0.018)	0.49	0.55	0.67	0.82	0.98	1.15	1.25	0.7	70	(3.2)
Males: 4-8	1001	1.02	(0.022)	0.65	0.72	0.84	1.00	1.18	1.37	1.49	0.9	66	(4.1)
Males: 9-13	850	1.25	(0.052)	0.74	0.83	1.00	1.21	1.46	1.71	1.89	1.2	51	(5.0)
Males: 14-18	808	1.52	(0.062)	0.89	0.99	1.19	1.45	1.76	2.09	2.31	1.6	36	(5.4)
Males: 19-30	1113	1.78	(0.050)	0.87	1.02	1.31	1.69	2.16	2.64	2.96	1.6	56	(3.4)
Males: 31-50	1825	1.78	(0.043)	0.95	1.09	1.36	1.72	2.15	2.61	2.91	1.6	58	(2.8)
Males: 19-50	2938	1.78	(0.035)	0.91	1.06	1.34	1.71	2.15	2.61	2.92	1.6	58	(2.5)
Males: 51-70	1773	1.77	(0.039)	0.98	1.11	1.37	1.70	2.10	2.52	2.78	1.6	58	(2.5)
Males: 71 and over	912	1.41	(0.041)	0.76	0.86	1.07	1.34	1.67	2.04	2.29	1.6	30	(2.9)
Males: 50 and over	2685	1.68	(0.031)	0.91	1.04	1.29	1.62	2.00	2.41	2.68	1.6	51	(2.0)
Males: 19 and over	5623	1.74	(0.028)	0.92	1.05	1.32	1.68	2.10	2.54	2.84	1.6	55	(2.0)
Females: 1-3	712	0.86	(0.028)	0.47	0.53	0.66	0.82	1.02	1.24	1.38	0.7	69	(3.9)
Females: 4-8	894	1.01	(0.022)	0.68	0.74	0.85	0.99	1.15	1.30	1.40	0.9	67	(4.4)
Females: 9-13	867	1.13	(0.038)	0.65	0.73	0.89	1.10	1.33	1.59	1.75	1	62	(3.9)
Females: 14-18	706	1.19	(0.035)	0.66	0.75	0.93	1.16	1.43	1.71	1.91	1.1	57	(4.9)
Females: 19-30	1039	1.33	(0.041)	0.75	0.85	1.04	1.28	1.56	1.86	2.04	1.1	69	(4.7)
Females: 31-50	1918	1.33	(0.039)	0.75	0.85	1.04	1.28	1.56	1.86	2.05	1.1	69	(4.9)
Females: 19-50	2957	1.33	(0.030)	0.75	0.85	1.04	1.28	1.56	1.85	2.04	1.1	69	(3.6)
Females: 51-70	1738	1.40	(0.029)	0.81	0.91	1.10	1.35	1.64	1.96	2.18	1.1	75	(3.0)
Females: 71 and over	964	1.25	(0.032)	0.57	0.67	0.87	1.15	1.51	1.91	2.19	1.1	54	(2.6)
Females: 50 and over	2702	1.35	(0.025)	0.72	0.82	1.02	1.29	1.61	1.96	2.21	1.1	68	(2.0)
Females: 19 and over	5659	1.34	(0.023)	0.74	0.84	1.03	1.28	1.59	1.91	2.12	1.1	68	(2.2)
All individuals 1 and over	17892	1.43	(0.018)	0.72	0.83	1.06	1.36	1.73	2.12	2.38		61	(1.5)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Cholesterol (mg/day)

Cholesterol (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	Above 300 mg: %	Above 300 mg: SE
Males: 1-3	772	171	(7.7)	72	87	117	158	209	266	305	5	(1.8)
Males: 4-8	1001	195	(6.3)	107	120	146	181	224	272	305	6	(1.9)
Males: 9-13	850	241	(10.2)	127	145	181	227	281	338	376	19	(4.3)
Males: 14-18	808	303	(11.9)	182	202	241	290	346	405	442	45	(6.9)
Males: 19-30	1113	344	(10.6)	180	207	260	330	414	501	559	61	(3.8)
Males: 31-50	1825	374	(9.3)	190	220	278	355	446	543	606	68	(2.7)
Males: 19-50	2938	363	(7.5)	185	215	272	346	433	525	587	66	(2.6)
Males: 51-70	1773	339	(7.2)	147	177	236	317	415	522	591	55	(2.4)
Males: 71 and over	912	274	(10.2)	120	143	192	258	342	434	498	36	(3.4)
Males: 50 and over	2685	323	(5.8)	137	166	224	302	398	502	573	51	(1.8)
Males: 19 and over	5623	348	(5.1)	165	194	251	329	422	521	588	59	(1.5)
Females: 1-3	712	170	(5.1)	79	91	119	156	204	260	299	5	(1.9)
Females: 4-8	894	182	(5.3)	123	133	152	176	203	231	248	<3	
Females: 9-13	867	208	(8.0)	111	126	157	196	242	291	323	8	(3.2)
Females: 14-18	706	203	(7.9)	120	134	162	197	237	279	307	6	(3.5)
Females: 19-30	1039	218	(8.1)	99	118	156	206	268	334	376	16	(3.7)
Females: 31-50	1918	238	(6.0)	123	141	178	225	282	342	380	19	(2.7)
Females: 19-50	2957	231	(4.7)	113	132	170	219	277	339	381	18	(2.4)
Females: 51-70	1738	228	(8.2)	105	124	163	215	278	347	393	19	(3.2)
Females: 71 and over	964	189	(4.7)	97	113	143	183	230	280	313	7	(1.8)
Females: 50 and over	2702	217	(5.2)	101	119	156	205	264	328	372	15	(2.1)
Females: 19 and over	5659	225	(4.1)	108	127	163	213	272	335	378	17	(1.9)
All individuals 1 and over	17892	267	(3.6)	115	137	182	246	326	414	473	32	(1.2)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. No Dietary Reference Intakes have been established for cholesterol; percentage of individuals with usual intake above 300 mg.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Moisture (g/day)

Moisture (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	1372	(26.6)	821	916	1098	1327	1589	1862	2037	1300	53	(2.6)
Males: 4-8	1001	1427	(25.0)	898	987	1157	1378	1643	1926	2117	1700	21	(2.4)
Males: 9-13	850	1867	(48.6)	1122	1251	1494	1806	2164	2532	2778	2400	14	(3.7)
Males: 14-18	808	2692	(107.6)	1397	1585	1970	2486	3142	3885	4392	3300	21	(3.5)
Males: 19-30	1113	3480	(88.6)	1776	2038	2553	3264	4154	5129	5799	3700	36	(3.0)
Males: 31-50	1825	3647	(67.5)	2014	2296	2828	3511	4312	5148	5681	3700	43	(2.3)
Males: 19-50	2938	3584	(62.0)	1911	2190	2723	3426	4252	5123	5719	3700	41	(2.1)
Males: 51-70	1773	3277	(59.0)	1779	2023	2499	3130	3886	4706	5240	3700	30	(2.1)
Males: 71 and over	912	2378	(44.7)	1418	1580	1896	2297	2764	3250	3570	3700	4	(0.9)
Males: 50 and over	2685	3061	(45.8)	1604	1841	2306	2920	3647	4415	4937	3700	24	(1.6)
Males: 19 and over	5623	3384	(41.4)	1769	2037	2547	3227	4037	4887	5463	3700	34	(1.5)
Females: 1-3	712	1318	(25.1)	852	934	1094	1288	1505	1729	1870	1300	48	(3.4)
Females: 4-8	894	1405	(29.3)	901	987	1152	1365	1609	1864	2025	1700	18	(2.9)
Females: 9-13	867	1657	(38.8)	1061	1156	1345	1590	1872	2172	2366	2100	13	(2.6)
Females: 14-18	706	2060	(68.6)	1098	1255	1567	1968	2428	2918	3250	2300	31	(4.4)
Females: 19-30	1039	2591	(76.9)	1352	1544	1920	2431	3057	3741	4193	2700	38	(3.5)
Females: 31-50	1918	2847	(35.9)	1477	1704	2143	2719	3410	4152	4626	2700	51	(1.6)
Females: 19-50	2957	2755	(36.9)	1414	1632	2055	2615	3286	4009	4498	2700	46	(1.6)
Females: 51-70	1738	2728	(46.6)	1474	1683	2088	2616	3231	3890	4320	2700	46	(1.9)
Females: 71 and over	964	2122	(35.8)	1183	1342	1645	2038	2498	2975	3291	2700	17	(1.5)
Females: 50 and over	2702	2551	(36.0)	1336	1534	1924	2435	3032	3663	4089	2700	38	(1.6)
Females: 19 and over	5659	2668	(26.9)	1385	1595	1998	2536	3183	3866	4331	2700	43	(1.2)
All individuals 1 and over	17892	2703	(26.6)	1148	1382	1872	2539	3325	4151	4703		35	(1.0)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin A (µg RAE/day)

Vitamin A (µg RAE/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	605	(22.9)	313	363	461	585	725	869	960	210	<3		600	25	(3.0)
Males: 4-8	1001	609	(14.8)	358	404	489	595	715	835	913	275	<3		900	<3	
Males: 9-13	850	659	(30.5)	350	404	507	639	789	942	1042	445	15	(4.4)	1700	<3	
Males: 14-18	808	673	(33.6)	335	390	499	639	807	985	1100	630	49	(5.4)	2800	<3	
Males: 19-30	1113	610	(20.7)	249	304	416	574	773	991	1139	625	57	(3.2)	3000	<3	
Males: 31-50	1825	671	(19.3)	271	334	460	634	851	1089	1245	625	49	(2.5)	3000	<3	
Males: 19-50	2938	648	(12.8)	261	321	443	612	821	1048	1206	625	52	(2.1)	3000	<3	
Males: 51-70	1773	681	(17.2)	252	316	449	635	867	1125	1294	625	49	(2.4)	3000	<3	
Males: 71 and over	912	717	(27.9)	323	383	507	678	893	1132	1297	625	42	(4.1)	3000	<3	
Males: 50 and over	2685	690	(17.2)	268	331	464	647	874	1125	1299	625	47	(2.5)	3000	<3	
Males: 19 and over	5623	664	(11.6)	264	324	449	624	844	1085	1249	625	50	(1.7)	3000	<3	
Females: 1-3	712	566	(20.2)	309	353	439	546	671	801	884	210	<3		600	20	(4.4)
Females: 4-8	894	546	(15.1)	300	343	425	531	651	775	852	275	3	(1.5)	900	<3	
Females: 9-13	867	576	(24.6)	284	332	428	553	696	846	941	420	24	(3.4)	1700	<3	
Females: 14-18	706	495	(23.7)	223	266	354	473	612	765	869	485	53	(4.6)	2800	<3	
Females: 19-30	1039	515	(17.3)	210	257	351	484	651	837	960	500	53	(2.9)	3000	<3	
Females: 31-50	1918	569	(25.2)	220	272	378	530	726	950	1100	500	45	(3.2)	3000	<3	
Females: 19-50	2957	549	(18.4)	216	266	369	513	698	906	1050	500	48	(2.5)	3000	<3	
Females: 51-70	1738	649	(21.1)	246	303	421	591	810	1063	1238	500	37	(2.7)	3000	<3	
Females: 71 and over	964	616	(17.3)	284	334	435	574	746	934	1063	500	37	(2.9)	3000	<3	
Females: 50 and over	2702	640	(14.6)	255	309	424	585	791	1024	1187	500	37	(2.1)	3000	<3	
Females: 19 and over	5659	588	(12.7)	231	282	390	543	741	963	1118	500	43	(1.9)	3000	<3	
All individuals 1 and over	17892	616	(9.0)	254	310	423	579	774	986	1132		40	(1.4)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. Vitamin A measured in Retinol Activity Equivalents (RAE). Comparison to the UL is for the retinol component only.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Alpha-carotene (µg/day)

Alpha-carotene (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	302	(48)	15	24	48	99	199	368	529
Males: 4-8	1001	272	(33)	17	27	51	94	170	283	380
Males: 9-13	850	290	(48)	11	17	37	85	188	380	565
Males: 14-18	808	236	(39)	14	21	40	75	137	230	311
Males: 19-30	1113	316	(26)	20	32	66	130	243	417	568
Males: 31-50	1825	394	(49)	29	44	84	161	300	516	708
Males: 19-50	2938	365	(32)	25	39	77	150	278	474	651
Males: 51-70	1773	401	(27)	30	47	93	186	362	649	913
Males: 71 and over	912	476	(39)	31	50	103	220	459	878	1274
Males: 50 and over	2685	419	(26)	30	47	95	195	383	699	997
Males: 19 and over	5623	385	(25)	25	40	82	165	321	568	796
Females: 1-3	712	205	(24)	7	13	31	77	189	412	653
Females: 4-8	894	262	(37)	13	21	44	88	165	288	391
Females: 9-13	867	243	(35)	14	22	42	76	131	205	270
Females: 14-18	706	255	(49)	10	16	35	78	165	313	464
Females: 19-30	1039	283	(26)	17	26	54	111	223	405	576
Females: 31-50	1918	398	(41)	24	37	73	152	309	581	838
Females: 19-50	2957	356	(28)	21	32	65	136	275	518	750
Females: 51-70	1738	465	(36)	46	68	124	237	441	760	1042
Females: 71 and over	964	429	(35)	38	56	106	206	387	683	941
Females: 50 and over	2702	454	(29)	44	64	119	229	428	737	1017
Females: 19 and over	5659	398	(22)	26	41	82	169	339	626	899
All individuals 1 and over	17892	358	(15)	20	32	66	140	287	531	761

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Beta-carotene (µg/day)

Beta-carotene (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	1159	(119.6)	238	305	466	739	1165	1767	2249
Males: 4-8	1001	1231	(109.6)	229	302	481	801	1329	2098	2748
Males: 9-13	850	1176	(138.8)	263	337	511	805	1258	1869	2369
Males: 14-18	808	1259	(120.8)	312	386	555	817	1203	1704	2081
Males: 19-30	1113	1525	(83.2)	384	499	763	1200	1857	2702	3352
Males: 31-50	1825	2083	(172.0)	383	526	872	1479	2450	3792	4841
Males: 19-50	2938	1874	(111.6)	375	508	824	1370	2217	3352	4279
Males: 51-70	1773	2226	(134.2)	470	634	1026	1700	2741	4160	5245
Males: 71 and over	912	2460	(176.6)	500	669	1085	1795	2898	4390	5572
Males: 50 and over	2685	2282	(126.8)	474	637	1043	1728	2781	4197	5323
Males: 19 and over	5623	2030	(90.2)	405	547	893	1496	2444	3729	4749
Females: 1-3	712	952	(67.5)	167	228	390	680	1165	1886	2481
Females: 4-8	894	1093	(88.8)	218	283	444	729	1189	1850	2381
Females: 9-13	867	1185	(113.0)	331	400	559	807	1155	1601	1930
Females: 14-18	706	1181	(141.6)	232	303	477	777	1244	1908	2468
Females: 19-30	1039	1514	(126.4)	192	282	520	985	1795	2999	3983
Females: 31-50	1918	2045	(159.7)	313	440	764	1363	2377	3868	5065
Females: 19-50	2957	1854	(118.1)	258	371	664	1216	2155	3548	4727
Females: 51-70	1738	2601	(138.0)	590	781	1236	2001	3153	4712	5916
Females: 71 and over	964	2284	(142.7)	512	679	1073	1742	2762	4117	5186
Females: 50 and over	2702	2509	(109.9)	564	744	1181	1915	3027	4520	5682
Females: 19 and over	5659	2133	(89.4)	348	486	836	1482	2555	4077	5334
All individuals 1 and over	17892	1852	(59.4)	311	430	728	1273	2170	3426	4475

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Beta-cryptoxanthin (µg/day)

Beta-cryptoxanthin (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	73	(10)	8	12	22	42	81	144	202
Males: 4-8	1001	79	(8)	10	16	29	53	93	151	200
Males: 9-13	850	60	(7)	8	12	21	39	66	106	138
Males: 14-18	808	71	(9)	9	14	25	43	71	108	138
Males: 19-30	1113	70	(6)	13	19	33	52	78	109	133
Males: 31-50	1825	84	(7)	12	17	29	52	91	151	201
Males: 19-50	2938	79	(5)	13	18	30	51	87	136	179
Males: 51-70	1773	98	(11)	10	15	30	59	112	193	264
Males: 71 and over	912	93	(7)	13	19	34	63	111	179	236
Males: 50 and over	2685	97	(8)	11	16	31	60	111	190	258
Males: 19 and over	5623	86	(4)	11	16	30	54	97	159	212
Females: 1-3	712	83	(10)	7	11	22	43	82	143	194
Females: 4-8	894	77	(9)	12	16	28	48	81	129	167
Females: 9-13	867	57	(6)	17	21	30	45	66	93	113
Females: 14-18	706	46	(4)	5	8	16	32	57	95	128
Females: 19-30	1039	62	(5)	9	13	23	39	63	94	119
Females: 31-50	1918	86	(13)	10	14	26	48	87	148	199
Females: 19-50	2957	77	(9)	9	14	25	45	78	127	169
Females: 51-70	1738	89	(6)	13	19	35	61	99	152	192
Females: 71 and over	964	90	(7)	12	18	32	60	105	168	219
Females: 50 and over	2702	90	(6)	13	19	34	60	102	157	203
Females: 19 and over	5659	83	(6)	10	15	28	51	89	143	188
All individuals 1 and over	17892	80	(4)	10	15	27	50	88	143	189

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Lycopene (µg/day)

Lycopene (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	3106	(312)	872	1192	1920	2867	3922	4953	5556
Males: 4-8	1001	4103	(215)	986	1438	2456	3907	5678	7569	8806
Males: 9-13	850	4737	(299)	2110	2537	3411	4586	6009	7554	8566
Males: 14-18	808	7087	(719)	2690	3323	4693	6515	8780	11139	12689
Males: 19-30	1113	7347	(553)	2734	3360	4635	6472	8802	11470	13312
Males: 31-50	1825	7235	(431)	2437	3050	4355	6298	8850	11795	13871
Males: 19-50	2938	7277	(334)	2570	3180	4471	6364	8866	11717	13737
Males: 51-70	1773	5853	(314)	1632	2162	3300	5058	7460	10344	12418
Males: 71 and over	912	4835	(388)	917	1295	2205	3737	6028	8929	11072
Males: 50 and over	2685	5609	(278)	1438	1916	3007	4746	7146	10038	12149
Males: 19 and over	5623	6639	(265)	1982	2564	3814	5721	8281	11263	13376
Females: 1-3	712	3376	(280)	1259	1612	2298	3169	4195	5315	6031
Females: 4-8	894	4202	(329)	863	1255	2184	3487	5072	6742	7770
Females: 9-13	867	4791	(480)	2362	2713	3401	4323	5427	6634	7440
Females: 14-18	706	4663	(456)	1733	2151	3021	4277	5871	7616	8889
Females: 19-30	1039	4985	(436)	889	1367	2559	4444	6952	9802	11767
Females: 31-50	1918	4717	(236)	1262	1694	2641	4038	5869	7941	9380
Females: 19-50	2957	4814	(209)	1116	1581	2619	4199	6259	8585	10220
Females: 51-70	1738	4415	(280)	942	1352	2338	3808	5710	7792	9195
Females: 71 and over	964	3553	(241)	983	1323	2087	3237	4825	6639	7911
Females: 50 and over	2702	4163	(203)	948	1345	2260	3658	5461	7452	8841
Females: 19 and over	5659	4537	(162)	1015	1454	2453	3969	5947	8140	9655
All individuals 1 and over	17892	5331	(142)	1418	1897	2956	4581	6776	9316	11130

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Lutein + zeaxanthin (µg/day)

Lutein + zeaxanthin (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	581	(32.1)	165	210	313	474	701	987	1197
Males: 4-8	1001	748	(89.7)	216	271	393	586	865	1221	1493
Males: 9-13	850	802	(112.5)	299	353	466	631	847	1099	1284
Males: 14-18	808	947	(116.9)	294	359	503	717	1020	1396	1671
Males: 19-30	1113	1025	(62.3)	331	414	595	876	1269	1743	2091
Males: 31-50	1825	1542	(151.5)	376	483	725	1116	1695	2445	3006
Males: 19-50	2938	1348	(102.9)	352	450	670	1023	1530	2168	2670
Males: 51-70	1773	1642	(129.3)	447	563	820	1222	1791	2511	3034
Males: 71 and over	912	1467	(89.0)	414	509	727	1067	1558	2187	2668
Males: 50 and over	2685	1600	(107.4)	440	550	803	1191	1738	2421	2936
Males: 19 and over	5623	1445	(80.6)	382	484	715	1085	1619	2294	2803
Females: 1-3	712	573	(45.7)	171	216	320	476	694	965	1161
Females: 4-8	894	625	(42.5)	255	302	401	546	734	952	1102
Females: 9-13	867	845	(95.7)	290	345	467	649	893	1190	1401
Females: 14-18	706	767	(81.6)	325	378	489	643	834	1055	1213
Females: 19-30	1039	1178	(93.2)	219	296	480	796	1287	1945	2446
Females: 31-50	1918	1439	(130.1)	303	400	631	1020	1624	2448	3075
Females: 19-50	2957	1345	(86.1)	264	354	568	934	1499	2267	2884
Females: 51-70	1738	1740	(101.7)	446	561	828	1267	1923	2817	3518
Females: 71 and over	964	1486	(99.7)	324	414	624	981	1537	2300	2922
Females: 50 and over	2702	1666	(76.5)	402	509	758	1172	1802	2661	3348
Females: 19 and over	5659	1482	(61.1)	312	409	641	1037	1654	2482	3145
All individuals 1 and over	17892	1285	(54.3)	296	384	587	925	1430	2083	2597

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Thiamin (mg/day)

Thiamin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	1.18	(0.034)	0.71	0.79	0.95	1.15	1.37	1.60	1.74	0.4	<3	
Males: 4-8	1001	1.44	(0.026)	0.96	1.05	1.22	1.42	1.65	1.88	2.03	0.5	<3	
Males: 9-13	850	1.71	(0.051)	1.15	1.26	1.45	1.68	1.93	2.18	2.35	0.7	<3	
Males: 14-18	808	1.97	(0.069)	1.14	1.28	1.56	1.91	2.31	2.73	2.99	1	<3	
Males: 19-30	1113	2.07	(0.091)	1.09	1.25	1.56	1.97	2.46	2.96	3.30	1	3	(1.3)
Males: 31-50	1825	1.97	(0.032)	1.13	1.28	1.57	1.93	2.35	2.79	3.07	1	<3	
Males: 19-50	2938	2.01	(0.041)	1.11	1.27	1.57	1.95	2.39	2.84	3.15	1	<3	
Males: 51-70	1773	1.83	(0.030)	1.10	1.23	1.48	1.79	2.15	2.52	2.75	1	<3	
Males: 71 and over	912	1.64	(0.034)	0.95	1.07	1.30	1.59	1.94	2.30	2.54	1	7	(1.2)
Males: 50 and over	2685	1.78	(0.027)	1.05	1.18	1.43	1.74	2.10	2.47	2.70	1	4	(0.7)
Males: 19 and over	5623	1.92	(0.027)	1.09	1.23	1.51	1.87	2.28	2.71	2.99	1	3	(0.4)
Females: 1-3	712	1.11	(0.030)	0.69	0.76	0.90	1.08	1.28	1.49	1.63	0.4	<3	
Females: 4-8	894	1.35	(0.029)	0.89	0.98	1.13	1.33	1.54	1.76	1.89	0.5	<3	
Females: 9-13	867	1.49	(0.041)	1.03	1.11	1.28	1.47	1.69	1.91	2.04	0.7	<3	
Females: 14-18	706	1.39	(0.063)	0.79	0.89	1.08	1.33	1.61	1.91	2.11	0.9	11	(3.8)
Females: 19-30	1039	1.39	(0.025)	0.85	0.95	1.13	1.36	1.62	1.88	2.04	0.9	7	(2.5)
Females: 31-50	1918	1.40	(0.026)	0.84	0.94	1.13	1.36	1.63	1.90	2.07	0.9	8	(2.2)
Females: 19-50	2957	1.39	(0.021)	0.85	0.95	1.13	1.36	1.63	1.89	2.06	0.9	7	(1.6)
Females: 51-70	1738	1.37	(0.033)	0.85	0.94	1.12	1.34	1.60	1.87	2.05	0.9	8	(1.9)
Females: 71 and over	964	1.33	(0.032)	0.76	0.86	1.04	1.28	1.55	1.84	2.03	0.9	13	(2.0)
Females: 50 and over	2702	1.36	(0.026)	0.82	0.91	1.09	1.32	1.59	1.87	2.05	0.9	9	(1.6)
Females: 19 and over	5659	1.38	(0.019)	0.83	0.93	1.11	1.35	1.61	1.88	2.06	0.9	8	(1.4)
All individuals 1 and over	17892	1.60	(0.014)	0.88	1.00	1.23	1.54	1.91	2.30	2.55		5	(0.6)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Riboflavin (mg/day)

Riboflavin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	1.89	(0.053)	1.05	1.21	1.50	1.85	2.23	2.61	2.85	0.4	<3	
Males: 4-8	1001	1.95	(0.035)	1.24	1.37	1.62	1.92	2.26	2.60	2.81	0.5	<3	
Males: 9-13	850	2.23	(0.079)	1.34	1.50	1.80	2.18	2.61	3.06	3.35	0.8	<3	
Males: 14-18	808	2.56	(0.090)	1.47	1.65	2.02	2.47	3.00	3.54	3.89	1.1	<3	
Males: 19-30	1113	2.48	(0.077)	1.20	1.40	1.81	2.35	3.00	3.67	4.12	1.1	3	(1.0)
Males: 31-50	1825	2.64	(0.049)	1.38	1.59	2.01	2.54	3.18	3.85	4.28	1.1	<3	
Males: 19-50	2938	2.58	(0.048)	1.30	1.51	1.93	2.47	3.11	3.78	4.23	1.1	<3	
Males: 51-70	1773	2.48	(0.051)	1.26	1.47	1.87	2.40	3.01	3.65	4.05	1.1	<3	
Males: 71 and over	912	2.22	(0.050)	1.26	1.43	1.75	2.16	2.63	3.11	3.42	1.1	<3	
Males: 50 and over	2685	2.41	(0.044)	1.24	1.45	1.84	2.34	2.92	3.52	3.91	1.1	<3	
Males: 19 and over	5623	2.52	(0.034)	1.28	1.49	1.89	2.42	3.04	3.69	4.12	1.1	<3	
Females: 1-3	712	1.84	(0.046)	1.09	1.22	1.47	1.79	2.15	2.52	2.76	0.4	<3	
Females: 4-8	894	1.81	(0.040)	1.08	1.21	1.46	1.77	2.12	2.46	2.68	0.5	<3	
Females: 9-13	867	1.86	(0.043)	1.14	1.27	1.52	1.83	2.17	2.52	2.74	0.8	<3	
Females: 14-18	706	1.70	(0.066)	0.94	1.07	1.32	1.65	2.01	2.40	2.66	0.9	4	(2.0)
Females: 19-30	1039	1.78	(0.060)	0.96	1.10	1.37	1.72	2.13	2.55	2.81	0.9	3	(1.0)
Females: 31-50	1918	1.89	(0.032)	1.02	1.18	1.47	1.83	2.26	2.70	2.98	0.9	<3	
Females: 19-50	2957	1.85	(0.036)	1.00	1.15	1.43	1.79	2.21	2.64	2.93	0.9	<3	
Females: 51-70	1738	1.91	(0.035)	1.04	1.18	1.47	1.84	2.27	2.74	3.04	0.9	<3	
Females: 71 and over	964	1.77	(0.033)	0.94	1.08	1.35	1.70	2.11	2.53	2.80	0.9	4	(0.6)
Females: 50 and over	2702	1.87	(0.024)	1.00	1.15	1.43	1.80	2.23	2.68	2.98	0.9	<3	
Females: 19 and over	5659	1.86	(0.025)	1.00	1.15	1.43	1.80	2.22	2.66	2.96	0.9	<3	
All individuals 1 and over	17892	2.13	(0.023)	1.08	1.26	1.59	2.04	2.57	3.13	3.49		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Niacin (mg/day)

Niacin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	14.2	(0.32)	8.2	9.2	11.3	13.8	16.7	19.7	21.6	5	<3	
Males: 4-8	1001	18.4	(0.32)	12.4	13.5	15.6	18.2	21.1	24.0	25.9	6	<3	
Males: 9-13	850	24.2	(0.83)	17.1	18.4	20.8	23.8	27.1	30.3	32.4	9	<3	
Males: 14-18	808	29.7	(0.96)	17.9	20.0	24.0	28.9	34.7	40.7	44.5	12	<3	
Males: 19-30	1113	33.8	(0.91)	20.0	22.5	27.1	32.9	39.5	46.2	50.5	12	<3	
Males: 31-50	1825	32.4	(0.52)	19.7	22.1	26.4	31.8	37.9	44.1	48.0	12	<3	
Males: 19-50	2938	32.9	(0.44)	19.8	22.2	26.6	32.2	38.5	44.7	48.9	12	<3	
Males: 51-70	1773	28.2	(0.46)	16.9	18.9	22.8	27.7	33.2	38.9	42.4	12	<3	
Males: 71 and over	912	22.9	(0.50)	13.7	15.3	18.4	22.4	27.1	32.0	35.2	12	<3	
Males: 50 and over	2685	27.0	(0.42)	15.6	17.7	21.6	26.4	31.9	37.5	41.1	12	<3	
Males: 19 and over	5623	30.6	(0.32)	17.8	20.2	24.5	30.0	36.2	42.4	46.4	12	<3	
Females: 1-3	712	12.9	(0.34)	7.3	8.3	10.1	12.4	15.1	18.1	19.9	5	<3	
Females: 4-8	894	17.5	(0.38)	10.6	11.8	14.1	17.1	20.4	23.7	25.8	6	<3	
Females: 9-13	867	20.3	(0.48)	13.8	15.0	17.2	19.9	22.9	25.8	27.6	9	<3	
Females: 14-18	706	20.3	(0.65)	12.5	13.9	16.6	19.9	23.4	27.1	29.5	11	<3	
Females: 19-30	1039	21.5	(0.46)	13.8	15.2	17.9	21.2	24.9	28.5	30.8	11	<3	
Females: 31-50	1918	20.9	(0.26)	12.6	14.2	17.0	20.5	24.5	28.5	31.0	11	<3	
Females: 19-50	2957	21.1	(0.29)	13.0	14.5	17.3	20.8	24.6	28.5	31.0	11	<3	
Females: 51-70	1738	20.3	(0.35)	12.1	13.6	16.3	19.9	23.9	28.2	30.9	11	<3	
Females: 71 and over	964	18.2	(0.37)	10.0	11.5	14.1	17.6	21.6	25.6	28.3	11	8	(1.4)
Females: 50 and over	2702	19.7	(0.28)	11.3	12.8	15.6	19.2	23.3	27.6	30.4	11	4	(1.0)
Females: 19 and over	5659	20.5	(0.22)	12.2	13.7	16.5	20.1	24.1	28.2	30.9	11	<3	
All individuals 1 and over	17892	24.2	(0.20)	12.5	14.4	18.1	23.1	29.2	35.5	39.5		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin B6 (mg/day)

Vitamin B6 (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	1.34	(0.029)	0.81	0.91	1.09	1.32	1.57	1.82	1.98	0.4	<3		30	<3	
Males: 4-8	1001	1.54	(0.026)	0.99	1.09	1.28	1.52	1.80	2.08	2.27	0.5	<3		40	<3	
Males: 9-13	850	1.93	(0.085)	1.18	1.31	1.54	1.84	2.19	2.56	2.80	0.8	<3		60	<3	
Males: 14-18	808	2.30	(0.096)	1.27	1.44	1.77	2.20	2.72	3.27	3.62	1.1	<3		80	<3	
Males: 19-30	1113	2.61	(0.091)	1.34	1.54	1.94	2.47	3.11	3.78	4.23	1.1	<3		100	<3	
Males: 31-50	1825	2.56	(0.043)	1.35	1.56	1.95	2.46	3.06	3.70	4.12	1.1	<3		100	<3	
Males: 19-50	2938	2.57	(0.039)	1.34	1.55	1.94	2.46	3.08	3.72	4.16	1.1	<3		100	<3	
Males: 51-70	1773	2.22	(0.038)	1.19	1.37	1.71	2.16	2.68	3.23	3.57	1.4	11	(1.4)	100	<3	
Males: 71 and over	912	2.02	(0.048)	1.05	1.21	1.51	1.92	2.41	2.95	3.31	1.4	19	(1.9)	100	<3	
Males: 50 and over	2685	2.17	(0.036)	1.15	1.32	1.66	2.10	2.62	3.16	3.52	1.4	13	(1.3)	100	<3	
Males: 19 and over	5623	2.42	(0.028)	1.27	1.46	1.83	2.32	2.91	3.52	3.93		6	(0.6)	100	<3	
Females: 1-3	712	1.22	(0.035)	0.69	0.77	0.95	1.17	1.43	1.71	1.90	0.4	<3		30	<3	
Females: 4-8	894	1.46	(0.028)	0.85	0.96	1.16	1.43	1.73	2.04	2.24	0.5	<3		40	<3	
Females: 9-13	867	1.60	(0.053)	0.99	1.09	1.30	1.55	1.84	2.14	2.32	0.8	<3		60	<3	
Females: 14-18	706	1.57	(0.051)	0.89	1.00	1.23	1.52	1.85	2.19	2.42	1	10	(3.8)	80	<3	
Females: 19-30	1039	1.69	(0.053)	0.99	1.11	1.34	1.63	1.98	2.35	2.58	1.1	9	(3.0)	100	<3	
Females: 31-50	1918	1.69	(0.036)	0.93	1.07	1.32	1.64	2.01	2.40	2.65	1.1	12	(2.6)	100	<3	
Females: 19-50	2957	1.69	(0.034)	0.94	1.07	1.32	1.63	2.00	2.39	2.64	1.1	11	(2.1)	100	<3	
Females: 51-70	1738	1.72	(0.043)	0.91	1.04	1.30	1.65	2.06	2.51	2.81	1.3	25	(2.5)	100	<3	
Females: 71 and over	964	1.59	(0.046)	0.82	0.95	1.19	1.51	1.90	2.31	2.59	1.3	33	(2.4)	100	<3	
Females: 50 and over	2702	1.68	(0.033)	0.87	1.00	1.26	1.60	2.01	2.45	2.75	1.3	28	(2.1)	100	<3	
Females: 19 and over	5659	1.69	(0.026)	0.91	1.04	1.29	1.62	2.01	2.42	2.70		18	(1.7)	100	<3	
All individuals 1 and over	17892	1.95	(0.021)	0.96	1.11	1.42	1.84	2.36	2.90	3.27		10	(0.8)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Folate (µg DFE/day)

Folate (µg DFE/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	374	(14.1)	198	227	285	360	448	540	600	120	<3		300	<3	
Males: 4-8	1001	495	(13.2)	304	337	400	482	579	682	751	160	<3		400	<3	
Males: 9-13	850	570	(20.9)	326	369	451	558	682	810	896	250	<3		600	<3	
Males: 14-18	808	632	(28.7)	324	372	470	602	767	952	1076	330	6	(2.1)	800	<3	
Males: 19-30	1113	665	(21.1)	366	418	517	647	800	959	1064	320	<3		1000	<3	
Males: 31-50	1825	645	(17.6)	330	382	483	617	780	955	1069	320	4	(1.0)	1000	<3	
Males: 19-50	2938	652	(13.5)	342	395	496	630	787	952	1065	320	4	(0.7)	1000	<3	
Males: 51-70	1773	574	(11.1)	312	357	444	560	698	848	945	320	6	(1.2)	1000	<3	
Males: 71 and over	912	550	(13.2)	267	310	399	521	672	841	957	320	11	(1.7)	1000	<3	
Males: 50 and over	2685	568	(9.9)	299	344	434	552	693	846	949	320	7	(1.1)	1000	<3	
Males: 19 and over	5623	620	(10.1)	325	375	470	599	753	915	1025	320	5	(0.7)	1000	<3	
Females: 1-3	712	353	(10.1)	187	213	265	334	419	514	578	120	<3		300	<3	
Females: 4-8	894	454	(11.8)	268	299	359	437	528	625	687	160	<3		400	<3	
Females: 9-13	867	513	(20.2)	290	326	399	497	614	743	828	250	<3		600	<3	
Females: 14-18	706	495	(24.4)	235	275	356	465	595	738	837	330	20	(4.4)	800	<3	
Females: 19-30	1039	464	(9.8)	275	309	372	454	548	646	708	320	12	(3.7)	1000	<3	
Females: 31-50	1918	474	(13.1)	246	284	358	455	574	702	785	320	17	(2.7)	1000	<3	
Females: 19-50	2957	470	(10.9)	256	292	363	455	565	681	758	320	15	(2.1)	1000	<3	
Females: 51-70	1738	465	(12.7)	245	281	352	446	558	682	765	320	18	(1.9)	1000	<3	
Females: 71 and over	964	449	(11.9)	217	252	322	419	541	678	773	320	25	(2.0)	1000	<3	
Females: 50 and over	2702	460	(9.6)	235	271	342	438	554	681	768	320	20	(1.6)	1000	<3	
Females: 19 and over	5659	466	(8.1)	247	283	354	447	561	683	765	320	17	(1.7)	1000	<3	
All individuals 1 and over	17892	530	(6.0)	264	307	392	506	647	797	899		9	(0.7)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. Folate measured in Dietary Folate Equivalents (DFE). Comparison to the UL is for the folic acid component only.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Food folate (µg/day)

Food folate (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	121	(2.8)	62	72	91	117	146	176	196
Males: 4-8	1001	143	(2.7)	87	98	116	140	167	194	211
Males: 9-13	850	170	(6.5)	104	115	137	164	196	228	249
Males: 14-18	808	194	(6.0)	119	132	156	187	224	262	286
Males: 19-30	1113	243	(6.2)	131	150	187	234	290	347	383
Males: 31-50	1825	262	(7.2)	135	157	198	252	317	386	430
Males: 19-50	2938	255	(5.6)	132	153	193	246	307	371	414
Males: 51-70	1773	253	(4.3)	136	156	194	243	301	362	401
Males: 71 and over	912	203	(4.8)	108	123	153	193	243	297	334
Males: 50 and over	2685	241	(3.7)	127	146	183	232	288	347	387
Males: 19 and over	5623	250	(4.1)	130	150	189	240	300	363	404
Females: 1-3	712	117	(3.4)	60	69	89	112	140	168	187
Females: 4-8	894	132	(3.0)	79	88	106	129	155	182	199
Females: 9-13	867	147	(3.9)	90	100	119	143	171	200	218
Females: 14-18	706	148	(5.7)	88	99	119	145	174	204	223
Females: 19-30	1039	172	(4.4)	91	105	131	165	204	244	270
Females: 31-50	1918	194	(5.5)	96	112	144	185	236	291	326
Females: 19-50	2957	186	(4.3)	92	108	138	178	225	275	308
Females: 51-70	1738	206	(5.2)	110	126	158	199	248	301	336
Females: 71 and over	964	172	(3.7)	93	106	131	164	203	245	272
Females: 50 and over	2702	196	(4.2)	103	119	149	188	235	286	320
Females: 19 and over	5659	190	(3.1)	97	112	142	182	230	280	314
All individuals 1 and over	17892	202	(2.7)	94	111	145	191	247	305	343

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Choline (mg/day)

Choline (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	215	(6.1)	115	132	166	208	257	307	339	200	55	(3.3)	1000	<3	
Males: 4-8	1001	234	(4.2)	156	170	196	228	266	305	331	250	34	(3.2)	1000	<3	
Males: 9-13	850	276	(8.0)	190	206	235	270	309	347	371	375	4	(2.8)	2000	<3	
Males: 14-18	808	337	(9.5)	195	220	266	324	392	462	506	550	<3		3000	<3	
Males: 19-30	1113	391	(8.9)	222	252	308	381	464	548	603	550	10	(2.5)	3500	<3	
Males: 31-50	1825	431	(7.6)	250	282	342	418	505	595	652	550	16	(1.9)	3500	<3	
Males: 19-50	2938	416	(6.5)	237	269	329	404	490	577	635	550	14	(1.6)	3500	<3	
Males: 51-70	1773	396	(5.8)	225	255	312	384	466	551	604	550	10	(1.2)	3500	<3	
Males: 71 and over	912	326	(8.3)	202	224	267	320	380	442	482	550	<3		3500	<3	
Males: 50 and over	2685	379	(4.9)	215	244	299	368	447	527	579	550	7	(0.9)	3500	<3	
Males: 19 and over	5623	402	(4.2)	229	259	316	390	474	560	616	550	11	(0.9)	3500	<3	
Females: 1-3	712	211	(4.9)	126	139	167	202	243	289	319	200	51	(3.4)	1000	<3	
Females: 4-8	894	221	(4.4)	148	161	186	217	250	284	305	250	25	(3.6)	1000	<3	
Females: 9-13	867	233	(6.6)	156	170	196	228	262	297	319	375	<3		2000	<3	
Females: 14-18	706	223	(6.3)	138	154	183	221	262	305	333	400	<3		3000	<3	
Females: 19-30	1039	251	(6.5)	159	176	207	245	289	333	360	425	<3		3500	<3	
Females: 31-50	1918	276	(5.1)	166	186	223	269	321	374	406	425	3	(1.1)	3500	<3	
Females: 19-50	2957	267	(4.3)	162	181	216	260	310	360	392	425	<3		3500	<3	
Females: 51-70	1738	274	(6.9)	161	181	218	265	320	378	415	425	4	(1.3)	3500	<3	
Females: 71 and over	964	240	(4.2)	143	160	193	235	282	329	360	425	<3		3500	<3	
Females: 50 and over	2702	264	(4.7)	154	173	209	256	309	365	401	425	3	(0.8)	3500	<3	
Females: 19 and over	5659	266	(3.5)	158	177	213	259	310	362	397	425	<3		3500	<3	
All individuals 1 and over	17892	311	(3.2)	160	184	230	294	373	455	508		10	(0.6)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake above the AI and the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin B12 (µg/day)

Vitamin B12 (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	4.37	(0.151)	2.08	2.47	3.24	4.22	5.33	6.47	7.19	0.7	<3	
Males: 4-8	1001	4.67	(0.101)	2.61	2.98	3.68	4.57	5.60	6.65	7.34	1	<3	
Males: 9-13	850	5.50	(0.193)	3.31	3.71	4.45	5.39	6.44	7.50	8.19	1.5	<3	
Males: 14-18	808	6.70	(0.196)	3.30	3.85	4.96	6.40	8.14	10.01	11.22	2	<3	
Males: 19-30	1113	6.44	(0.213)	2.94	3.48	4.55	6.04	7.88	9.89	11.25	2	<3	
Males: 31-50	1825	6.60	(0.193)	3.19	3.76	4.86	6.36	8.20	10.20	11.51	2	<3	
Males: 19-50	2938	6.54	(0.151)	3.09	3.65	4.75	6.25	8.07	10.03	11.39	2	<3	
Males: 51-70	1773	6.06	(0.209)	2.61	3.13	4.18	5.65	7.48	9.52	10.88	2	<3	
Males: 71 and over	912	5.58	(0.226)	2.59	3.03	3.97	5.28	6.97	8.91	10.28	2	<3	
Males: 50 and over	2685	5.94	(0.188)	2.61	3.11	4.15	5.59	7.38	9.38	10.75	2	<3	
Males: 19 and over	5623	6.31	(0.131)	2.90	3.44	4.50	5.98	7.83	9.83	11.22	2	<3	
Females: 1-3	712	4.43	(0.156)	2.24	2.59	3.30	4.22	5.32	6.51	7.29	0.7	<3	
Females: 4-8	894	4.29	(0.090)	2.12	2.48	3.19	4.13	5.21	6.34	7.06	1	<3	
Females: 9-13	867	4.45	(0.171)	2.27	2.63	3.35	4.30	5.38	6.51	7.23	1.5	<3	
Females: 14-18	706	3.95	(0.221)	1.85	2.18	2.87	3.79	4.90	6.13	6.98	2	7	(3.7)
Females: 19-30	1039	4.25	(0.117)	2.11	2.47	3.17	4.13	5.29	6.55	7.36	2	4	(2.0)
Females: 31-50	1918	4.57	(0.168)	2.19	2.55	3.26	4.21	5.39	6.69	7.54	2	3	(1.2)
Females: 19-50	2957	4.45	(0.117)	2.17	2.52	3.24	4.19	5.36	6.63	7.49	2	3	(1.1)
Females: 51-70	1738	4.44	(0.158)	1.93	2.29	3.02	4.03	5.30	6.74	7.71	2	6	(1.2)
Females: 71 and over	964	4.21	(0.166)	1.77	2.13	2.87	3.92	5.25	6.74	7.78	2	8	(1.7)
Females: 50 and over	2702	4.38	(0.120)	1.88	2.23	2.97	3.99	5.29	6.74	7.74	2	7	(1.0)
Females: 19 and over	5659	4.42	(0.098)	2.04	2.40	3.12	4.10	5.34	6.70	7.64	2	5	(0.7)
All individuals 1 and over	17892	5.21	(0.068)	2.29	2.73	3.62	4.86	6.43	8.15	9.33		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR. It is advised that persons over 50 meet their B12 requirement mainly with fortified foods or supplements.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin C (mg/day) - all individuals

Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	94.8	(3.74)	29.5	37.7	56.1	83.3	119.2	161.4	190.7	13	<3		400	<3	
Males: 4-8	1001	84.0	(3.20)	37.2	44.7	59.9	80.7	106.4	134.4	153.4	22	<3		650	<3	
Males: 9-13	850	77.5	(4.85)	24.6	31.4	46.2	68.2	97.0	130.1	153.7	39	17	(5.0)	1200	<3	
Males: 14-18	808	88.8	(4.99)	24.3	31.7	48.9	75.2	112.3	157.8	190.3	63	39	(3.3)	1800	<3	
Males: 19-30	1113	98.7	(5.29)	28.0	36.6	55.6	85.3	126.8	176.3	212.1	75	42	(3.6)	2000	<3	
Males: 31-50	1825	95.9	(4.20)	22.7	31.0	49.9	80.1	123.5	177.1	215.5	75	46	(2.8)	2000	<3	
Males: 19-50	2938	97.0	(3.26)	24.4	32.8	52.0	82.2	124.5	175.5	214.1	75	44	(2.4)	2000	<3	
Males: 51-70	1773	88.3	(3.09)	25.5	33.5	51.2	78.1	114.3	157.3	186.9	75	47	(2.4)	2000	<3	
Males: 71 and over	912	87.8	(4.09)	22.4	30.3	48.4	76.1	113.8	158.1	189.6	75	49	(2.5)	2000	<3	
Males: 50 and over	2685	88.2	(2.62)	24.6	32.5	50.7	77.8	114.3	156.9	187.5	75	48	(2.0)	2000	<3	
Males: 19 and over	5623	93.6	(2.45)	24.7	32.8	51.3	80.3	120.8	169.3	204.6	75	46	(1.8)	2000	<3	
Females: 1-3	712	87.5	(4.54)	21.5	29.1	47.2	75.3	115.1	164.7	200.3	13	<3		400	<3	
Females: 4-8	894	80.4	(3.75)	37.8	44.5	58.2	76.9	99.7	124.5	140.7	22	<3		650	<3	
Females: 9-13	867	70.6	(4.49)	21.2	26.9	40.3	60.8	88.6	122.5	146.3	39	23	(3.5)	1200	<3	
Females: 14-18	706	74.4	(4.15)	28.1	34.5	48.3	67.9	92.5	121.0	141.3	56	35	(6.5)	1800	<3	
Females: 19-30	1039	77.3	(4.09)	21.7	28.4	43.1	66.0	97.6	135.2	161.5	60	44	(3.6)	2000	<3	
Females: 31-50	1918	76.2	(3.64)	18.4	25.0	40.1	64.0	98.0	140.1	169.7	60	46	(3.4)	2000	<3	
Females: 19-50	2957	76.6	(3.24)	19.5	26.1	41.2	64.7	97.7	137.7	166.7	60	45	(2.9)	2000	<3	
Females: 51-70	1738	86.6	(4.26)	25.1	32.8	49.8	75.4	109.4	150.0	178.4	60	35	(3.7)	2000	<3	
Females: 71 and over	964	76.2	(2.26)	22.0	29.1	44.6	67.7	98.0	132.5	156.6	60	42	(2.0)	2000	<3	
Females: 50 and over	2702	83.6	(3.16)	24.2	31.6	48.1	72.9	105.9	144.5	171.6	60	37	(2.5)	2000	<3	
Females: 19 and over	5659	79.6	(2.40)	21.1	28.1	43.8	68.1	101.8	141.9	170.9	60	42	(2.1)	2000	<3	
All individuals 1 and over	17892	85.1	(1.84)	23.5	31.0	47.7	73.7	109.2	151.1	181.6		37	(1.4)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) for non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. The usual intake distribution is compared to the EAR for non-smokers for all individuals regardless of smoking status.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin C (mg/day) - smokers

SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for smokers in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 20-30	322	92.0	(8.60)	21.5*	29.2	47.0	76.6	120.5	175.8	217.4*	110	70	(4.8)	2000	<3	
Males: 31-50	550	71.0	(4.66)	18.4	24.6	38.8	61.5	94.2	135.1	164.6	110	82	(3.5)	2000	<3	
Males: 20-50	872	79.6	(4.50)	19.3	26.1	41.8	67.2	103.7	149.9	184.9	110	78	(2.9)	2000	<3	
Males: 51-70	421	75.7	(5.44)	20.5	26.8	40.9	62.9	93.3	130.6	156.8	110	83	(4.0)	2000	<3	
Males: 71 and over	67	52.1	(5.68)	10.0*	14.5*	25.7*	44.0	70.5*	103.2*	127.1*	110	92*	(3.2)	2000	<3	
Males: 50 and over	488	73.4	(4.93)	18.5	24.5	38.3	59.8	89.6	125.8	152.4	110	85	(3.4)	2000	<3	
Males: 20 and over	1360	77.9	(4.14)	19.4	25.9	40.9	65.3	100.3	144.0	176.7	110	80	(2.7)	2000	<3	
Females: 20-30	244	50.2	(5.73)	18.0*	22.2	31.0	44.2	61.6	81.9	95.9*	95	95*	(3.8)	2000	<3	
Females: 31-50	483	63.3	(5.77)	13.6	18.6	30.3	49.3	77.2	112.9	138.7	95	84	(4.1)	2000	<3	
Females: 20-50	727	58.4	(4.41)	15.0	19.7	30.5	47.3	71.1	100.4	122.2	95	88	(3.4)	2000	<3	
Females: 51-70	282	67.6	(7.93)	12.2*	17.4	30.6	53.1	86.8	131.3	164.8*	95	79	(5.0)	2000	<3	
Females: 71 and over	53	59.4*	(8.07)	11.4*	16.6*	29.0*	48.6	75.5*	106.8*	128.9*	95	86*	(6.3)	2000	<3	
Females: 50 and over	335	66.5	(6.64)	12.4*	17.8	31.0	53.4	86.8	129.8	162.6*	95	79	(3.7)	2000	<3	
Females: 20 and over	1062	60.5	(3.39)	14.6	19.7	31.5	50.8	79.1	114.5	141.3	95	83	(2.6)	2000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) for smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

* Estimate may be less reliable than others due to small sample size and/or large relative standard error. Smoking status determined by self-reported cigarette use. Available for those 20 years and older.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin C (mg/day) - non-smokers

NON-SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for non-smokers in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 20-30	619	102.0	(5.49)	31.4	40.4	59.7	89.2	129.1	175.5	208.5	75	38	(4.6)	2000	<3	
Males: 31-50	1274	104.9	(5.08)	26.1	35.1	55.5	87.7	133.1	188.5	227.8	75	41	(2.8)	2000	<3	
Males: 20-50	1893	103.9	(3.57)	27.4	36.5	56.8	88.1	131.2	182.5	220.7	75	40	(2.2)	2000	<3	
Males: 51-70	1351	91.5	(3.25)	27.8	36.3	54.7	82.3	119.0	161.8	191.0	75	44	(2.6)	2000	<3	
Males: 71 and over	845	90.5	(4.30)	24.3	32.4	51.0	79.1	116.9	161.1	192.4	75	47	(2.8)	2000	<3	
Males: 50 and over	2196	91.2	(2.68)	26.7	35.0	53.9	81.7	118.5	161.0	191.2	75	44	(2.1)	2000	<3	
Males: 20 and over	4089	98.5	(2.38)	27.3	36.0	55.3	85.1	125.8	173.9	208.6	75	42	(1.6)	2000	<3	
Females: 20-30	679	86.4	(4.72)	26.3	33.9	50.4	75.3	108.9	148.2	175.3	60	35	(4.1)	2000	<3	
Females: 31-50	1435	80.4	(3.67)	21.9	29.0	44.9	69.5	103.5	144.6	173.1	60	41	(3.6)	2000	<3	
Females: 20-50	2114	82.4	(3.31)	23.2	30.5	46.8	71.4	105.2	145.2	174.1	60	39	(3.2)	2000	<3	
Females: 51-70	1456	89.9	(4.63)	29.4	37.3	54.4	79.5	112.3	150.8	177.5	60	31	(3.9)	2000	<3	
Females: 71 and over	911	77.3	(2.17)	22.9	30.1	45.8	69.0	99.3	133.6	157.6	60	41	(2.0)	2000	<3	
Females: 50 and over	2367	85.9	(3.36)	27.3	34.9	51.5	76.1	108.1	145.3	171.3	60	34	(2.5)	2000	<3	
Females: 20 and over	4481	84.1	(2.61)	24.8	32.3	48.6	73.1	106.4	145.2	173.0	60	37	(2.2)	2000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) for non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. Smoking status determined by self-reported cigarette use. Available for those 20 years and older.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin C (mg/day) - adults, smokers and non-smokers

ADULTS, SMOKERS and NON-SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for smokers and non-smokers in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 20-30	941	98.7	(5.44)	27.2	35.7	54.8	84.7	126.6	176.8	213.2		49	(3.8)	2000	<3	
Males: 31-50	1824	95.9	(4.20)	22.7	30.9	49.8	80.1	123.5	177.1	215.5		52	(2.8)	2000	<3	
Males: 20-50	2765	96.9	(3.26)	24.1	32.5	51.6	81.8	124.2	175.5	214.4		51	(2.3)	2000	<3	
Males: 51-70	1772	88.3	(3.09)	25.5	33.5	51.2	78.1	114.3	157.3	186.9		52	(2.5)	2000	<3	
Males: 71 and over	912	87.8	(4.09)	22.4	30.3	48.4	76.1	113.8	158.1	189.6		50	(2.6)	2000	<3	
Males: 50 and over	2684	88.2	(2.62)	24.6	32.5	50.7	77.8	114.3	156.9	187.5		51	(2.1)	2000	<3	
Males: 20 and over	5449	93.5	(2.41)	24.4	32.6	51.0	80.0	120.5	169.1	204.4		51	(1.7)	2000	<3	
Females: 20-30	923	76.0	(4.41)	21.2	27.8	42.4	64.9	96.1	133.3	159.3		52	(4.2)	2000	<3	
Females: 31-50	1918	76.2	(3.64)	18.4	25.0	40.1	64.0	98.0	140.1	169.7		51	(3.5)	2000	<3	
Females: 20-50	2841	76.1	(3.23)	19.2	25.8	40.9	64.2	97.1	136.9	165.9		52	(3.2)	2000	<3	
Females: 51-70	1738	86.6	(4.26)	25.1	32.8	49.8	75.4	109.4	150.0	178.4		38	(3.8)	2000	<3	
Females: 71 and over	964	76.2	(2.26)	22.0	29.1	44.6	67.7	98.0	132.5	156.6		43	(2.0)	2000	<3	
Females: 50 and over	2702	83.6	(3.16)	24.2	31.6	48.1	72.9	105.9	144.5	171.6		39	(2.5)	2000	<3	
Females: 20 and over	5543	79.3	(2.42)	21.0	27.9	43.5	67.8	101.4	141.3	170.4		46	(2.3)	2000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) for smokers and non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. Percentage under the EAR is a weighted average by smoking status. Smoking status determined by self-reported cigarette use. Available for those 20 years and older.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin D (µg/day)

Vitamin D (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	7.7	(0.28)	2.5	3.3	4.9	7.2	9.8	12.6	14.4	10	76	(2.2)	63	<3	
Males: 4-8	1001	6.2	(0.14)	2.7	3.3	4.4	6.0	7.7	9.5	10.7	10	92	(1.7)	75	<3	
Males: 9-13	850	6.1	(0.30)	2.4	2.9	4.1	5.7	7.7	9.7	11.1	10	91	(1.9)	100	<3	
Males: 14-18	808	6.4	(0.30)	2.2	2.8	4.1	5.9	8.2	10.8	12.6	10	86	(2.6)	100	<3	
Males: 19-30	1113	5.2	(0.17)	1.5	2.0	3.0	4.6	6.8	9.3	11.2	10	92	(1.2)	100	<3	
Males: 31-50	1825	5.5	(0.30)	1.7	2.2	3.3	4.8	7.0	9.6	11.4	10	91	(2.0)	100	<3	
Males: 19-50	2938	5.4	(0.20)	1.6	2.1	3.2	4.8	6.9	9.4	11.3	10	92	(1.3)	100	<3	
Males: 51-70	1773	5.5	(0.19)	1.7	2.2	3.2	4.8	7.0	9.7	11.6	10	91	(1.1)	100	<3	
Males: 71 and over	912	5.4	(0.25)	1.8	2.3	3.3	4.8	6.8	9.0	10.7	10	93	(1.6)	100	<3	
Males: 50 and over	2685	5.5	(0.16)	1.7	2.2	3.2	4.8	6.9	9.5	11.4	10	92	(0.8)	100	<3	
Males: 19 and over	5623	5.4	(0.14)	1.7	2.1	3.2	4.8	6.9	9.5	11.4	10	92	(0.8)	100	<3	
Females: 1-3	712	7.7	(0.24)	2.8	3.6	5.2	7.2	9.6	12.2	13.9	10	78	(2.6)	63	<3	
Females: 4-8	894	5.5	(0.17)	2.3	2.8	3.9	5.2	6.8	8.4	9.4	10	97	(1.2)	75	<3	
Females: 9-13	867	4.8	(0.19)	1.8	2.2	3.2	4.5	6.2	7.9	9.1	10	>97		100	<3	
Females: 14-18	706	3.9	(0.24)	1.3	1.7	2.5	3.6	5.1	6.9	8.2	10	>97		100	<3	
Females: 19-30	1039	3.8	(0.18)	1.3	1.7	2.4	3.4	4.8	6.3	7.4	10	>97		100	<3	
Females: 31-50	1918	4.0	(0.11)	1.5	1.8	2.5	3.6	5.1	6.7	7.9	10	>97		100	<3	
Females: 19-50	2957	3.9	(0.10)	1.4	1.8	2.5	3.6	5.0	6.6	7.7	10	>97		100	<3	
Females: 51-70	1738	4.4	(0.21)	1.3	1.7	2.5	3.8	5.5	7.5	9.0	10	97	(0.7)	100	<3	
Females: 71 and over	964	4.2	(0.13)	1.2	1.6	2.4	3.6	5.3	7.3	8.7	10	>97		100	<3	
Females: 50 and over	2702	4.3	(0.15)	1.3	1.6	2.5	3.7	5.4	7.4	8.9	10	>97		100	<3	
Females: 19 and over	5659	4.1	(0.10)	1.3	1.7	2.5	3.6	5.2	7.0	8.3	10	>97		100	<3	
All individuals 1 and over	17892	5.0	(0.07)	1.5	2.0	3.0	4.4	6.4	8.8	10.5	10	94	(0.4)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin E as alpha-tocopherol (mg/day)

Vitamin E as alpha-tocopherol (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	4.3	(0.14)	2.2	2.5	3.2	4.1	5.1	6.2	6.9	5	73	(3.6)
Males: 4-8	1001	5.4	(0.10)	3.3	3.7	4.4	5.3	6.4	7.5	8.3	6	67	(3.2)
Males: 9-13	850	6.7	(0.47)	3.6	4.0	5.0	6.2	7.8	9.4	10.6	9	87	(5.3)
Males: 14-18	808	7.7	(0.30)	5.0	5.4	6.3	7.3	8.6	9.9	10.7	12	>97	
Males: 19-30	1113	8.4	(0.24)	3.9	4.6	6.0	7.9	10.3	12.8	14.6	12	86	(2.2)
Males: 31-50	1825	9.1	(0.28)	4.5	5.2	6.7	8.6	11.1	13.7	15.5	12	82	(3.4)
Males: 19-50	2938	8.8	(0.21)	4.3	5.0	6.4	8.4	10.8	13.3	15.1	12	84	(2.3)
Males: 51-70	1773	8.4	(0.18)	4.2	4.9	6.3	8.1	10.3	12.7	14.3	12	87	(2.0)
Males: 71 and over	912	7.6	(0.24)	3.4	4.0	5.3	7.1	9.4	11.9	13.7	12	90	(1.3)
Males: 50 and over	2685	8.2	(0.16)	4.0	4.7	6.0	7.9	10.1	12.5	14.2	12	88	(1.5)
Males: 19 and over	5623	8.6	(0.15)	4.2	4.9	6.3	8.2	10.5	13.1	14.8	12	85	(1.5)
Females: 1-3	712	3.9	(0.09)	2.2	2.5	3.1	3.8	4.6	5.5	6.1	5	83	(2.9)
Females: 4-8	894	5.4	(0.17)	3.0	3.4	4.1	5.2	6.4	7.7	8.5	6	68	(3.4)
Females: 9-13	867	6.2	(0.29)	3.6	4.0	4.8	5.9	7.1	8.5	9.4	9	93	(3.2)
Females: 14-18	706	6.3	(0.35)	3.6	4.1	4.9	6.0	7.3	8.6	9.5	12	>97	
Females: 19-30	1039	6.4	(0.25)	3.1	3.6	4.7	6.0	7.7	9.5	10.7	12	>97	
Females: 31-50	1918	7.2	(0.24)	3.2	3.8	5.0	6.6	8.7	11.0	12.5	12	94	(1.9)
Females: 19-50	2957	6.9	(0.21)	3.2	3.7	4.9	6.4	8.3	10.4	11.9	12	95	(1.1)
Females: 51-70	1738	7.5	(0.20)	3.4	4.0	5.2	6.9	9.1	11.8	13.6	12	91	(1.2)
Females: 71 and over	964	6.2	(0.16)	3.0	3.5	4.5	5.8	7.5	9.4	10.6	12	>97	
Females: 50 and over	2702	7.1	(0.15)	3.2	3.8	4.9	6.6	8.7	11.1	12.8	12	93	(0.9)
Females: 19 and over	5659	7.0	(0.14)	3.2	3.7	4.9	6.5	8.5	10.7	12.3	12	94	(0.8)
All individuals 1 and over	17892	7.3	(0.11)	3.3	3.9	5.1	6.8	8.9	11.2	12.8		88	(0.7)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Vitamin K (µg/day)

Vitamin K (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	38.0	(1.77)	16.5	19.5	25.8	34.6	45.8	58.7	67.6	30	63	(3.1)
Males: 4-8	1001	51.6	(3.74)	22.4	26.2	34.1	45.7	61.1	79.4	92.8	55	33	(4.2)
Males: 9-13	850	60.6	(6.18)	34.0	37.5	44.3	53.3	63.9	75.3	83.1	60	33	(8.8)
Males: 14-18	808	70.9	(5.67)	36.7	41.2	50.3	62.4	77.5	94.4	105.8	75	28	(7.7)
Males: 19-30	1113	84.3	(4.27)	36.1	43.0	56.9	76.8	102.6	131.7	152.0	120	15	(4.3)
Males: 31-50	1825	106.0	(6.37)	36.9	45.0	62.4	88.8	125.7	171.4	204.5	120	28	(3.6)
Males: 19-50	2938	97.8	(4.63)	36.1	43.9	60.2	84.5	117.1	155.9	185.0	120	23	(3.0)
Males: 51-70	1773	116.3	(5.98)	43.7	52.3	70.3	96.9	132.6	176.0	206.6	120	32	(3.0)
Males: 71 and over	912	97.2	(4.59)	34.9	41.6	56.2	78.0	108.2	145.5	173.4	120	19	(2.6)
Males: 50 and over	2685	111.7	(4.97)	41.2	49.2	66.6	92.3	126.9	168.8	199.6	120	29	(2.4)
Males: 19 and over	5623	103.2	(3.86)	38.1	45.9	62.6	87.5	121.3	161.9	191.4	120	26	(2.4)
Females: 1-3	712	40.2	(2.77)	17.4	20.2	26.4	35.2	47.0	61.2	71.3	30	65	(3.8)
Females: 4-8	894	46.8	(2.18)	25.0	28.3	34.9	43.9	55.1	67.7	76.0	55	25	(6.4)
Females: 9-13	867	58.6	(4.35)	25.7	29.7	38.3	50.7	66.7	85.7	98.8	60	34	(4.7)
Females: 14-18	706	59.0	(4.67)	25.5	29.8	39.1	52.3	69.1	89.0	103.6	75	19	(4.7)
Females: 19-30	1039	82.7	(4.85)	26.0	32.2	45.7	66.6	95.9	132.0	158.0	90	29	(2.7)
Females: 31-50	1918	95.2	(6.90)	32.4	39.4	54.5	77.3	109.1	148.6	176.9	90	38	(4.1)
Females: 19-50	2957	90.7	(4.80)	29.9	36.7	51.3	73.4	104.0	142.0	170.4	90	35	(3.0)
Females: 51-70	1738	117.2	(6.35)	40.2	48.4	66.4	94.0	132.5	182.0	219.0	90	53	(4.1)
Females: 71 and over	964	98.1	(5.37)	32.6	39.5	54.6	78.0	111.4	153.4	185.6	90	39	(2.8)
Females: 50 and over	2702	111.7	(4.68)	37.4	45.2	62.3	88.8	126.1	173.7	209.9	90	49	(2.9)
Females: 19 and over	5659	99.6	(3.28)	32.6	39.8	55.5	79.7	114.3	157.1	189.8	90	41	(2.3)
All individuals 1 and over	17892	89.6	(2.76)	29.2	36.0	50.7	73.3	104.6	142.2	170.5		34	(2.1)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Calcium (mg/day)

Calcium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	1067	(39.1)	535	627	806	1030	1280	1536	1696	500	4	(1.5)	2500	<3	
Males: 4-8	1001	1011	(21.1)	598	674	814	991	1190	1393	1523	800	23	(3.2)	2500	<3	
Males: 9-13	850	1129	(48.9)	648	731	888	1090	1321	1558	1716	1100	51	(5.4)	3000	<3	
Males: 14-18	808	1244	(41.3)	667	764	954	1194	1478	1776	1967	1100	40	(4.3)	3000	<3	
Males: 19-30	1113	1193	(32.0)	584	681	871	1126	1438	1769	1991	800	19	(2.7)	2500	<3	
Males: 31-50	1825	1142	(26.6)	590	683	861	1098	1383	1689	1888	800	19	(1.8)	2500	<3	
Males: 19-50	2938	1161	(19.5)	587	681	866	1110	1402	1710	1925	800	19	(1.7)	2500	<3	
Males: 51-70	1773	1030	(22.1)	479	565	736	972	1264	1590	1805	800	32	(2.3)	2000	<3	
Males: 71 and over	912	868	(22.9)	454	521	655	830	1040	1264	1413	1000	71	(2.9)	2000	<3	
Males: 50 and over	2685	991	(20.1)	467	549	714	938	1211	1511	1715		41	(2.1)	2000	<3	
Males: 19 and over	5623	1096	(13.7)	535	625	800	1041	1334	1649	1863		28	(1.3)		<3	
Females: 1-3	712	1041	(30.1)	536	619	785	996	1242	1502	1670	500	4	(1.1)	2500	<3	
Females: 4-8	894	935	(24.6)	533	603	737	909	1104	1305	1430	800	34	(3.4)	2500	<3	
Females: 9-13	867	948	(26.3)	552	620	754	925	1118	1318	1444	1100	73	(4.3)	3000	<3	
Females: 14-18	706	879	(26.7)	462	532	672	852	1059	1280	1429	1100	79	(3.8)	3000	<3	
Females: 19-30	1039	890	(22.5)	514	580	705	864	1047	1234	1352	800	40	(4.2)	2500	<3	
Females: 31-50	1918	883	(21.2)	436	510	655	845	1074	1318	1474	800	44	(2.6)	2500	<3	
Females: 19-50	2957	885	(17.4)	460	532	672	852	1064	1286	1432	800	43	(2.3)	2500	<3	
Females: 51-70	1738	845	(18.2)	429	496	630	807	1018	1248	1400	1000	73	(1.9)	2000	<3	
Females: 71 and over	964	776	(12.8)	377	441	566	734	935	1150	1294	1000	81	(1.3)	2000	<3	
Females: 50 and over	2702	825	(13.1)	410	476	608	784	995	1222	1373	1000	76	(1.4)	2000	<3	
Females: 19 and over	5659	860	(13.3)	439	509	644	823	1036	1261	1413		57	(1.6)		<3	
All individuals 1 and over	17892	988	(9.8)	485	566	726	940	1199	1474	1659		42	(1.1)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Phosphorus (mg/day)

Phosphorus (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	1096	(31.4)	630	716	878	1073	1284	1494	1624	380	<3		3000	<3	
Males: 4-8	1001	1161	(18.1)	784	855	985	1145	1322	1499	1612	405	<3		3000	<3	
Males: 9-13	850	1401	(40.3)	916	1004	1166	1366	1587	1805	1947	1055	14	(2.9)	4000	<3	
Males: 14-18	808	1612	(45.9)	1005	1114	1319	1569	1853	2140	2320	1055	7	(3.1)	4000	<3	
Males: 19-30	1113	1666	(36.1)	979	1105	1336	1624	1948	2268	2470	580	<3		4000	<3	
Males: 31-50	1825	1713	(28.8)	1036	1164	1396	1681	2001	2320	2517	580	<3		4000	<3	
Males: 19-50	2938	1695	(23.7)	1009	1139	1373	1662	1980	2295	2500	580	<3		4000	<3	
Males: 51-70	1773	1523	(23.9)	874	992	1212	1488	1799	2117	2314	580	<3		4000	<3	
Males: 71 and over	912	1253	(28.3)	791	875	1034	1230	1449	1669	1810	580	<3		3000	<3	
Males: 50 and over	2685	1458	(22.1)	834	947	1161	1426	1723	2022	2215	580	<3			<3	
Males: 19 and over	5623	1605	(15.4)	930	1055	1283	1570	1891	2207	2412	580	<3			<3	
Females: 1-3	712	1053	(23.5)	650	719	854	1021	1213	1414	1543	380	<3		3000	<3	
Females: 4-8	894	1126	(21.9)	738	809	942	1106	1288	1470	1582	405	<3		3000	<3	
Females: 9-13	867	1184	(29.6)	804	874	1007	1167	1338	1507	1609	1055	32	(3.6)	4000	<3	
Females: 14-18	706	1136	(33.8)	724	801	946	1122	1314	1509	1636	1055	40	(6.6)	4000	<3	
Females: 19-30	1039	1158	(25.6)	742	821	963	1138	1330	1520	1636	580	<3		4000	<3	
Females: 31-50	1918	1196	(18.7)	706	798	966	1171	1398	1626	1764	580	<3		4000	<3	
Females: 19-50	2957	1182	(15.6)	716	804	965	1159	1374	1586	1721	580	<3		4000	<3	
Females: 51-70	1738	1152	(20.8)	712	793	944	1130	1336	1546	1678	580	<3		4000	<3	
Females: 71 and over	964	1013	(15.3)	588	665	809	989	1189	1388	1516	580	5	(0.9)	3000	<3	
Females: 50 and over	2702	1111	(14.6)	665	746	898	1087	1296	1508	1644	580	<3			<3	
Females: 19 and over	5659	1152	(12.7)	694	779	935	1128	1343	1555	1693	580	<3			<3	
All individuals 1 and over	17892	1338	(10.4)	745	846	1040	1293	1587	1887	2078		4	(0.4)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Magnesium (mg/day)

Magnesium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE
Males: 1-3	772	198	(3.9)	120	134	161	194	230	266	288	65	<3	
Males: 4-8	1001	216	(3.8)	149	161	184	213	245	277	297	110	<3	
Males: 9-13	850	251	(7.9)	157	173	205	244	289	334	364	200	22	(2.6)
Males: 14-18	808	294	(7.3)	181	200	238	285	340	397	435	340	75	(3.5)
Males: 19-30	1113	335	(8.4)	186	212	261	324	399	476	526	330	52	(3.2)
Males: 31-50	1825	362	(7.2)	204	232	284	351	429	511	563	350	50	(2.3)
Males: 19-50	2938	352	(6.1)	196	223	275	341	418	498	551		51	(2.2)
Males: 51-70	1773	335	(4.8)	194	219	267	327	397	469	514	350	59	(2.0)
Males: 71 and over	912	285	(6.2)	160	180	221	274	337	405	450	350	79	(2.4)
Males: 50 and over	2685	323	(4.5)	182	207	254	314	384	456	503	350	64	(1.9)
Males: 19 and over	5623	341	(4.1)	191	217	266	331	406	483	534		56	(1.6)
Females: 1-3	712	186	(3.9)	118	130	153	181	213	246	267	65	<3	
Females: 4-8	894	205	(4.2)	136	149	172	201	234	266	286	110	<3	
Females: 9-13	867	221	(5.7)	147	160	185	217	252	287	308	200	36	(3.1)
Females: 14-18	706	223	(7.4)	127	143	176	217	263	311	343	300	87	(3.6)
Females: 19-30	1039	246	(6.0)	149	167	199	240	285	331	360	255	59	(3.2)
Females: 31-50	1918	271	(6.2)	145	166	207	261	324	390	432	265	52	(2.9)
Females: 19-50	2957	262	(5.2)	144	165	204	253	310	370	409		55	(2.5)
Females: 51-70	1738	271	(5.0)	155	176	215	264	321	380	417	265	50	(2.1)
Females: 71 and over	964	236	(3.8)	133	151	185	227	277	328	361	265	70	(1.9)
Females: 50 and over	2702	261	(3.8)	146	166	204	253	308	366	404	265	56	(1.8)
Females: 19 and over	5659	261	(3.8)	146	166	204	253	310	369	408		55	(1.9)
All individuals 1 and over	17892	282	(3.1)	147	170	213	270	339	410	457		49	(1.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Iron (mg/day)

Iron (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	10.5	(0.30)	5.4	6.2	7.9	10.1	12.7	15.4	17.1	3	<3		40	<3	
Males: 4-8	1001	13.0	(0.27)	9.0	9.8	11.1	12.8	14.7	16.7	18.0	4.1	<3		40	<3	
Males: 9-13	850	15.5	(0.39)	9.8	10.9	12.8	15.2	17.9	20.6	22.4	5.9	<3		40	<3	
Males: 14-18	808	17.2	(0.40)	10.3	11.5	13.9	17.0	20.7	24.7	27.3	7.7	<3		45	<3	
Males: 19-30	1113	17.8	(0.47)	9.8	11.2	13.9	17.4	21.4	25.5	28.1	6	<3		45	<3	
Males: 31-50	1825	18.1	(0.41)	9.8	11.3	14.0	17.5	21.8	26.3	29.2	6	<3		45	<3	
Males: 19-50	2938	18.0	(0.32)	9.7	11.2	14.0	17.5	21.6	25.9	28.8	6	<3		45	<3	
Males: 51-70	1773	16.9	(0.32)	9.5	10.7	13.2	16.4	20.3	24.3	26.9	6	<3		45	<3	
Males: 71 and over	912	16.1	(0.38)	8.4	9.7	12.1	15.4	19.4	23.8	26.8	6	<3		45	<3	
Males: 50 and over	2685	16.7	(0.28)	9.2	10.4	13.0	16.2	20.1	24.2	26.9	6	<3		45	<3	
Males: 19 and over	5623	17.5	(0.23)	9.5	10.9	13.5	17.0	21.1	25.3	28.2	6	<3		45	<3	
Females: 1-3	712	9.5	(0.28)	5.3	5.9	7.3	9.1	11.2	13.5	15.0	3	<3		40	<3	
Females: 4-8	894	12.2	(0.31)	7.3	8.1	9.7	11.8	14.2	16.8	18.4	4.1	<3		40	<3	
Females: 9-13	867	13.7	(0.37)	8.6	9.5	11.2	13.5	16.0	18.6	20.3	5.7	<3		40	<3	
Females: 14-18	706	13.0	(0.50)	6.9	7.9	9.8	12.4	15.4	18.6	20.8	7.9	15	(2.7)	45	<3	
Females: 19-30	1039	12.9	(0.25)	7.6	8.5	10.2	12.5	15.2	18.1	19.9	8.1	16	(1.7)	45	<3	
Females: 31-50	1918	13.3	(0.30)	7.6	8.6	10.5	12.9	15.7	18.6	20.4	8.1	15	(1.7)	45	<3	
Females: 19-50	2957	13.2	(0.24)	7.6	8.6	10.4	12.8	15.5	18.4	20.2	8.1	16	(1.3)	45	<3	
Females: 51-70	1738	12.9	(0.26)	7.3	8.3	10.1	12.5	15.4	18.5	20.5	5	<3		45	<3	
Females: 71 and over	964	12.5	(0.29)	6.7	7.6	9.5	12.0	15.0	18.2	20.4	5	<3		45	<3	
Females: 50 and over	2702	12.8	(0.19)	7.1	8.0	9.9	12.3	15.3	18.4	20.5	5	<3		45	<3	
Females: 19 and over	5659	13.0	(0.19)	7.4	8.3	10.2	12.6	15.4	18.4	20.4		9	(0.8)	45	<3	
All individuals 1 and over	17892	14.7	(0.13)	7.7	8.8	11.1	14.2	17.8	21.7	24.3		5	(0.3)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL. EAR comparisons by probability method for groups.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. 7/2013

Zinc (mg/day)

Zinc (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	8.0	(0.22)	4.8	5.4	6.4	7.8	9.3	10.9	11.9	2.5	<3		7	65	(4.3)
Males: 4-8	1001	9.6	(0.19)	6.6	7.1	8.2	9.5	11.0	12.5	13.5	4	<3		12	14	(3.5)
Males: 9-13	850	11.8	(0.33)	8.1	8.8	10.0	11.5	13.2	14.8	15.9	7	<3		23	<3	
Males: 14-18	808	13.9	(0.34)	8.4	9.3	11.2	13.4	16.1	18.9	20.7	8.5	5	(3.0)	34	<3	
Males: 19-30	1113	14.4	(0.42)	8.1	9.2	11.3	14.0	17.1	20.2	22.3	9.4	11	(3.0)	40	<3	
Males: 31-50	1825	15.2	(0.33)	9.0	10.1	12.1	14.7	17.8	21.0	23.0	9.4	7	(1.7)	40	<3	
Males: 19-50	2938	14.9	(0.26)	8.6	9.7	11.8	14.5	17.6	20.7	22.8	9.4	8	(1.9)	40	<3	
Males: 51-70	1773	13.9	(0.61)	7.4	8.4	10.3	13.0	16.2	19.8	22.1	9.4	17	(2.5)	40	<3	
Males: 71 and over	912	11.8	(0.47)	6.5	7.3	8.9	11.1	13.9	17.0	19.2	9.4	30	(3.8)	40	<3	
Males: 50 and over	2685	13.4	(0.56)	7.1	8.1	10.0	12.5	15.7	19.1	21.5	9.4	20	(2.5)	40	<3	
Males: 19 and over	5623	14.3	(0.24)	7.9	9.0	11.0	13.7	16.9	20.2	22.5	9.4	12	(1.5)	40	<3	
Females: 1-3	712	7.6	(0.18)	4.6	5.1	6.1	7.3	8.8	10.4	11.4	2.5	<3		7	56	(3.7)
Females: 4-8	894	8.8	(0.20)	5.0	5.6	6.9	8.5	10.4	12.5	13.8	4	<3		12	13	(2.3)
Females: 9-13	867	10.1	(0.35)	6.8	7.4	8.5	9.8	11.3	12.9	13.9	7	6	(3.6)	23	<3	
Females: 14-18	706	8.9	(0.29)	6.0	6.5	7.6	8.8	10.2	11.5	12.5	7.3	21	(6.9)	34	<3	
Females: 19-30	1039	9.7	(0.17)	6.1	6.7	8.0	9.5	11.3	13.1	14.2	6.8	11	(3.5)	40	<3	
Females: 31-50	1918	10.2	(0.17)	5.8	6.6	8.0	9.8	12.0	14.2	15.6	6.8	12	(2.3)	40	<3	
Females: 19-50	2957	10.0	(0.13)	5.9	6.6	8.0	9.7	11.7	13.8	15.1	6.8	12	(2.0)	40	<3	
Females: 51-70	1738	9.7	(0.24)	5.7	6.4	7.7	9.4	11.4	13.6	15.1	6.8	14	(1.9)	40	<3	
Females: 71 and over	964	9.2	(0.24)	5.0	5.7	7.0	8.7	10.9	13.3	15.0	6.8	23	(2.1)	40	<3	
Females: 50 and over	2702	9.6	(0.18)	5.4	6.1	7.4	9.2	11.3	13.6	15.1	6.8	17	(1.6)	40	<3	
Females: 19 and over	5659	9.8	(0.13)	5.7	6.4	7.8	9.5	11.6	13.7	15.2	6.8	14	(1.5)	40	<3	
All individuals 1 and over	17892	11.5	(0.12)	6.1	6.9	8.6	10.9	13.8	16.8	18.8		11	(1.1)		3	(0.2)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Copper (mg/day)

Copper (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	0.8	(0.02)	0.5	0.5	0.6	0.8	0.9	1.1	1.2	0.26	<3		1	15	(3.1)
Males: 4-8	1001	1.0	(0.02)	0.6	0.7	0.8	0.9	1.1	1.3	1.4	0.34	<3		3	<3	
Males: 9-13	850	1.1	(0.03)	0.7	0.7	0.9	1.1	1.3	1.5	1.6	0.54	<3		5	<3	
Males: 14-18	808	1.3	(0.05)	0.8	0.9	1.0	1.3	1.5	1.8	2.0	0.685	<3		8	<3	
Males: 19-30	1113	1.5	(0.04)	0.9	1.0	1.2	1.4	1.8	2.1	2.4	0.7	<3		10	<3	
Males: 31-50	1825	1.6	(0.03)	0.9	1.0	1.2	1.5	1.9	2.3	2.5	0.7	<3		10	<3	
Males: 19-50	2938	1.5	(0.02)	0.9	1.0	1.2	1.5	1.8	2.2	2.5	0.7	<3		10	<3	
Males: 51-70	1773	1.5	(0.03)	0.9	0.9	1.1	1.4	1.7	2.1	2.3	0.7	<3		10	<3	
Males: 71 and over	912	1.3	(0.03)	0.7	0.8	1.0	1.2	1.5	1.8	2.1	0.7	5	(1.1)	10	<3	
Males: 50 and over	2685	1.4	(0.03)	0.8	0.9	1.1	1.4	1.7	2.0	2.3	0.7	<3		10	<3	
Males: 19 and over	5623	1.5	(0.02)	0.8	0.9	1.2	1.4	1.8	2.2	2.4	0.7	<3		10	<3	
Females: 1-3	712	0.8	(0.02)	0.4	0.5	0.6	0.7	0.9	1.0	1.2	0.26	<3		1	13	(2.1)
Females: 4-8	894	0.9	(0.02)	0.6	0.7	0.8	0.9	1.0	1.2	1.3	0.34	<3		3	<3	
Females: 9-13	867	1.0	(0.02)	0.6	0.7	0.8	1.0	1.1	1.3	1.4	0.54	<3		5	<3	
Females: 14-18	706	1.0	(0.03)	0.6	0.6	0.8	1.0	1.2	1.4	1.5	0.685	14	(4.1)	8	<3	
Females: 19-30	1039	1.1	(0.02)	0.6	0.7	0.9	1.0	1.3	1.5	1.7	0.7	8	(2.5)	10	<3	
Females: 31-50	1918	1.2	(0.03)	0.7	0.7	0.9	1.1	1.4	1.7	1.9	0.7	7	(2.0)	10	<3	
Females: 19-50	2957	1.1	(0.02)	0.7	0.7	0.9	1.1	1.4	1.6	1.8	0.7	8	(1.7)	10	<3	
Females: 51-70	1738	1.2	(0.03)	0.7	0.8	0.9	1.2	1.4	1.8	2.0	0.7	6	(1.0)	10	<3	
Females: 71 and over	964	1.1	(0.03)	0.6	0.7	0.8	1.0	1.2	1.5	1.6	0.7	10	(1.8)	10	<3	
Females: 50 and over	2702	1.2	(0.02)	0.7	0.7	0.9	1.1	1.4	1.7	1.9	0.7	7	(1.0)	10	<3	
Females: 19 and over	5659	1.2	(0.02)	0.7	0.7	0.9	1.1	1.4	1.7	1.9	0.7	7	(1.1)	10	<3	
All individuals 1 and over	17892	1.2	(0.01)	0.6	0.7	0.9	1.2	1.5	1.8	2.1		4	(0.5)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Selenium (µg/day)

Selenium (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	EAR	Below EAR: %	Below EAR: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	66	(1.6)	40	45	54	65	77	90	97	17	<3		90	10	(2.3)
Males: 4-8	1001	80	(0.9)	54	59	68	79	92	105	113	23	<3		150	<3	
Males: 9-13	850	104	(2.6)	74	80	90	103	116	129	137	35	<3		280	<3	
Males: 14-18	808	131	(4.6)	75	85	104	127	153	180	197	45	<3		400	<3	
Males: 19-30	1113	142	(2.7)	89	99	117	140	165	190	206	45	<3		400	<3	
Males: 31-50	1825	141	(2.0)	87	97	116	138	163	188	204	45	<3		400	<3	
Males: 19-50	2938	141	(1.7)	88	98	116	139	164	188	204	45	<3		400	<3	
Males: 51-70	1773	126	(2.2)	77	86	103	123	146	170	184	45	<3		400	<3	
Males: 71 and over	912	100	(2.4)	65	71	84	98	115	132	142	45	<3		400	<3	
Males: 50 and over	2685	120	(1.9)	72	81	97	117	140	162	177	45	<3		400	<3	
Males: 19 and over	5623	133	(1.4)	80	90	108	131	155	180	196	45	<3		400	<3	
Females: 1-3	712	66	(1.4)	42	46	54	65	76	88	96	17	<3		90	9	(2.1)
Females: 4-8	894	79	(1.8)	53	58	67	78	90	102	109	23	<3		150	<3	
Females: 9-13	867	89	(2.4)	63	68	77	88	99	110	117	35	<3		280	<3	
Females: 14-18	706	89	(2.7)	57	63	74	87	102	117	126	45	<3		400	<3	
Females: 19-30	1039	91	(1.6)	60	66	77	91	105	120	128	45	<3		400	<3	
Females: 31-50	1918	96	(1.6)	60	67	79	94	110	127	137	45	<3		400	<3	
Females: 19-50	2957	94	(1.2)	60	66	78	93	109	124	134	45	<3		400	<3	
Females: 51-70	1738	90	(1.9)	58	64	75	88	104	119	129	45	<3		400	<3	
Females: 71 and over	964	79	(1.6)	46	52	63	77	93	109	119	45	4	(1.5)	400	<3	
Females: 50 and over	2702	87	(1.3)	53	59	71	85	101	117	127	45	<3		400	<3	
Females: 19 and over	5659	91	(1.0)	57	63	75	89	105	121	132	45	<3		400	<3	
All individuals 1 and over	17892	106	(0.9)	58	66	81	102	127	152	168		<3			<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Sodium (mg/day)

Sodium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE	UL	Above UL: %	Above UL: SE
Males: 1-3	772	2026	(49.1)	1170	1319	1605	1963	2368	2787	3053	1000	>97		1500	81	(4.0)
Males: 4-8	1001	2710	(46.7)	1772	1944	2263	2664	3119	3584	3885	1200	>97		1900	92	(1.9)
Males: 9-13	850	3505	(103.8)	2343	2550	2933	3407	3936	4464	4809	1500	>97		2200	>97	
Males: 14-18	808	4272	(124.5)	2425	2735	3341	4106	5009	5958	6569	1500	>97		2300	96	(1.4)
Males: 19-30	1113	4477	(95.8)	2644	2980	3598	4375	5252	6122	6676	1500	>97		2300	>97	
Males: 31-50	1825	4517	(74.6)	2748	3074	3674	4422	5275	6141	6684	1500	>97		2300	>97	
Males: 19-50	2938	4502	(65.6)	2697	3032	3648	4410	5264	6114	6676	1500	>97		2300	>97	
Males: 51-70	1773	4015	(71.2)	2454	2738	3267	3927	4670	5430	5902	1300	>97		2300	97	(0.7)
Males: 71 and over	912	3183	(74.0)	2079	2282	2664	3132	3655	4180	4515	1200	>97		2300	89	(2.2)
Males: 50 and over	2685	3816	(65.6)	2294	2571	3087	3732	4450	5174	5642		>97		2300	95	(0.8)
Males: 19 and over	5623	4240	(44.7)	2500	2820	3406	4147	4980	5810	6346		>97		2300	97	(0.3)
Females: 1-3	712	2010	(41.8)	1189	1333	1614	1955	2339	2732	2979	1000	>97		1500	82	(3.1)
Females: 4-8	894	2576	(47.1)	1666	1825	2128	2512	2949	3398	3681	1200	>97		1900	87	(3.0)
Females: 9-13	867	2962	(71.1)	2052	2218	2534	2918	3332	3745	3998	1500	>97		2200	91	(2.8)
Females: 14-18	706	3030	(106.2)	1946	2137	2504	2955	3454	3967	4307	1500	>97		2300	84	(6.2)
Females: 19-30	1039	3115	(71.2)	1929	2150	2552	3051	3607	4160	4501	1500	>97		2300	85	(3.6)
Females: 31-50	1918	3109	(52.0)	1860	2088	2508	3026	3609	4200	4562	1500	>97		2300	83	(2.6)
Females: 19-50	2957	3111	(40.5)	1884	2108	2526	3035	3606	4176	4539	1500	>97		2300	84	(2.0)
Females: 51-70	1738	2917	(43.5)	1911	2096	2440	2867	3342	3831	4141	1300	>97		2300	82	(2.3)
Females: 71 and over	964	2550	(49.6)	1614	1788	2109	2507	2950	3392	3675	1200	>97		2300	63	(2.5)
Females: 50 and over	2702	2810	(31.0)	1793	1979	2327	2758	3238	3725	4040		>97		2300	76	(1.6)
Females: 19 and over	5659	2983	(27.9)	1840	2051	2436	2916	3455	3993	4343		>97		2300	81	(1.6)
All individuals 1 and over	17892	3440	(28.3)	1845	2112	2623	3301	4108	4940	5468		>97			89	(0.8)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake above the AI and the UL. Discretionary salt use at the table not included. Post-processing salt adjustment omitted for 2007-2008.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Potassium (mg/day)

Potassium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th	AI	Above AI: %	Above AI: SE
Males: 1-3	772	2039	(41.2)	1230	1382	1664	2002	2367	2727	2948	3000	4	(1.2)
Males: 4-8	1001	2108	(32.2)	1445	1571	1801	2085	2402	2720	2923	3800	<3	
Males: 9-13	850	2335	(67.2)	1485	1640	1926	2278	2668	3054	3304	4500	<3	
Males: 14-18	808	2756	(89.6)	1555	1762	2161	2657	3232	3826	4203	4700	<3	
Males: 19-30	1113	2925	(75.0)	1581	1824	2274	2844	3492	4136	4547	4700	4	(1.4)
Males: 31-50	1825	3240	(53.0)	1852	2106	2576	3163	3834	4515	4940	4700	8	(1.7)
Males: 19-50	2938	3122	(45.6)	1728	1981	2452	3044	3710	4374	4816	4700	6	(1.1)
Males: 51-70	1773	3135	(47.4)	1844	2088	2536	3082	3680	4276	4639	4700	4	(0.9)
Males: 71 and over	912	2750	(58.8)	1640	1839	2217	2682	3204	3727	4060	4700	<3	
Males: 50 and over	2685	3042	(43.4)	1772	2010	2452	2988	3574	4153	4521	4700	3	(0.7)
Males: 19 and over	5623	3091	(33.1)	1749	1993	2448	3022	3664	4302	4713	4700	5	(0.7)
Females: 1-3	712	1964	(41.2)	1233	1362	1611	1914	2255	2607	2829	3000	<3	
Females: 4-8	894	1985	(35.2)	1284	1410	1647	1947	2283	2625	2838	3800	<3	
Females: 9-13	867	2042	(50.6)	1391	1511	1738	2013	2306	2598	2775	4500	<3	
Females: 14-18	706	1927	(57.8)	1174	1314	1580	1905	2256	2612	2843	4700	<3	
Females: 19-30	1039	2132	(41.9)	1346	1496	1768	2099	2463	2820	3037	4700	<3	
Females: 31-50	1918	2358	(40.2)	1308	1503	1863	2305	2800	3296	3598	4700	<3	
Females: 19-50	2957	2277	(34.2)	1300	1483	1819	2230	2685	3135	3424	4700	<3	
Females: 51-70	1738	2493	(49.2)	1464	1656	2012	2449	2926	3408	3707	4700	<3	
Females: 71 and over	964	2252	(32.7)	1290	1463	1785	2190	2647	3107	3403	4700	<3	
Females: 50 and over	2702	2423	(35.7)	1397	1585	1936	2370	2848	3329	3636	4700	<3	
Females: 19 and over	5659	2339	(27.5)	1337	1522	1865	2291	2764	3230	3527	4700	<3	
All individuals 1 and over	17892	2567	(24.0)	1374	1583	1977	2486	3072	3661	4038		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Caffeine (mg/day)

Caffeine (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	4.8	(0.50)	0.1	0.2	0.6	1.7	4.7	10.5	16.5
Males: 4-8	1001	13.8	(0.91)	1.7	2.5	4.7	8.6	15.4	25.1	33.2
Males: 9-13	850	31.5	(2.49)	1.4	2.7	6.9	17.7	40.5	81.6	119.6
Males: 14-18	808	79.3	(10.84)	2.7	6.0	17.9	45.9	97.7	173.5	237.7
Males: 19-30	1113	133.0	(8.64)	4.9	12.4	39.4	95.2	182.9	296.8	382.7
Males: 31-50	1825	222.8	(10.54)	11.4	27.4	76.6	168.0	306.5	478.5	607.9
Males: 19-50	2938	189.1	(9.00)	7.3	18.6	58.5	138.6	260.0	419.4	537.8
Males: 51-70	1773	259.9	(11.36)	15.0	35.4	95.4	201.2	357.8	548.0	689.1
Males: 71 and over	912	163.0	(8.07)	6.6	17.8	53.3	121.2	228.2	365.3	469.4
Males: 50 and over	2685	236.6	(8.83)	11.4	28.8	82.1	180.6	327.1	508.0	644.9
Males: 19 and over	5623	207.3	(7.60)	7.8	20.9	65.8	153.2	287.1	454.7	578.9
Females: 1-3	712	4.7	(0.68)		0.1	0.6	2.2	5.9	11.3	16.0
Females: 4-8	894	12.5	(1.39)	0.8	1.4	3.2	7.1	14.4	25.7	36.2
Females: 9-13	867	24.1	(2.25)	1.5	2.7	6.6	14.8	30.0	52.0	71.7
Females: 14-18	706	63.3	(3.99)	4.0	7.6	19.2	43.5	84.7	142.3	191.0
Females: 19-30	1039	111.9	(8.18)	3.0	8.8	32.0	80.0	155.9	253.4	325.7
Females: 31-50	1918	176.0	(7.92)	7.7	18.5	54.3	126.1	240.3	388.1	499.9
Females: 19-50	2957	152.9	(7.02)	4.9	13.3	43.7	107.7	209.3	343.5	444.7
Females: 51-70	1738	183.2	(10.03)	8.4	21.6	60.2	133.1	246.7	393.0	503.0
Females: 71 and over	964	128.4	(7.37)	4.4	11.7	37.4	90.3	176.4	287.8	372.5
Females: 50 and over	2702	167.2	(6.65)	6.9	18.0	52.5	120.1	228.3	366.3	470.9
Females: 19 and over	5659	159.0	(5.89)	5.4	14.8	47.3	112.4	217.7	352.5	455.6
All individuals 1 and over	17892	144.6	(4.85)	1.1	4.4	26.1	87.9	197.5	347.2	465.1

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Sodium (mg/1000 kcal/day)

Sodium (mg/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	1415	(22.2)	1077	1145	1265	1402	1546	1684	1770
Males: 4-8	1001	1559	(23.5)	1229	1292	1401	1528	1663	1792	1870
Males: 9-13	850	1648	(25.5)	1328	1392	1499	1627	1766	1902	1992
Males: 14-18	808	1696	(25.4)	1286	1364	1499	1655	1819	1968	2064
Males: 19-30	1113	1690	(16.8)	1351	1415	1529	1659	1799	1936	2020
Males: 31-50	1825	1716	(16.1)	1288	1364	1501	1670	1858	2043	2166
Males: 19-50	2938	1706	(11.5)	1312	1383	1511	1667	1837	2004	2113
Males: 51-70	1773	1763	(25.8)	1306	1387	1536	1718	1924	2132	2268
Males: 71 and over	912	1755	(27.5)	1327	1406	1542	1710	1893	2078	2199
Males: 50 and over	2685	1761	(21.0)	1306	1388	1536	1716	1918	2122	2254
Males: 19 and over	5623	1727	(10.5)	1308	1384	1519	1685	1868	2051	2168
Females: 1-3	712	1469	(19.2)	1104	1180	1307	1459	1623	1782	1888
Females: 4-8	894	1532	(16.9)	1176	1243	1364	1508	1664	1823	1920
Females: 9-13	867	1615	(24.9)	1306	1363	1468	1591	1731	1865	1950
Females: 14-18	706	1673	(25.9)	1346	1408	1513	1639	1776	1906	1986
Females: 19-30	1039	1716	(28.0)	1279	1360	1497	1664	1844	2026	2140
Females: 31-50	1918	1719	(17.4)	1337	1407	1529	1677	1837	1994	2095
Females: 19-50	2957	1718	(14.6)	1309	1383	1514	1671	1843	2011	2122
Females: 51-70	1738	1751	(22.8)	1291	1372	1520	1703	1906	2114	2254
Females: 71 and over	964	1739	(18.0)	1334	1410	1544	1704	1882	2058	2170
Females: 50 and over	2702	1748	(15.7)	1304	1383	1526	1701	1900	2099	2231
Females: 19 and over	5659	1731	(11.1)	1305	1382	1519	1684	1868	2051	2169
All individuals 1 and over	17892	1694	(7.6)	1274	1352	1489	1654	1835	2012	2125

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Discretionary salt use at the table not included. Post-processing salt adjustment omitted for 2007-2008.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Cholesterol (mg/1000 kcal/day)

Cholesterol (mg/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

Dietary Reference Intake Group	Day 1: N	Day 1: Mean	Day 1: SE	Percentile of Usual Intake: 5th	Percentile of Usual Intake: 10th	Percentile of Usual Intake: 25th	Percentile of Usual Intake: 50th	Percentile of Usual Intake: 75th	Percentile of Usual Intake: 90th	Percentile of Usual Intake: 95th
Males: 1-3	772	120	(5.7)	60	69	88	113	144	177	200
Males: 4-8	1001	112	(4.1)	70	76	89	106	125	146	160
Males: 9-13	850	112	(4.6)	61	70	86	108	135	165	186
Males: 14-18	808	121	(4.4)	88	94	104	117	131	144	153
Males: 19-30	1113	128	(3.6)	78	87	104	126	152	180	199
Males: 31-50	1825	139	(2.7)	84	93	112	136	165	196	216
Males: 19-50	2938	135	(2.1)	82	91	109	132	159	189	209
Males: 51-70	1773	145	(3.4)	74	86	108	138	175	214	241
Males: 71 and over	912	152	(4.4)	67	79	105	142	191	249	292
Males: 50 and over	2685	147	(2.7)	72	84	107	139	178	221	251
Males: 19 and over	5623	140	(1.8)	77	88	108	134	167	202	225
Females: 1-3	712	125	(4.3)	67	76	94	118	150	184	209
Females: 4-8	894	108	(3.1)	93	96	101	107	114	121	125
Females: 9-13	867	112	(3.6)	61	69	86	108	136	167	188
Females: 14-18	706	112	(4.7)	74	80	93	110	128	147	159
Females: 19-30	1039	118	(3.9)	54	64	84	113	150	192	222
Females: 31-50	1918	130	(2.6)	77	86	103	126	153	182	201
Females: 19-50	2957	126	(2.5)	66	76	95	121	154	189	213
Females: 51-70	1738	134	(4.0)	70	80	100	128	162	199	225
Females: 71 and over	964	129	(3.2)	77	86	103	125	151	178	196
Females: 50 and over	2702	133	(2.9)	71	81	101	127	158	193	217
Females: 19 and over	5659	129	(2.1)	68	78	97	123	155	190	214
All individuals 1 and over	17892	129	(1.5)	70	80	99	124	155	189	212

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 7/2013

Appendix E-2.2: Usual Intake Distributions as a Percent of Energy for Fatty Acids and Macronutrients, 2007-2010, by Age/Gender Groups

Usual Intakes from Food and Beverages 2007-2010 Compared To Dietary Reference Intakes -- continued

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

2/2014

PFA 20:5 (EPA) (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Males:										
1-3................................	772	0.01	(0.001)	#	#	#	#	0.01	0.01	0.01
4-8................................	1001	0.01	(0.002)	#	#	#	0.01	0.01	0.02	0.02
9-13..............................	850	0.02	(0.003)	0.01	0.01	0.01	0.01	0.01	0.02	0.02
14-18............................	808	0.02	(0.004)	#	0.01	0.01	0.01	0.02	0.03	0.03
19-30............................	1113	0.04	(0.003)	0.01	0.01	0.01	0.02	0.03	0.05	0.06
31-50............................	1825	0.05	(0.004)	0.01	0.01	0.02	0.02	0.03	0.05	0.05
19-50..........................	2938	0.04	(0.003)	0.01	0.01	0.02	0.02	0.03	0.05	0.06
51-70............................	1773	0.05	(0.006)	0.01	0.01	0.01	0.02	0.04	0.05	0.07
71 and over....................	912	0.04	(0.006)	0.01	0.01	0.01	0.02	0.02	0.03	0.04
50 and over.................	2685	0.05	(0.005)	0.01	0.01	0.01	0.02	0.03	0.05	0.06
19 and over...............	5623	0.05	(0.003)	0.01	0.01	0.01	0.02	0.03	0.05	0.06
Females:										
1-3................................	712	0.01	(0.002)	#	#	#	0.01	0.01	0.01	0.02
4-8................................	894	0.01	(0.003)	#	#	0.01	0.01	0.01	0.02	0.02
9-13..............................	867	0.01	(0.002)	#	#	0.01	0.01	0.01	0.02	0.02
14-18............................	706	0.02	(0.003)	0.01	0.01	0.01	0.01	0.01	0.01	0.01
19-30............................	1039	0.02	(0.003)	#	0.01	0.01	0.01	0.02	0.02	0.03
31-50............................	1918	0.03	(0.005)	#	0.01	0.01	0.01	0.02	0.03	0.04
19-50..........................	2957	0.03	(0.004)	#	0.01	0.01	0.01	0.02	0.03	0.03
51-70............................	1738	0.04	(0.006)	0.01	0.01	0.01	0.02	0.02	0.03	0.04
71 and over....................	964	0.03	(0.004)	#	#	0.01	0.01	0.02	0.03	0.04
50 and over.................	2702	0.04	(0.004)	0.01	0.01	0.01	0.02	0.02	0.03	0.04
19 and over...............	5659	0.03	(0.003)	#	0.01	0.01	0.01	0.02	0.03	0.04
All individuals 1 and over..	17892	0.03	(0.002)	#	0.01	0.01	0.02	0.02	0.03	0.04

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
# Indicates a non-zero value too small to report.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

PFA 22:6 (DHA) (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----						
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th
Males:										
1-3................................	772	0.02	(0.003)	#	#	0.01	0.01	0.02	0.04	0.05
4-8................................	1001	0.03	(0.003)	0.01	0.01	0.01	0.02	0.02	0.03	0.04
9-13..............................	850	0.04	(0.005)	0.01	0.01	0.01	0.02	0.03	0.05	0.06
14-18............................	808	0.04	(0.006)	0.01	0.01	0.02	0.03	0.04	0.06	0.07
19-30............................	1113	0.08	(0.006)	0.01	0.02	0.03	0.05	0.09	0.13	0.17
31-50............................	1825	0.09	(0.007)	0.02	0.02	0.04	0.06	0.09	0.13	0.16
19-50..........................	2938	0.09	(0.005)	0.02	0.02	0.04	0.06	0.09	0.13	0.17
51-70............................	1773	0.10	(0.009)	0.02	0.03	0.04	0.06	0.09	0.13	0.16
71 and over....................	912	0.08	(0.009)	0.01	0.02	0.03	0.05	0.07	0.11	0.13
50 and over.................	2685	0.09	(0.007)	0.02	0.02	0.04	0.06	0.09	0.13	0.16
19 and over...............	5623	0.09	(0.004)	0.02	0.02	0.04	0.06	0.09	0.13	0.16
Females:										
1-3................................	712	0.02	(0.002)	#	0.01	0.01	0.01	0.02	0.03	0.04
4-8................................	894	0.03	(0.003)	0.01	0.01	0.01	0.02	0.03	0.04	0.05
9-13..............................	867	0.03	(0.004)	0.01	0.01	0.01	0.02	0.03	0.04	0.06
14-18............................	706	0.03	(0.004)	0.01	0.02	0.02	0.03	0.03	0.04	0.04
19-30............................	1039	0.05	(0.006)	0.01	0.01	0.02	0.03	0.05	0.06	0.08
31-50............................	1918	0.06	(0.007)	0.01	0.02	0.02	0.04	0.06	0.09	0.11
19-50..........................	2957	0.06	(0.005)	0.01	0.01	0.02	0.04	0.05	0.08	0.10
51-70............................	1738	0.08	(0.008)	0.02	0.02	0.03	0.05	0.07	0.09	0.10
71 and over....................	964	0.05	(0.005)	0.01	0.01	0.02	0.03	0.05	0.08	0.10
50 and over.................	2702	0.07	(0.006)	0.01	0.02	0.03	0.04	0.06	0.09	0.11
19 and over...............	5659	0.06	(0.004)	0.01	0.02	0.02	0.04	0.06	0.08	0.10
All individuals 1 and over..	17892	0.06	(0.003)	0.01	0.01	0.02	0.04	0.06	0.09	0.12

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
# Indicates a non-zero value too small to report.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Protein (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Within AMDR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Males:													
1-3	772	14.8	(0.22)	11.1	11.8	13.1	14.6	16.2	17.7	18.8	5-20%	>97	
4-8	1001	13.8	(0.15)	10.9	11.5	12.5	13.6	14.9	16.1	16.8	10-30%	>97	
9-13	850	14.6	(0.18)	12.0	12.6	13.5	14.6	15.9	17.1	17.9	10-30%	>97	
14-18	808	15.2	(0.20)	12.0	12.7	13.7	15.0	16.3	17.6	18.4	10-30%	>97	
19-30	1113	15.6	(0.17)	12.3	13.0	14.1	15.4	16.9	18.4	19.3	10-35%	>97	
31-50	1825	16.0	(0.17)	12.2	12.9	14.1	15.7	17.4	19.2	20.4	10-35%	>97	
19-50	2938	15.9	(0.13)	12.2	12.9	14.1	15.6	17.2	18.9	20.0	10-35%	>97	
51-70	1773	16.3	(0.20)	12.1	12.8	14.3	16.0	17.9	19.8	21.1	10-35%	>97	
71 and over	912	16.0	(0.19)	12.3	13.0	14.2	15.7	17.3	18.9	19.9	10-35%	>97	
50 and over	2685	16.2	(0.16)	12.1	12.9	14.2	15.9	17.7	19.6	20.8	10-35%	>97	
19 and over	5623	16.0	(0.11)	12.2	12.9	14.1	15.7	17.4	19.2	20.3	10-35%	>97	
Females:													
1-3	712	15.1	(0.19)	11.5	12.2	13.4	14.9	16.5	18.1	19.2	5-20%	>97	
4-8	894	14.0	(0.25)	10.9	11.5	12.5	13.7	15.0	16.3	17.1	10-30%	>97	
9-13	867	14.0	(0.26)	11.1	11.6	12.6	13.9	15.2	16.6	17.5	10-30%	>97	
14-18	706	14.1	(0.23)	12.1	12.5	13.2	14.0	14.8	15.5	16.0	10-30%	>97	
19-30	1039	15.1	(0.21)	11.2	11.9	13.1	14.7	16.5	18.2	19.4	10-35%	>97	
31-50	1918	15.6	(0.13)	11.8	12.5	13.7	15.2	16.8	18.5	19.6	10-35%	>97	
19-50	2957	15.4	(0.12)	11.6	12.3	13.5	15.0	16.7	18.4	19.5	10-35%	>97	
51-70	1738	16.0	(0.19)	11.6	12.4	13.8	15.5	17.4	19.3	20.5	10-35%	>97	
71 and over	964	15.8	(0.17)	11.7	12.5	13.8	15.5	17.3	19.1	20.3	10-35%	>97	
50 and over	2702	15.9	(0.15)	11.7	12.4	13.8	15.5	17.3	19.2	20.4	10-35%	>97	
19 and over	5659	15.6	(0.10)	11.6	12.3	13.6	15.2	17.0	18.8	20.0	10-35%	>97	
All individuals 1 and over	17892	15.5	(0.08)	11.6	12.3	13.6	15.1	16.8	18.5	19.6		>97	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Carbohydrate (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1					----- Percentiles of Usual Intake -----					Within AMDR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Males:													
1-3................................	772	54.9	(0.65)	45.0	47.0	50.4	54.4	58.5	62.4	64.9	45-65%	90	(3.5)
4-8................................	1001	55.2	(0.37)	49.1	50.3	52.4	54.7	57.2	59.5	60.9	45-65%	>97	
9-13..............................	850	54.3	(0.47)	48.8	49.9	51.5	53.4	55.2	56.9	57.8	45-65%	>97	
14-18............................	808	52.7	(0.55)	45.0	46.5	49.1	52.1	55.2	58.1	59.8	45-65%	95	(3.6)
19-30............................	1113	50.1	(0.37)	40.1	42.0	45.3	49.1	53.0	56.9	59.2	45-65%	76	(3.6)
31-50............................	1825	47.2	(0.37)	35.1	37.4	41.4	46.1	51.2	56.1	59.3	45-65%	55	(2.1)
19-50..........................	2938	48.3	(0.30)	36.7	38.9	42.7	47.3	52.2	56.9	59.9	45-65%	62	(1.9)
51-70............................	1773	46.6	(0.46)	35.1	37.3	41.1	45.7	50.7	55.7	59.0	45-65%	53	(2.4)
71 and over....................	912	49.6	(0.38)	38.4	40.6	44.3	48.8	53.6	58.3	61.4	45-65%	70	(2.6)
50 and over.................	2685	47.3	(0.38)	35.7	37.9	41.7	46.4	51.5	56.6	59.9	45-65%	56	(2.1)
19 and over...............	5623	47.9	(0.27)	36.2	38.4	42.3	46.9	51.9	56.8	59.9	45-65%	59	(1.7)
Females:													
1-3................................	712	53.6	(0.44)	44.4	46.2	49.3	53.0	56.8	60.4	62.7	45-65%	91	(2.2)
4-8................................	894	54.9	(0.33)	48.8	50.0	52.1	54.6	57.1	59.4	60.8	45-65%	>97	
9-13..............................	867	54.5	(0.35)	47.5	48.9	51.3	54.1	57.0	59.7	61.3	45-65%	>97	
14-18............................	706	53.7	(0.56)	46.5	47.9	50.3	53.0	55.7	58.2	59.8	45-65%	>97	
19-30............................	1039	51.9	(0.49)	41.1	43.1	46.6	50.8	55.3	59.7	62.5	45-65%	80	(2.7)
31-50............................	1918	50.8	(0.30)	39.0	41.3	45.2	49.8	54.7	59.4	62.5	45-65%	73	(2.4)
19-50..........................	2957	51.2	(0.27)	39.7	41.9	45.7	50.1	54.9	59.4	62.3	45-65%	76	(1.6)
51-70............................	1738	49.5	(0.40)	38.6	40.7	44.4	48.6	53.2	57.4	60.1	45-65%	70	(2.6)
71 and over....................	964	51.7	(0.41)	42.1	44.0	47.3	51.1	55.1	58.8	61.3	45-65%	85	(2.4)
50 and over.................	2702	50.1	(0.32)	39.4	41.5	45.1	49.3	53.8	58.0	60.7	45-65%	74	(1.9)
19 and over...............	5659	50.7	(0.21)	39.6	41.7	45.4	49.7	54.4	58.9	61.7	45-65%	75	(1.2)
All individuals 1 and over..	17892	50.6	(0.18)	39.3	41.3	45.0	49.5	54.4	59.2	62.3	45-65%	75	(0.9)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Total fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Within AMDR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Males:													
1-3................................	772	31.7	(0.48)	25.2	26.5	28.9	31.8	34.8	37.8	39.6	30-40%	62	(5.2)
4-8................................	1001	32.3	(0.29)	28.0	29.0	30.7	32.6	34.6	36.5	37.7	25-35%	78	(4.3)
9-13..............................	850	32.2	(0.41)	28.3	29.3	30.9	32.8	34.7	36.6	37.7	25-35%	78	(6.0)
14-18............................	808	32.8	(0.45)	27.6	28.8	30.8	33.2	35.8	38.2	39.8	25-35%	67	(4.8)
19-30............................	1113	31.1	(0.33)	24.4	25.9	28.5	31.5	34.6	37.5	39.3	20-35%	77	(4.1)
31-50............................	1825	33.5	(0.34)	26.0	27.6	30.4	33.6	37.1	40.3	42.4	20-35%	61	(2.9)
19-50..........................	2938	32.6	(0.23)	25.3	26.9	29.7	32.8	36.2	39.3	41.3	20-35%	67	(2.1)
51-70............................	1773	34.4	(0.32)	25.6	27.5	30.8	34.6	38.6	42.5	44.9	20-35%	52	(2.2)
71 and over....................	912	33.5	(0.35)	25.5	27.2	30.2	33.7	37.5	41.0	43.2	20-35%	59	(2.4)
50 and over.................	2685	34.2	(0.25)	25.5	27.4	30.6	34.3	38.3	42.2	44.6	20-35%	54	(1.8)
19 and over...............	5623	33.2	(0.20)	25.3	27.0	29.9	33.4	37.0	40.6	42.7	20-35%	62	(1.5)
Females:													
1-3................................	712	32.6	(0.34)	26.4	27.7	30.0	32.8	35.7	38.6	40.4	30-40%	69	(4.4)
4-8................................	894	32.4	(0.31)	28.3	29.2	30.9	32.8	34.8	36.7	37.9	25-35%	77	(5.1)
9-13..............................	867	32.7	(0.33)	26.8	28.1	30.3	32.9	35.7	38.3	39.9	25-35%	68	(5.7)
14-18............................	706	33.0	(0.47)	29.1	30.0	31.6	33.5	35.5	37.4	38.6	25-35%	70	(7.7)
19-30............................	1039	32.1	(0.37)	25.8	27.4	29.9	32.6	35.4	38.1	39.6	20-35%	71	(3.3)
31-50............................	1918	32.8	(0.21)	26.0	27.5	30.2	33.2	36.4	39.4	41.3	20-35%	65	(2.2)
19-50..........................	2957	32.6	(0.18)	26.0	27.5	30.1	33.0	36.1	39.0	40.7	20-35%	67	(1.7)
51-70............................	1738	34.1	(0.26)	26.8	28.4	31.3	34.6	38.2	41.5	43.6	20-35%	53	(2.2)
71 and over....................	964	33.3	(0.33)	26.4	27.9	30.6	33.6	36.9	40.0	42.0	20-35%	61	(2.5)
50 and over.................	2702	33.9	(0.22)	26.6	28.2	31.0	34.3	37.8	41.1	43.3	20-35%	55	(1.9)
19 and over...............	5659	33.1	(0.14)	26.2	27.7	30.4	33.5	36.9	40.0	41.9	20-35%	62	(1.2)
All individuals 1 and over..	17892	33.0	(0.13)	26.0	27.5	30.2	33.3	36.6	39.9	41.9		65	(1.0)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Saturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below 10%	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	%	SE
Males:												
1-3................................	772	12.1	(0.25)	8.5	9.2	10.5	12.1	13.8	15.5	16.6	18	(3.1)
4-8................................	1001	11.4	(0.16)	9.1	9.6	10.4	11.5	12.6	13.7	14.4	16	(2.9)
9-13..............................	850	11.3	(0.18)	9.1	9.6	10.4	11.4	12.6	13.6	14.3	17	(4.4)
14-18............................	808	11.3	(0.17)	9.0	9.5	10.3	11.4	12.5	13.5	14.1	18	(4.7)
19-30............................	1113	10.2	(0.15)	7.3	7.9	9.0	10.3	11.7	13.0	13.8	43	(4.1)
31-50............................	1825	11.0	(0.13)	7.8	8.5	9.7	11.0	12.5	13.9	14.7	30	(2.7)
19-50..........................	2938	10.7	(0.11)	7.6	8.3	9.4	10.8	12.2	13.6	14.4	35	(2.6)
51-70............................	1773	11.2	(0.14)	7.5	8.2	9.6	11.2	12.9	14.5	15.5	31	(2.5)
71 and over....................	912	10.8	(0.15)	7.5	8.2	9.4	10.8	12.5	14.0	15.0	35	(3.0)
50 and over.................	2685	11.1	(0.12)	7.4	8.2	9.5	11.1	12.8	14.4	15.4	32	(2.0)
19 and over...............	5623	10.9	(0.09)	7.5	8.2	9.5	10.9	12.4	13.9	14.9	34	(1.7)
Females:												
1-3................................	712	12.6	(0.17)	9.1	9.8	11.0	12.6	14.2	15.9	16.9	12	(2.3)
4-8................................	894	11.5	(0.18)	9.7	10.1	10.8	11.6	12.5	13.3	13.8	8	(4.5)
9-13..............................	867	11.4	(0.13)	8.7	9.2	10.2	11.4	12.8	14.0	14.9	21	(4.9)
14-18............................	706	11.1	(0.20)	9.1	9.6	10.4	11.3	12.2	13.1	13.7	17	(7.3)
19-30............................	1039	10.7	(0.15)	8.0	8.6	9.7	10.8	12.1	13.2	13.8	32	(4.8)
31-50............................	1918	10.8	(0.10)	7.7	8.4	9.5	10.9	12.3	13.7	14.6	33	(2.1)
19-50..........................	2957	10.8	(0.08)	7.8	8.5	9.6	10.9	12.3	13.6	14.4	33	(2.1)
51-70............................	1738	11.0	(0.13)	7.8	8.5	9.6	11.1	12.6	14.2	15.1	31	(3.3)
71 and over....................	964	11.0	(0.11)	7.8	8.4	9.6	11.0	12.5	14.0	15.0	33	(2.0)
50 and over.................	2702	11.0	(0.10)	7.8	8.5	9.6	11.1	12.6	14.2	15.2	31	(2.5)
19 and over...............	5659	10.9	(0.07)	7.8	8.4	9.6	10.9	12.4	13.8	14.7	32	(1.8)
All individuals 1 and over..	17892	11.0	(0.06)	7.9	8.6	9.7	11.1	12.6	14.0	15.0	29	(1.2)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. No Dietary Reference Intakes have been established for saturated fat; percentage of individuals with usual intake below 10% of total energy.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Monounsaturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----						
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th
Males:										
1-3................................	772	11.1	(0.19)	8.4	9.0	10.0	11.2	12.5	13.7	14.5
4-8................................	1001	11.7	(0.13)	9.8	10.2	11.0	11.8	12.8	13.6	14.2
9-13..............................	850	11.7	(0.16)	9.9	10.3	11.1	11.9	12.8	13.7	14.2
14-18............................	808	12.0	(0.22)	9.8	10.2	11.1	12.2	13.3	14.3	15.0
19-30............................	1113	11.3	(0.14)	8.6	9.2	10.2	11.4	12.7	13.9	14.7
31-50............................	1825	12.5	(0.13)	9.5	10.2	11.2	12.5	13.9	15.2	16.1
19-50..........................	2938	12.0	(0.08)	9.1	9.8	10.9	12.1	13.5	14.8	15.6
51-70............................	1773	12.7	(0.12)	9.3	10.0	11.3	12.8	14.4	16.0	17.0
71 and over....................	912	12.5	(0.16)	8.8	9.6	10.9	12.5	14.2	15.9	17.0
50 and over.................	2685	12.7	(0.10)	9.2	9.9	11.2	12.7	14.4	16.0	17.0
19 and over...............	5623	12.3	(0.07)	9.1	9.8	11.0	12.3	13.8	15.3	16.2
Females:										
1-3................................	712	11.4	(0.13)	8.8	9.3	10.3	11.4	12.6	13.8	14.5
4-8................................	894	11.6	(0.16)	9.5	9.9	10.8	11.8	12.8	13.8	14.4
9-13..............................	867	11.8	(0.15)	9.3	9.8	10.8	11.9	13.0	14.1	14.8
14-18............................	706	11.8	(0.25)	10.0	10.4	11.2	12.1	13.0	13.9	14.5
19-30............................	1039	11.5	(0.16)	8.8	9.4	10.5	11.7	12.9	14.0	14.7
31-50............................	1918	11.9	(0.12)	8.9	9.5	10.6	12.0	13.4	14.8	15.6
19-50..........................	2957	11.7	(0.10)	8.9	9.5	10.6	11.9	13.2	14.5	15.3
51-70............................	1738	12.3	(0.14)	9.4	10.0	11.2	12.5	13.9	15.2	16.1
71 and over....................	964	11.9	(0.14)	9.3	9.9	10.9	12.0	13.3	14.5	15.3
50 and over.................	2702	12.2	(0.12)	9.4	10.0	11.1	12.3	13.7	15.1	15.9
19 and over...............	5659	11.9	(0.06)	9.1	9.7	10.8	12.1	13.4	14.8	15.6
All individuals 1 and over..	17892	12.0	(0.05)	9.1	9.7	10.8	12.1	13.5	14.9	15.7

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Polyunsaturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Males:										
1-3................................	772	5.8	(0.12)	4.0	4.4	5.0	5.7	6.6	7.4	7.9
4-8................................	1001	6.4	(0.08)	5.0	5.3	5.8	6.5	7.2	7.8	8.3
9-13..............................	850	6.5	(0.20)	5.2	5.5	6.0	6.5	7.2	7.8	8.2
14-18............................	808	6.7	(0.18)	5.4	5.7	6.2	6.8	7.4	8.0	8.4
19-30............................	1113	6.8	(0.11)	5.3	5.6	6.1	6.8	7.5	8.2	8.6
31-50............................	1825	7.0	(0.12)	5.1	5.5	6.2	7.0	8.0	8.9	9.5
19-50..........................	2938	7.0	(0.08)	5.1	5.5	6.1	6.9	7.8	8.7	9.2
51-70............................	1773	7.5	(0.11)	5.2	5.7	6.5	7.5	8.6	9.7	10.5
71 and over....................	912	7.3	(0.12)	5.1	5.6	6.4	7.3	8.3	9.3	10.0
50 and over.................	2685	7.5	(0.09)	5.2	5.7	6.5	7.4	8.5	9.6	10.3
19 and over...............	5623	7.1	(0.07)	5.1	5.5	6.2	7.1	8.1	9.1	9.7
Females:										
1-3................................	712	6.0	(0.14)	4.0	4.4	5.1	5.9	6.9	7.8	8.4
4-8................................	894	6.6	(0.13)	5.1	5.4	5.9	6.6	7.3	8.1	8.5
9-13..............................	867	6.8	(0.14)	5.4	5.7	6.2	6.8	7.5	8.0	8.4
14-18............................	706	7.3	(0.18)	5.6	5.9	6.5	7.3	8.1	8.9	9.4
19-30............................	1039	7.1	(0.15)	5.5	5.8	6.4	7.2	7.9	8.6	9.1
31-50............................	1918	7.3	(0.09)	5.6	6.0	6.6	7.4	8.2	9.1	9.6
19-50..........................	2957	7.2	(0.08)	5.6	5.9	6.6	7.3	8.1	8.9	9.4
51-70............................	1738	7.9	(0.08)	5.5	6.0	6.9	7.9	9.1	10.3	11.0
71 and over....................	964	7.6	(0.13)	5.1	5.6	6.5	7.6	8.8	9.9	10.7
50 and over.................	2702	7.8	(0.07)	5.4	5.9	6.8	7.8	9.0	10.2	10.9
19 and over...............	5659	7.5	(0.06)	5.4	5.9	6.6	7.5	8.5	9.5	10.1
All individuals 1 and over..	17892	7.1	(0.05)	5.1	5.5	6.3	7.1	8.1	9.1	9.7

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

PFA 18:2 (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----								Within AMDR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Males:													
1-3	772	5.1	(0.11)	3.4	3.7	4.3	5.0	5.8	6.7	7.2	05-10%	51	(4.0)
4-8	1001	5.7	(0.07)	4.4	4.6	5.2	5.8	6.5	7.1	7.5	05-10%	80	(4.3)
9-13	850	5.8	(0.19)	4.5	4.7	5.2	5.8	6.5	7.1	7.5	05-10%	83	(5.9)
14-18	808	5.9	(0.17)	4.7	5.0	5.4	6.0	6.6	7.2	7.6	05-10%	90	(7.2)
19-30	1113	6.0	(0.10)	4.7	4.9	5.4	6.0	6.6	7.2	7.5	05-10%	89	(7.0)
31-50	1825	6.2	(0.11)	4.4	4.8	5.4	6.2	7.1	7.9	8.5	05-10%	85	(3.7)
19-50	2938	6.1	(0.08)	4.5	4.8	5.4	6.1	6.9	7.7	8.2	05-10%	86	(3.7)
51-70	1773	6.6	(0.10)	4.5	4.9	5.7	6.6	7.6	8.6	9.3	05-10%	86	(2.6)
71 and over	912	6.4	(0.10)	4.4	4.8	5.5	6.4	7.3	8.2	8.8	05-10%	86	(3.0)
50 and over	2685	6.5	(0.08)	4.5	4.9	5.6	6.5	7.6	8.6	9.2	05-10%	86	(2.0)
19 and over	5623	6.3	(0.06)	4.4	4.8	5.5	6.3	7.2	8.0	8.6	05-10%	86	(2.2)
Females:													
1-3	712	5.2	(0.13)	3.4	3.7	4.4	5.2	6.1	7.0	7.6	05-10%	55	(4.2)
4-8	894	5.9	(0.12)	4.4	4.7	5.3	5.9	6.6	7.3	7.8	05-10%	84	(5.2)
9-13	867	6.1	(0.14)	4.8	5.1	5.5	6.1	6.7	7.2	7.6	05-10%	91	(6.5)
14-18	706	6.5	(0.17)	4.9	5.2	5.8	6.5	7.3	8.0	8.5	05-10%	94	(6.2)
19-30	1039	6.3	(0.13)	4.8	5.1	5.7	6.3	7.0	7.7	8.1	05-10%	92	(4.1)
31-50	1918	6.5	(0.08)	4.9	5.2	5.8	6.5	7.3	8.1	8.6	05-10%	93	(3.1)
19-50	2957	6.4	(0.07)	4.8	5.2	5.8	6.5	7.2	8.0	8.4	05-10%	93	(2.2)
51-70	1738	6.9	(0.07)	4.8	5.2	6.0	7.0	8.0	9.1	9.8	05-10%	89	(2.1)
71 and over	964	6.6	(0.12)	4.5	4.9	5.7	6.6	7.7	8.7	9.4	05-10%	86	(3.4)
50 and over	2702	6.8	(0.06)	4.7	5.1	5.9	6.9	7.9	9.0	9.6	05-10%	88	(2.1)
19 and over	5659	6.6	(0.05)	4.7	5.1	5.8	6.6	7.5	8.4	9.0	05-10%	91	(1.4)
All individuals 1 and over	17892	6.3	(0.04)	4.5	4.8	5.5	6.3	7.2	8.1	8.6	05-10%	87	(1.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table. Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data. Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

PFA 18:3 (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Within AMDR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Males:													
1-3................................	772	0.53	(0.009)	0.36	0.39	0.45	0.52	0.60	0.69	0.74	0.6-1.2%	26	(2.3)
4-8................................	1001	0.52	(0.010)	0.40	0.43	0.47	0.52	0.57	0.62	0.66	0.6-1.2%	16	(6.1)
9-13..............................	850	0.51	(0.016)	0.39	0.42	0.47	0.52	0.58	0.64	0.67	0.6-1.2%	18	(8.5)
14-18............................	808	0.53	(0.016)	0.39	0.42	0.47	0.53	0.60	0.67	0.72	0.6-1.2%	25	(5.8)
19-30............................	1113	0.59	(0.010)	0.39	0.43	0.50	0.58	0.67	0.76	0.82	0.6-1.2%	43	(3.8)
31-50............................	1825	0.60	(0.011)	0.40	0.44	0.50	0.59	0.68	0.77	0.84	0.6-1.2%	46	(3.3)
19-50..........................	2938	0.59	(0.008)	0.40	0.43	0.50	0.58	0.68	0.77	0.84	0.6-1.2%	45	(2.6)
51-70............................	1773	0.68	(0.014)	0.48	0.52	0.59	0.68	0.77	0.87	0.94	0.6-1.2%	73	(3.7)
71 and over....................	912	0.67	(0.012)	0.48	0.52	0.58	0.67	0.76	0.85	0.91	0.6-1.2%	71	(4.6)
50 and over.................	2685	0.68	(0.011)	0.48	0.52	0.59	0.68	0.77	0.87	0.93	0.6-1.2%	72	(2.7)
19 and over...............	5623	0.63	(0.007)	0.42	0.46	0.53	0.62	0.72	0.82	0.88	0.6-1.2%	55	(2.2)
Females:													
1-3................................	712	0.57	(0.014)	0.38	0.41	0.48	0.56	0.65	0.75	0.81	0.6-1.2%	38	(4.3)
4-8................................	894	0.53	(0.009)	0.44	0.46	0.50	0.53	0.58	0.62	0.64	0.6-1.2%	15	(10.4)
9-13..............................	867	0.54	(0.015)	0.40	0.43	0.48	0.54	0.61	0.69	0.73	0.6-1.2%	29	(4.8)
14-18............................	706	0.59	(0.016)	0.41	0.45	0.51	0.58	0.66	0.74	0.79	0.6-1.2%	44	(7.1)
19-30............................	1039	0.62	(0.014)	0.46	0.50	0.56	0.63	0.71	0.80	0.85	0.6-1.2%	61	(5.5)
31-50............................	1918	0.64	(0.012)	0.46	0.50	0.56	0.64	0.73	0.82	0.88	0.6-1.2%	64	(5.1)
19-50..........................	2957	0.63	(0.010)	0.46	0.50	0.56	0.64	0.73	0.81	0.87	0.6-1.2%	63	(3.7)
51-70............................	1738	0.74	(0.015)	0.53	0.57	0.64	0.73	0.83	0.93	0.99	0.6-1.2%	83	(4.4)
71 and over....................	964	0.73	(0.015)	0.45	0.50	0.59	0.71	0.86	1.01	1.12	0.6-1.2%	70	(4.1)
50 and over.................	2702	0.74	(0.013)	0.50	0.54	0.62	0.72	0.84	0.96	1.03	0.6-1.2%	79	(3.4)
19 and over...............	5659	0.68	(0.009)	0.47	0.51	0.58	0.67	0.78	0.88	0.95	0.6-1.2%	70	(2.2)
All individuals 1 and over..	17892	0.62	(0.006)	0.43	0.46	0.53	0.62	0.72	0.82	0.89	0.6-1.2%	54	(1.4)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Dietary fiber (g/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----						
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th
Males:										
1-3	772	7.3	(0.19)	4.0	4.5	5.6	7.0	8.6	10.4	11.5
4-8	1001	7.4	(0.14)	4.5	5.0	5.9	7.1	8.6	10.1	11.2
9-13	850	7.0	(0.14)	4.8	5.2	5.8	6.7	7.6	8.5	9.0
14-18	808	6.2	(0.11)	4.4	4.7	5.3	6.1	6.9	7.7	8.2
19-30	1113	6.7	(0.15)	3.7	4.2	5.1	6.3	7.7	9.1	10.1
31-50	1825	7.3	(0.18)	3.6	4.2	5.3	6.8	8.6	10.6	12.0
19-50	2938	7.1	(0.14)	3.6	4.2	5.2	6.6	8.3	10.1	11.3
51-70	1773	8.3	(0.23)	4.3	4.9	6.1	7.6	9.5	11.6	13.0
71 and over	912	9.3	(0.18)	5.0	5.7	7.1	8.8	10.8	12.8	14.2
50 and over	2685	8.5	(0.19)	4.4	5.1	6.3	7.9	9.8	11.9	13.4
19 and over	5623	7.6	(0.13)	3.8	4.4	5.5	7.1	8.9	10.9	12.3
Females:										
1-3	712	7.2	(0.16)	3.8	4.4	5.4	6.7	8.3	10.0	11.1
4-8	894	7.4	(0.14)	5.2	5.6	6.3	7.2	8.3	9.3	10.0
9-13	867	7.4	(0.18)	5.1	5.5	6.3	7.2	8.2	9.2	9.9
14-18	706	7.2	(0.19)	4.3	4.8	5.7	6.8	8.0	9.3	10.1
19-30	1039	7.5	(0.24)	4.0	4.5	5.6	7.0	8.6	10.2	11.4
31-50	1918	8.3	(0.18)	4.2	4.8	6.1	7.8	9.9	12.1	13.6
19-50	2957	8.0	(0.16)	3.9	4.6	5.8	7.5	9.4	11.6	13.0
51-70	1738	9.6	(0.20)	5.3	6.0	7.3	9.0	11.0	13.1	14.5
71 and over	964	10.0	(0.18)	5.5	6.2	7.6	9.4	11.6	13.9	15.5
50 and over	2702	9.7	(0.16)	5.3	6.1	7.4	9.1	11.2	13.2	14.7
19 and over	5659	8.7	(0.11)	4.4	5.1	6.4	8.2	10.2	12.4	13.9
All individuals 1 and over	17892	7.9	(0.09)	4.1	4.7	5.8	7.4	9.2	11.3	12.7

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 1 year and over (excluding breast-fed children and pregnant or lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 2/2014

Appendix E-2.3: Usual intake distributions for individuals age 71 and older, 2007-2010

Individuals age 71 and older: Usual Intake from Food and Beverages 2007-2010 Compared To Dietary Reference Intakes

Some of the estimates are based on a relatively small number for a national probability sample. These statistics should be viewed with this consideration.

PLEASE NOTE: The values flagged with an asterisk (*) may be less reliable; interpret with caution.

Usual intake from food and beverages.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

6/2014

Protein (g/kg body weight): Mean intake and percentiles of usual intake from food and beverages, persons aged 71 and over in the United States, 2007-2010

		Food					----- Percentiles of Usual Intake -----					Below EAR	
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**
Males:													
71-79............................	548	1.02	(0.025)	0.68	0.75	0.87	1.01	1.18	1.34	1.45	0.66	4	(1.4)
80 and over....................	333	0.97	(0.030)	0.65*	0.71	0.82	0.96	1.11	1.27	1.38*	0.66	6	(1.8)
71 and over.................	881	1.01	(0.022)	0.67	0.73	0.85	0.99	1.15	1.32	1.42	0.66	4	(1.4)
Females:													
71-79............................	572	0.98	(0.019)	0.57	0.64	0.78	0.95	1.15	1.34	1.47	0.66	11	(1.8)
80 and over....................	369	0.98	(0.028)	0.58	0.65	0.79	0.96	1.15	1.35	1.47	0.66	11	(1.9)
71 and over.................	941	0.98	(0.018)	0.57	0.65	0.78	0.96	1.15	1.35	1.47	0.66	11	(1.7)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size. Individuals with incomplete dietary supplement data excluded.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.
Excludes individuals with incomplete height and weight data. Body weights outside of normal range are set to the normal weight boundary fitting their BMI cutoffs.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 71 years and over, dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 6/2014

Dietary fiber (g): Mean intake and percentiles of usual intake from food and beverages, persons aged 71 and over in the United States, 2007-2010

		Food		----- Percentiles of Usual Intake -----								Above AI	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AI	%	SE
Males:													
71-79............................	563	17.1	(0.57)	8.0	9.5	12.5	16.3	21.0	25.8	29.2	30	4	(1.0)
80 and over....................	349	16.9	(0.41)	7.8	9.3	12.0	15.8	20.3	25.2	28.4	30	4*	(0.7)
71 and over.................	912	17.0	(0.43)	7.9	9.4	12.3	16.1	20.7	25.6	28.9	30	4	(0.9)
Females:													
71-79............................	583	15.1	(0.33)	7.5	8.8	11.2	14.4	18.2	22.1	24.8	21	13	(1.6)
80 and over....................	381	13.7	(0.43)	6.9	8.1	10.3	13.3	16.9	20.6	23.2	21	9	(2.0)
71 and over.................	964	14.5	(0.28)	7.2	8.4	10.7	13.9	17.6	21.4	24.0	21	11	(1.6)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size. Individuals with incomplete dietary supplement data excluded.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 71 years and over, dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 6/2014

Sodium (mg): Mean intake and percentiles of usual intake from food and beverages, persons aged 71 and over in the United States, 2007-2010

		Food		----- Percentiles of Usual Intake -----								Above AI			Above UL	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AI	%	SE	UL	%	SE
Males:																
71-79............................	563	3286	(83.4)	2164	2378	2761	3231	3758	4269	4615	1200	>97		2300	92	(2.0)
80 and over....................	349	2998	(84.9)	1971	2168	2517	2958	3452	3945	4266	1200	>97		2300	85	(3.0)
71 and over.................	912	3183	(74.0)	2079	2282	2664	3132	3655	4180	4515	1200	>97		2300	89	(2.2)
Females:																
71-79............................	583	2611	(43.3)	1647	1830	2155	2555	3008	3447	3735	1200	>97		2300	66	(2.7)
80 and over....................	381	2466	(74.9)	1570	1743	2051	2439	2873	3305	3577	1200	>97		2300	59	(3.5)
71 and over.................	964	2550	(49.6)	1614	1788	2109	2507	2950	3392	3675	1200	>97		2300	63	(2.5)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size. Individuals with incomplete dietary supplement data excluded.
Adequate Intake (AI), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake above the AI and the UL.
Discretionary salt use at the table not included. Post-processing salt adjustment omitted for 2007-2008.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, individuals 71 years and over, dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 6/2014

Appendix E-2.4: Usual intake distributions, 2007-2010, for pregnant and non-pregnant women in the U.S. ages 19-50 years

Usual Intakes from Food and Beverages 2007-2010 Compared To Dietary Reference Intakes -- females 19-50 years old

The following tables provide separate analysis of pregnant females. This is a relatively small number (n=133) for a national probability sample; therefore, data should be viewed with this consideration.

PLEASE NOTE: The values flagged with an asterisk (*) may be less reliable; interpret with caution.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

revised 7/2014

Energy (kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	1848	(19.6)	|	1153	1284	1526	1816	2138	2455	2654
Pregnant................................	133	2131	(74.5)	|	1443*	1583*	1814	2096	2407	2726*	2909*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Protein (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	69.4	(0.74)	|	44.1	49.0	57.8	68.3	79.9	91.2	98.3
Pregnant................................	133	78.6	(4.40)	|	57.8*	61.9*	68.7	77.0	86.1	95.5*	100.9*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Protein (g/day/kg body weight): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Below EAR	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		EAR	%	SE
Females 20-50:															
Non-pregnant, non-lactating..	2943	1.11	(0.013)	|	0.68	0.76	0.91	1.09	1.29	1.49	1.61	|	0.66	4	(1.1)
Estimates not available for pregnant females............															

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

* Estimate may be less reliable than others due to small sample size.

Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR. Excludes individuals 4 and over without height and weight data. Body weights outside of normal range are set to the normal weight boundary fitting their Body Mass Index cutoffs. Not presented for pregnant females.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Carbohydrate (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Below EAR		
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		EAR	%	SE
Females 19-50:															
Non-pregnant, non-lactating..	2957	233	(2.5)	|	135	153	186	227	274	320	350	|	100	<3	
Pregnant................................	133	277	(11.4)	|	174*	195*	230	272	317	364*	391*	|	135	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Total sugars (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	109	(1.8)	|	47	57	77	104	135	169	191
Pregnant................................	133	126	(7.0)	|	59*	71*	93	121	153	187*	207*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Dietary fiber (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Above AI		
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**		**AI**	**%**	**SE**
Females 19-50:															
Non-pregnant, non-lactating..	2957	14.4	(0.34)	|	6.4	7.7	10.3	13.7	17.7	21.9	24.7	|	25	5	(0.8)
Pregnant................................	133	17.3	(1.19)	|	8.5*	9.9*	12.6	16.3	21.1	26.8*	30.4*	|	28	8*	(3.0)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Total fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			**----- Percentiles of Usual Intake -----**						
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:										
Non-pregnant, non-lactating..	2957	68.6	(0.92)	38.0	43.5	53.9	66.7	81.3	95.8	105.2
Pregnant................................	133	80.5	(3.33)	50.0*	55.8*	65.8	78.4	93.0	108.7*	118.0*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Saturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	22.7	(0.31)	|	11.7	13.6	17.3	21.9	27.3	32.9	36.5
Pregnant................................	133	26.3	(1.51)	|	15.6*	17.6*	21.1	25.6	31.0	37.0*	40.7*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Monounsaturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	24.7	(0.36)	|	13.2	15.3	19.2	24.0	29.5	35.1	38.8
Pregnant................................	133	29.2	(1.23)	|	17.8*	20.0*	23.7	28.4	33.7	39.5*	42.8*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Polyunsaturated fat (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	15.2	(0.27)	|	8.5	9.7	12.0	14.7	18.0	21.2	23.4
Pregnant.................................	133	18.1	(0.99)	|	9.6*	11.1*	13.6	17.1	21.3	26.1*	29.0*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 18:2 (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Above AI		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AI	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	13.4	(0.24)	7.4	8.5	10.5	13.0	15.9	18.9	20.9	12	60	(3.0)
Pregnant................................	133	16.0	(0.88)	8.4*	9.7*	12.0	15.1	18.8	23.0*	25.7*	13	67	(9.4)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 18:3 (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Above AI		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**AI**	**%**	**SE**
Females 19-50:													
Non-pregnant, non-lactating..	2957	1.33	(0.030)	0.75	0.85	1.04	1.28	1.56	1.85	2.04	1.1	69	(3.6)
Pregnant................................	133	1.59	(0.124)	0.73*	0.87*	1.12	1.47	1.93	2.46*	2.80*	1.4	55	(9.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Cholesterol (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Above 300 mg	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		%	SE
Females 19-50:														
Non-pregnant, non-lactating..	2957	231	(4.7)	|	113	132	170	219	277	339	381	|	18	(2.4)
Pregnant................................	133	286	(23.5)	|	163*	184*	221	271	331	399*	442*	|	37*	(19.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
No Dietary Reference Intakes have been established for cholesterol; percentage of individuals with usual intake above 300 mg.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Moisture (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Above AI		
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		AI	%	SE
Females 19-50:															
Non-pregnant, non-lactating..	2957	2755	(36.9)	|	1414	1632	2055	2615	3286	4009	4498	|	2700	46	(1.6)
Pregnant................................	133	2883	(78.9)	|	1537*	1798*	2243	2801	3431	4087*	4468*	|	3000	41	(4.1)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin A (µg RAE/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	549	(18.4)	216	266	369	513	698	906	1050	500	48	(2.5)	3000	<3	
Pregnant................................	133	728	(86.5)	385*	441*	542	676	838	1020*	1133*	550	26*	(16.5)	3000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

* Estimate may be less reliable than others due to small sample size.

Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

Vitamin A measured in Retinol Activity Equivalents (RAE). Comparison to the UL is for the retinol component only.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Alpha-carotene (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:										
Non-pregnant, non-lactating..	2957	356	(28)	21	32	65	136	275	518	750
Pregnant................................	133	389	(92)	39*	58*	110	217	425	771*	1118*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Beta-carotene (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	1854	(118.1)	|	258	371	664	1216	2155	3548	4727
Pregnant................................	133	2199	(407.1)	|	514*	693*	1080	1740	2761	4204*	5246*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Beta-cryptoxanthin (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	77	(9)	|	9	14	25	45	78	127	169
Pregnant................................	133	154*	(53)	|	24*	30*	47	76	119	184*	231*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Lycopene (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	4814	(209)	|	1116	1581	2619	4199	6259	8585	10220
Pregnant................................	133	5688	(984)	|	1453*	1958*	3149	4932	7239	9995*	11780*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Lutein + zeaxanthin (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

		Day 1			----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	1345	(86.1)	|	264	354	568	934	1499	2267	2884
Pregnant................................	133	1790	(460.3)	|	369*	482*	722	1125	1748	2634*	3281*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Thiamin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	1.39	(0.021)	0.85	0.95	1.13	1.36	1.63	1.89	2.06	0.9	7	(1.6)
Pregnant................................	133	1.70	(0.099)	1.22*	1.32*	1.48	1.68	1.90	2.12*	2.25*	1.2	4*	(5.6)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Riboflavin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----								Below EAR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	1.85	(0.036)	1.00	1.15	1.43	1.79	2.21	2.64	2.93	0.9	<3	
Pregnant................................	133	2.09	(0.114)	1.21*	1.37*	1.65	2.01	2.43	2.89*	3.17*	1.2	5*	(3.4)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Niacin (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

		Day 1					----- Percentiles of Usual Intake -----					Below EAR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	21.1	(0.29)	13.0	14.5	17.3	20.8	24.6	28.5	31.0	11	<3	
Pregnant................................	133	23.4	(1.18)	16.3*	17.8*	20.2	23.1	26.3	29.6*	31.5*	14	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin B6 (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**	**UL**	**%**	**SE**
Females 19-50:																
Non-pregnant, non-lactating..	2957	1.69	(0.034)	0.94	1.07	1.32	1.63	2.00	2.39	2.64	1.1	11	(2.1)	100	<3	
Pregnant................................	133	1.99	(0.105)	1.22*	1.36*	1.61	1.93	2.31	2.72*	2.96*	1.6	24	(8.1)	100	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Folate (μg DFE/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	470	(10.9)	256	292	363	455	565	681	758	320	15	(2.1)	1000	<3	
Pregnant................................	133	622	(52.1)	379*	425*	503	603	718	841*	914*	520	29*	(12.2)	1000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.
Folate measured in Dietary Folate Equivalents (DFE). Comparison to the UL is for the folic acid component only.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Food folate (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	186	(4.3)	|	92	108	138	178	225	275	308
Pregnant................................	133	223	(14.9)	|	121*	138*	170	212	262	320*	355*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Choline (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			**----- Percentiles of Usual Intake -----**							**Above AI**			**Above UL**		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**AI**	**%**	**SE**	**UL**	**%**	**SE**
Females 19-50:																
Non-pregnant, non-lactating..	2957	267	(4.3)	162	181	216	260	310	360	392	425	<3		3500	<3	
Pregnant................................	133	314	(18.1)	200*	221*	257	304	358	418*	454*	450	5*	(4.2)	3500	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake above the AI and the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin B12 (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Below EAR		
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**		**EAR**	**%**	**SE**
Females 19-50:															
Non-pregnant, non-lactating..	2957	4.45	(0.117)	|	2.17	2.52	3.24	4.19	5.36	6.63	7.49	|	2	3	(1.1)
Pregnant................................	133	5.99	(0.803)	|	2.34*	2.79*	3.64	4.88	6.53	8.56*	9.89*	|	2.2	3*	(2.2)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.
It is advised that persons over 50 meet their B12 requirement mainly with fortified foods or supplements.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	76.6	(3.24)	19.5	26.1	41.2	64.7	97.7	137.7	166.7	60	45	(2.9)	2000	<3	
Pregnant................................	133	121.0	(16.16)	30.4*	41.4*	64.0	99.4	148.8	211.3*	252.6*	70	30	(7.4)	2000	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) for non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.
The usual intake distribution is compared to the EAR for non-smokers for all individuals regardless of smoking status.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for smokers in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 20-50:																
Non-pregnant, non-lactating..	727	58.4	(4.41)	15.0	19.7	30.5	47.3	71.1	100.4	122.2	95	88	(3.4)	2000	<3	
Estimates not available for pregnant females............																

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) for smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.
Smoking status determined by self-reported cigarette use. Available for those 20 years and older.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

NON-SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for non-smokers in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 20-50:																
Non-pregnant, non-lactating..	2114	82.4	(3.31)	23.2	30.5	46.8	71.4	105.2	145.2	174.1	60	39	(3.2)	2000	<3	
Estimates not available for pregnant females............																

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) for non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.
Smoking status determined by self-reported cigarette use. Available for those 20 years and older.
DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

SMOKERS and NON-SMOKERS: Vitamin C (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups for smokers and non-smokers in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 20-50:																
Non-pregnant, non-lactating..	2841	76.1	(3.23)	19.2	25.8	40.9	64.2	97.1	136.9	165.9		52	(3.2)	2000	<3	
Estimates not available for pregnant females............																

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

* Estimate may be less reliable than others due to small sample size.

Estimated Average Requirement (EAR) for smokers and non-smokers, Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

Percentage under the EAR is a weighted average by smoking status. Smoking status determined by self-reported cigarette use. Available for those 20 years and older.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin D (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**	**UL**	**%**	**SE**
Females 19-50:																
Non-pregnant, non-lactating..	2957	3.9	(0.10)	1.4	1.8	2.5	3.6	5.0	6.6	7.7	10	>97		100	<3	
Pregnant................................	133	5.6	(0.65)	1.7*	2.3*	3.3	5.0	7.2	9.9*	11.7*	10	90*	(4.8)	100	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin E as alpha-tocopherol (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Below EAR		
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		EAR	%	SE
Females 19-50:															
Non-pregnant, non-lactating..	2957	6.9	(0.21)	|	3.2	3.7	4.9	6.4	8.3	10.4	11.9	|	12	95	(1.1)
Pregnant................................	133	7.4	(0.43)	|	3.9*	4.5*	5.6	7.2	9.0	11.1*	12.5*	|	12	94*	(5.3)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Vitamin K (µg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Above AI		
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		AI	%	SE
Females 19-50:															
Non-pregnant, non-lactating..	2957	90.7	(4.80)	|	29.9	36.7	51.3	73.4	104.0	142.0	170.4	|	90	35	(3.0)
Pregnant................................	133	113.7	(19.81)	|	33.2*	41.5*	58.4	84.8	122.9	173.7*	209.0*	|	90	46	(9.1)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Calcium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**	**UL**	**%**	**SE**
Females 19-50:																
Non-pregnant, non-lactating..	2957	885	(17.4)	460	532	672	852	1064	1286	1432	800	43	(2.3)	2500	<3	
Pregnant................................	133	1123	(75.9)	509*	616*	809	1068	1379	1724*	1932*	800	24	(8.6)	2500	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Phosphorus (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	1182	(15.6)	716	804	965	1159	1374	1586	1721	580	<3		4000	<3	
Pregnant................................	133	1401	(72.4)	878*	976*	1144	1358	1605	1870*	2028*	580	<3		3500	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Magnesium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----								Below EAR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	262	(5.2)	144	165	204	253	310	370	409		55	(2.5)
Pregnant................................	133	299	(14.5)	156*	182*	227	286	356	433*	479*			

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR) and percentage of individuals with usual intake below the EAR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Iron (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	13.2	(0.24)	7.6	8.6	10.4	12.8	15.5	18.4	20.2	8.1	16	(1.3)	45	<3	
Pregnant................................	133	16.9	(1.20)	12.1*	12.9*	14.4	16.2	18.2	20.3*	21.5*	22	96*	(6.4)	45	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.
EAR comparisons for non-pregnant, non-lactating females by probabilty method for groups.
DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Zinc (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	10.0	(0.13)	5.9	6.6	8.0	9.7	11.7	13.8	15.1	6.8	12	(2.0)	40	<3	
Pregnant................................	133	11.2	(0.59)	7.3*	8.0*	9.3	10.9	12.8	14.8*	16.0*	9.5	29	(7.6)	40	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Copper (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	1.1	(0.02)	0.7	0.7	0.9	1.1	1.4	1.6	1.8	0.7	8	(1.7)	10	<3	
Pregnant................................	133	1.5	(0.14)	0.9*	1.0*	1.1	1.4	1.6	1.9*	2.1*	0.8	<3		10	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Selenium (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**	**UL**	**%**	**SE**
Females 19-50:																
Non-pregnant, non-lactating..	2957	94	(1.2)	60	66	78	93	109	124	134	45	<3		400	<3	
Pregnant................................	133	109	(6.4)	82*	88*	97	108	120	131*	138*	49	<3		400	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Estimated Average Requirement (EAR), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake below the EAR and above the UL.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Sodium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Above AI			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AI	%	SE	UL	%	SE
Females 19-50:																
Non-pregnant, non-lactating..	2957	3111	(40.5)	1884	2108	2526	3035	3606	4176	4539	1500	>97		2300	84	(2.0)
Pregnant................................	133	3523	(163.6)	2714*	2916*	3237	3615	4015	4411*	4633*	1500	>97		2300	>97	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI), Tolerable Upper Intake Level (UL), and percentage of individuals with usual intake above the AI and the UL.
Discretionary salt use at the table not included. Post-processing salt adjustment omitted for 2007-2008.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Potassium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----									Above AI	
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**		**AI**	**%**	**SE**
Females 19-50:															
Non-pregnant, non-lactating..	2957	2277	(34.2)	|	1300	1483	1819	2230	2685	3135	3424	|	4700	<3	
Pregnant................................	133	2660	(128.2)	|	1557*	1764*	2120	2574	3101	3666*	4001*	|	4700	<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Adequate Intake (AI) and percentage of individuals with usual intake above the AI.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Caffeine (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	152.9	(7.02)	|	4.9	13.3	43.7	107.7	209.3	343.5	444.7
Pregnant................................	133	57.3	(8.80)	|	1.3*	3.3*	11.8	32.7	70.6	127.5*	175.6*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Sodium (mg/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	1718	(14.6)	|	1309	1383	1514	1671	1843	2011	2122
Pregnant................................	133	1698	(60.3)	|	1266*	1347*	1489	1663	1859	2054*	2184*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

Discretionary salt use at the table not included. Post-processing salt adjustment omitted for 2007-2008.
DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Cholesterol (mg/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	126	(2.5)	|	66	76	95	121	154	189	213
Pregnant................................	133	141	(13.0)	|	81*	90*	107	132	162	195*	218*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 20:5 (EPA) (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	0.03	(0.004)	|	#	0.01	0.01	0.01	0.02	0.03	0.03
Pregnant................................	133	0.03	(0.008)	|	0.01*	0.01*	0.01	0.02	0.02	0.04*	0.04*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
# Indicates a non-zero value too small to report.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 22:6 (DHA) (g/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

		Day 1			----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	0.06	(0.005)	|	0.01	0.01	0.02	0.04	0.05	0.08	0.10
Pregnant................................	133	0.07	(0.012)	|	0.02*	0.02*	0.03	0.05	0.07	0.11*	0.13*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Protein (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Within AMDR	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		AMDR	%	SE
Females 19-50:														
Non-pregnant, non-lactating..	2957	15.4	(0.12)	|	11.6	12.3	13.5	15.0	16.7	18.4	19.5	|	10-35%	>97	
Pregnant................................	133	14.9	(0.57)	|	12.3*	12.8*	13.7	14.7	15.9	17.0*	17.7*	|	10-35%	>97	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Carbohydrate (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Within AMDR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	51.2	(0.27)	39.7	41.9	45.7	50.1	54.9	59.4	62.3	45-65%	76	(1.6)
Pregnant................................	133	52.2	(1.36)	43.4*	45.1*	48.2	51.4	54.9	58.3*	60.1*	45-65%	90*	(5.9)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Total fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Within AMDR	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		AMDR	%	SE
Females 19-50:														
Non-pregnant, non-lactating..	2957	32.6	(0.18)	|	26.0	27.5	30.1	33.0	36.1	39.0	40.7	|	20-35%	67	(1.7)
Pregnant................................	133	33.8	(1.00)	|	27.2*	28.6*	31.0	33.9	37.0	40.0*	41.9*	|	20-35%	60	(8.9)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Saturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Below 10%	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		%	SE
Females 19-50:														
Non-pregnant, non-lactating..	2957	10.8	(0.08)	|	7.8	8.5	9.6	10.9	12.3	13.6	14.4	|	33	(2.1)
Pregnant................................	133	11.1	(0.54)	|	8.0*	8.6*	9.7	11.1	12.7	14.3*	15.4*	|	30	(8.5)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
No Dietary Reference Intakes have been established for saturated fat; percentage of individuals with usual intake below 10% of total energy.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Monounsaturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

		Day 1				**----- Percentiles of Usual Intake -----**					
	N	**Mean**	**SE**		**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Females 19-50:											
Non-pregnant, non-lactating..	2957	11.7	(0.10)	|	8.9	9.5	10.6	11.9	13.2	14.5	15.3
Pregnant................................	133	12.2	(0.34)	|	9.3*	9.9*	11.0	12.2	13.5	14.8*	15.7*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Polyunsaturated fat (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	7.2	(0.08)	|	5.6	5.9	6.6	7.3	8.1	8.9	9.4
Pregnant................................	133	7.6	(0.39)	|	5.2*	5.6*	6.4	7.4	8.5	9.6*	10.3*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 18:2 (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----								Within AMDR	
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th		AMDR	%	SE
Females 19-50:															
Non-pregnant, non-lactating..	2957	6.4	(0.07)	|	4.8	5.2	5.8	6.5	7.2	8.0	8.4	|	05-10%	93	(2.2)
Pregnant................................	133	6.7	(0.35)	|	4.6*	5.0*	5.7	6.6	7.5	8.5*	9.0*	|	05-10%	88*	(6.8)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

PFA 18:3 (% of energy/day): Mean intake and percentiles of usual intake from food and beverages as a percentage of total energy by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1			----- Percentiles of Usual Intake -----							Within AMDR		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	AMDR	%	SE
Females 19-50:													
Non-pregnant, non-lactating..	2957	0.63	(0.010)	0.46	0.50	0.56	0.64	0.73	0.81	0.87	0.6-1.2%	63	(3.7)
Pregnant................................	133	0.67	(0.051)	0.44*	0.48*	0.55	0.64	0.74	0.84*	0.91*	0.6-1.2%	61	(12.7)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.
Acceptable Macronutrient Distribution Range (AMDR) and the percentage of individuals with usual intake within the AMDR.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Dietary fiber (g/1000 kcal/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, females 19-50, 2007-2010

	Day 1				----- Percentiles of Usual Intake -----						
	N	Mean	SE		5th	10th	25th	50th	75th	90th	95th
Females 19-50:											
Non-pregnant, non-lactating..	2957	8.0	(0.16)	|	3.9	4.6	5.8	7.5	9.4	11.6	13.0
Pregnant................................	133	8.5	(0.52)	|	4.5*	5.1*	6.3	7.9	9.8	11.8*	13.3*

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
* Estimate may be less reliable than others due to small sample size.

DATA SOURCE: What We Eat in America, NHANES 2007-2010, females 19-50 years old (excluding lactating females), dietary intake data.
Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. revised 7/2014

Appendix E-2.5: Usual Intake Distributions for Supplement Users for Folate, Folic Acid, Vitamin D, Calcium, and Iron, 2007-2010, by Age/Gender Groups

Total Usual Intake from Food, Beverages, and Dietary Supplements 2007-2010 Compared To Dietary Reference Intakes -- all individuals regardless of supplement use and users of supplements containing the specific nutrient

The percentage of users of supplements containing these specific nutrients varies by sex / age group. Some of the estimates are based on a relatively small number for a national probability sample. These statistics should be viewed with this consideration.

PLEASE NOTE: The values flagged with an asterisk (*) may be less reliable; interpret with caution.

All individuals regardless of supplement use

Users of supplements containing the specific nutrients

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

3/2014

Folate (μg DFE/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Users		Total intake		----- Percentiles of Total Usual Intake -----								Below EAR	
	N	%	SE	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Males:															
1-3................................	766	29	(2.1)	467	(16.3)	207	241	307	405	558	808	980	120	<3	
4-8................................	997	40	(2.8)	648	(21.7)	339	379	461	586	784	1027	1158	160	<3	
9-13..............................	842	23	(2.1)	646	(23.1)	338	386	478	605	777	998	1152	250	<3	
14-18............................	801	15	(1.7)	692	(31.6)	333	386	492	644	852	1104	1280	330	5	(1.9)
19-30............................	1104	22	(1.8)	775	(27.2)	375	431	543	697	924	1277	1498	320	<3	
31-50............................	1795	27	(1.5)	802	(20.2)	341	398	511	684	981	1372	1587	320	4	(0.9)
19-50..........................	2899	25	(1.2)	792	(16.4)	353	410	522	688	953	1343	1562	320	3	(0.6)
51-70............................	1751	38	(2.1)	835	(22.8)	328	381	491	689	1177	1477	1673	320	4	(0.9)
71 and over....................	899	43	(2.6)	860	(25.7)	289	342	464	716	1223	1520	1747	320	8	(1.2)
50 and over.................	2650	39	(1.8)	841	(19.8)	316	370	482	692	1192	1488	1689	320	5	(0.8)
19 and over...............	5549	30	(1.2)	811	(13.7)	338	394	508	687	1042	1417	1620	320	4	(0.5)
Females:															
1-3................................	708	26	(2.1)	457	(16.4)	199	229	291	383	527	757	920	120	<3	
4-8................................	887	37	(3.1)	588	(13.5)	300	337	413	528	699	943	1079	160	<3	
9-13..............................	863	22	(2.4)	586	(20.7)	304	347	427	542	706	928	1089	250	<3	
14-18............................	705	16	(2.3)	566	(30.4)	236	279	362	486	665	961	1201	330	19	(4.2)
19-30............................	1029	24	(1.9)	626	(19.2)	281	316	386	490	676	1213	1532	320	11	(3.2)
31-50............................	1895	34	(1.7)	698	(23.4)	259	302	391	537	899	1274	1530	320	13	(2.0)
19-50..........................	2924	30	(1.5)	672	(19.7)	266	307	389	518	816	1254	1530	320	12	(1.7)
51-70............................	1720	46	(2.0)	815	(33.0)	261	307	403	618	1143	1425	1760	320	12	(1.6)
71 and over....................	951	44	(1.7)	770	(22.1)	241	287	386	599	1101	1348	1579	320	15	(1.4)
50 and over.................	2671	45	(1.7)	802	(25.1)	254	299	399	613	1131	1402	1715	320	13	(1.3)
19 and over...............	5595	37	(1.1)	727	(16.4)	260	302	391	545	1013	1331	1627	320	13	(1.3)
All individuals 1 and over..	17713	32	(0.9)	724	(10.6)	279	328	432	597	924	1295	1511		7	(0.5)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Folate measured in Dietary Folate Equivalents (DFE).
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.

Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Folic acid (μg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Users		Total intake		----- Percentiles of Total Usual Intake -----								Above UL	
	N	%	SE	Mean	SE	5th	10th	25th	50th	75th	90th	95th	UL	%	SE
Males:															
1-3................................	766	29	(2.1)	203	(8.8)	65	81	113	164	251	399	505	300	18	(2.1)
4-8................................	997	40	(2.8)	298	(12.0)	130	150	192	259	373	520	594	400	21	(3.0)
9-13..............................	842	23	(2.1)	280	(11.7)	120	143	190	257	351	478	571	600	4	(0.8)
14-18............................	801	15	(1.7)	293	(16.8)	118	143	194	270	372	504	600	800	<3	
19-30............................	1104	22	(1.8)	313	(13.7)	118	142	192	265	379	584	704	1000	<3	
31-50............................	1795	27	(1.5)	318	(9.2)	90	114	165	248	402	623	733	1000	<3	
19-50..........................	2899	25	(1.2)	316	(7.4)	99	124	174	254	391	612	725	1000	<3	
51-70............................	1751	38	(2.1)	342	(13.0)	77	99	150	250	542	700	807	1000	<3	
71 and over...................	899	43	(2.6)	387	(13.7)	82	107	165	293	597	748	872	1000	<3	
50 and over.................	2650	39	(1.8)	353	(10.8)	77	100	152	257	558	713	823	1000	<3	
19 and over...............	5549	30	(1.2)	330	(6.5)	90	114	166	254	454	663	769	1000	<3	
Females:															
1-3................................	708	26	(2.1)	200	(9.4)	68	82	112	157	230	368	470	300	15	(1.7)
4-8................................	887	37	(3.1)	269	(7.9)	114	132	171	231	326	471	553	400	15	(1.9)
9-13..............................	863	22	(2.4)	258	(11.6)	111	132	172	231	316	441	544	600	3	(0.9)
14-18............................	705	16	(2.3)	246	(16.2)	82	102	139	198	287	452	595	800	<3	
19-30............................	1029	24	(1.9)	267	(10.3)	89	106	139	190	286	594	776	1000	<3	
31-50............................	1895	34	(1.7)	297	(11.8)	73	91	131	201	399	610	744	1000	<3	
19-50..........................	2924	30	(1.5)	286	(10.1)	78	96	134	197	353	603	754	1000	<3	
51-70............................	1720	46	(2.0)	358	(18.1)	62	82	127	240	543	692	905	1000	3	(0.6)
71 and over...................	951	44	(1.7)	352	(11.9)	63	84	133	248	545	676	804	1000	<3	
50 and over.................	2671	45	(1.7)	356	(13.7)	62	82	129	242	544	688	885	1000	<3	
19 and over...............	5595	37	(1.1)	316	(8.3)	70	89	131	209	482	645	818	1000	<3	
All individuals 1 and over..	17713	32	(0.9)	307	(5.0)	81	103	150	232	412	619	727		4	(0.2)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method. Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.

* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.

Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Vitamin D (D2+D3) (μg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Users		Total intake		----- Percentiles of Total Usual Intake -----								Below EAR			Above UL	
	N	%	SE	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																		
1-3................................	766	33	(2.1)	9.4	(0.32)	2.9	3.8	5.8	8.5	12.2	16.1	18.5	10	61	(2.5)	63	<3	
4-8................................	997	43	(2.9)	9.3	(0.56)	3.0	3.8	5.3	7.7	11.4	15.6	17.9	10	68	(2.6)	75	<3	
9-13..............................	842	26	(2.7)	7.5	(0.32)	2.5	3.2	4.5	6.5	9.3	13.2	15.7	10	79	(2.3)	100	<3	
14-18............................	801	16	(1.6)	7.5	(0.45)	2.2	2.8	4.2	6.3	9.2	13.1	16.4	10	79	(2.8)	100	<3	
19-30............................	1104	21	(1.6)	6.7	(0.26)	1.6	2.2	3.4	5.4	8.7	13.2	16.0	10	81	(1.7)	100	<3	
31-50............................	1795	27	(1.5)	8.5	(0.46)	1.9	2.4	3.7	5.9	10.6	16.5	20.7	10	73	(1.7)	100	<3	
19-50..........................	2899	25	(1.3)	7.8	(0.34)	1.8	2.4	3.6	5.7	9.7	15.3	19.0	10	76	(1.2)	100	<3	
51-70............................	1751	41	(2.0)	13.5	(1.17)	1.9	2.5	4.0	7.3	15.7	24.4	35.1	10	60	(1.6)	100	<3	
71 and over...................	899	48	(2.9)	12.8	(0.65)	2.2	2.9	4.5	9.0	16.5	25.0	33.5	10	52	(2.1)	100	<3	
50 and over.................	2650	42	(1.8)	13.3	(0.90)	2.0	2.6	4.0	7.5	15.9	24.5	34.8	10	58	(1.4)	100	<3	
19 and over...............	5549	32	(1.1)	9.9	(0.40)	1.8	2.4	3.7	6.2	12.2	18.7	25.4	10	69	(0.9)	100	<3	
Females:																		
1-3................................	708	29	(2.0)	9.7	(0.28)	3.2	4.1	5.9	8.4	11.9	15.9	18.7	10	63	(1.8)	63	<3	
4-8................................	887	39	(3.1)	7.8	(0.24)	2.8	3.5	4.9	6.8	9.6	13.5	15.4	10	77	(2.1)	75	<3	
9-13..............................	863	23	(2.4)	6.1	(0.28)	1.8	2.4	3.5	5.1	7.5	11.7	14.7	10	86	(2.0)	100	<3	
14-18............................	705	17	(2.3)	5.0	(0.38)	1.3	1.7	2.5	3.9	6.1	10.8	14.6	10	89	(2.3)	100	<3	
19-30............................	1029	25	(2.0)	6.5	(0.25)	1.4	1.8	2.6	3.9	6.9	15.1	22.2	10	82	(1.6)	100	<3	
31-50............................	1895	37	(1.8)	12.1	(2.41)	1.6	2.1	3.0	4.9	12.0	22.9	28.4	10	71	(1.4)	100	<3	
19-50..........................	2924	33	(1.5)	10.1	(1.55)	1.6	2.0	2.8	4.5	10.1	20.3	26.8	10	75	(1.2)	100	<3	
51-70............................	1720	55	(2.0)	16.9	(1.54)	1.6	2.1	3.6	10.2	22.4	33.4	43.2	10	50	(1.6)	100	<3	
71 and over...................	951	54	(2.2)	15.0	(0.81)	1.6	2.1	3.6	9.0	21.5	34.3	44.8	10	52	(2.2)	100	<3	
50 and over.................	2671	55	(1.6)	16.4	(1.06)	1.5	2.1	3.6	9.8	22.2	33.5	43.8	10	50	(1.4)	100	<3	
19 and over...............	5595	42	(1.2)	12.8	(0.96)	1.5	2.0	3.0	5.5	14.9	27.1	35.1	10	64	(0.9)	100	<3	
All individuals 1 and over..	17713	35	(0.8)	10.4	(0.36)	1.7	2.3	3.5	6.0	12.2	20.4	28.1	10	69	(0.7)		<3	

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Vitamin D dietary intake estimates reflect the sum of only vitamin D2 and vitamin D3; 25(OH)D values are not provided by USDA SR.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Calcium (mg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Users		Total intake		----- Percentiles of Total Usual Intake -----								Below EAR			Above UL	
	N	%	SE	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																		
1-3................................	766	15	(1.4)	1078	(39.1)	539	638	818	1043	1299	1549	1710	500	4	(1.5)	2500	<3	
4-8................................	997	19	(2.3)	1029	(22.3)	600	678	822	1007	1214	1418	1556	800	22	(3.0)	2500	<3	
9-13..............................	842	14	(1.8)	1142	(50.4)	644	734	895	1100	1342	1588	1751	1100	50	(5.0)	3000	<3	
14-18............................	801	17	(2.2)	1264	(42.4)	672	773	964	1213	1506	1807	2004	1100	38	(4.1)	3000	<3	
19-30............................	1104	29	(1.8)	1251	(31.4)	601	704	909	1180	1518	1882	2139	800	16	(2.2)	2500	<3	
31-50............................	1795	37	(1.4)	1209	(27.4)	601	698	887	1146	1464	1817	2062	800	17	(1.7)	2500	<3	
19-50..........................	2899	34	(1.2)	1225	(20.5)	600	701	893	1158	1483	1836	2089	800	17	(1.6)	2500	<3	
51-70............................	1751	47	(2.0)	1185	(27.9)	511	610	810	1092	1458	1893	2220	800	24	(2.1)	2000	8	(1.0)
71 and over....................	899	52	(2.6)	1040	(28.5)	493	573	733	955	1247	1610	1893	1000	55	(2.8)	2000	4	(0.7)
50 and over.................	2650	48	(1.7)	1150	(25.2)	501	598	787	1058	1409	1820	2140		31	(1.8)	2000	7	(0.8)
19 and over...............	5549	39	(1.1)	1196	(15.8)	556	656	850	1119	1457	1836	2114		22	(1.2)		4	(0.4)
Females:																		
1-3................................	708	15	(2.3)	1048	(28.1)	540	628	792	1003	1250	1504	1666	500	3	(1.1)	2500	<3	
4-8................................	887	21	(1.8)	951	(24.7)	545	618	751	926	1125	1324	1465	800	32	(3.2)	2500	<3	
9-13..............................	863	17	(2.1)	965	(28.1)	558	632	764	937	1141	1350	1490	1100	71	(4.5)	3000	<3	
14-18............................	705	21	(2.5)	907	(31.1)	464	539	680	871	1103	1343	1508	1100	75	(4.1)	3000	<3	
19-30............................	1029	31	(1.9)	979	(27.3)	526	597	732	918	1154	1433	1649	800	34	(3.7)	2500	<3	
31-50............................	1895	45	(1.7)	1040	(25.7)	455	539	705	945	1269	1662	1950	800	35	(2.3)	2500	<3	
19-50..........................	2924	40	(1.4)	1018	(21.9)	478	557	714	935	1228	1582	1855	800	35	(2.1)	2500	<3	
51-70............................	1720	60	(2.2)	1244	(33.8)	466	556	749	1089	1617	2165	2495	1000	44	(2.1)	2000	14	(1.2)
71 and over....................	951	62	(1.4)	1160	(27.7)	432	516	700	1010	1499	2023	2321	1000	49	(1.8)	2000	11	(1.2)
50 and over.................	2671	60	(1.6)	1220	(28.1)	453	542	734	1065	1582	2128	2446	1000	46	(1.7)	2000	13	(1.1)
19 and over...............	5595	49	(0.9)	1104	(20.9)	466	549	719	974	1354	1857	2199		40	(1.6)		6	(0.5)
All individuals 1 and over..	17713	37	(0.8)	1123	(13.1)	512	603	784	1037	1363	1748	2035		33	(1.1)		4	(0.2)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Supplement intake includes antacids.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.

Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Iron (mg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Users		Total intake		----- Percentiles of Total Usual Intake -----							Below EAR			Above UL		
	N	**%**	**SE**	**Mean**	**SE**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**EAR**	**%**	**SE**	**UL**	**%**	**SE**
Males:																		
1-3................................	766	15	(1.4)	12.4	(0.48)	5.5	6.4	8.2	10.7	14.1	19.5	25.6	3	<3		40	<3	
4-8................................	997	18	(2.4)	15.5	(0.63)	9.1	9.9	11.4	13.4	16.4	25.7	30.8	4.1	<3		40	<3	
9-13..............................	842	11	(1.5)	16.6	(0.42)	9.9	11.0	13.1	15.7	18.9	23.2	28.0	5.9	<3		40	<3	
14-18............................	801	10	(1.6)	18.1	(0.50)	10.4	11.7	14.2	17.5	21.8	26.8	30.6	7.7	<3		45	<3	
19-30............................	1104	13	(1.7)	19.2	(0.60)	10.0	11.5	14.3	18.0	22.6	27.8	31.9	6	<3		45	<3	
31-50............................	1795	15	(1.0)	20.0	(0.44)	9.9	11.4	14.3	18.3	23.7	31.8	37.3	6	<3		45	<3	
19-50..........................	2899	14	(0.9)	19.7	(0.33)	9.9	11.4	14.3	18.2	23.2	30.1	35.5	6	<3		45	<3	
51-70............................	1751	14	(1.4)	19.2	(0.52)	9.6	11.0	13.6	17.3	22.2	30.2	36.1	6	<3		45	<3	
71 and over....................	899	18	(1.7)	20.4	(0.78)	8.7	10.1	12.7	16.7	23.1	33.1	39.7	6	<3		45	3	(0.7)
50 and over..................	2650	15	(1.3)	19.5	(0.47)	9.3	10.7	13.4	17.1	22.4	31.1	36.9	6	<3		45	<3	
19 and over...............	5549	14	(0.8)	19.6	(0.29)	9.7	11.1	13.9	17.8	23.0	30.4	36.1	6	<3		45	<3	
Females:																		
1-3................................	708	12	(1.9)	11.2	(0.45)	5.4	6.1	7.6	9.6	12.3	16.4	23.0	3	<3		40	<3	
4-8................................	887	17	(1.9)	14.2	(0.36)	7.6	8.5	10.2	12.7	16.1	22.8	28.4	4.1	<3		40	<3	
9-13..............................	863	13	(1.8)	15.2	(0.42)	8.8	9.8	11.6	14.1	17.3	21.8	27.3	5.7	<3		40	<3	
14-18............................	705	14	(2.3)	14.6	(0.61)	6.9	8.0	9.9	12.8	16.6	23.4	30.5	7.9	15	(2.7)	45	<3	
19-30............................	1029	21	(1.6)	16.7	(0.47)	7.7	8.7	10.6	13.5	18.1	30.5	37.4	8.1	14	(1.6)	45	<3	
31-50............................	1895	28	(1.5)	17.7	(0.50)	7.8	8.9	11.0	14.2	20.3	31.5	36.2	8.1	12	(1.4)	45	<3	
19-50..........................	2924	25	(1.3)	17.3	(0.40)	7.8	8.8	10.9	13.9	19.4	31.2	36.5	8.1	13	(1.2)	45	<3	
51-70............................	1720	26	(1.1)	18.0	(0.48)	7.6	8.6	10.7	13.9	19.7	31.1	36.4	5	<3		45	<3	
71 and over....................	951	22	(1.3)	17.3	(0.61)	6.9	8.0	10.1	13.2	18.8	30.8	36.0	5	<3		45	<3	
50 and over..................	2671	25	(0.7)	17.8	(0.37)	7.3	8.4	10.5	13.7	19.4	31.0	36.3	5	<3		45	<3	
19 and over...............	5595	25	(0.8)	17.5	(0.32)	7.5	8.6	10.7	13.8	19.4	31.1	36.5		8	(0.7)	45	<3	
All individuals 1 and over..	17713	18	(0.5)	17.7	(0.19)	7.9	9.1	11.7	15.3	20.6	29.1	34.5		4	(0.3)		<3	

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
EAR comparisons by probabilty method for groups.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

USERS OF SUPPLEMENTS CONTAINING FOLIC ACID: Folate (µg DFE/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Total intake		----- Percentiles of Total Usual Intake -----								Below EAR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Males:													
1-3................................	166	704	(30.4)	353*	406*	522	685	894	1069*	1161*	120	<3	
4-8................................	311	845	(33.9)	474*	534	659	826	1026	1196	1304*	160	<3	
9-13..............................	162	938	(39.7)	492*	562*	701	893	1103	1288*	1401*	250	<3	
14-18............................	98	1060	(65.5)	555*	639*	808	1046	1279	1507*	1665*	330	<3	
19-30............................	178	1285	(71.1)	648*	737	938	1207	1463	1746	1982*	320	<3	
31-50............................	424	1289	(35.0)	638	759	998	1246	1497	1794	2037	320	<3	
19-50..........................	602	1288	(23.8)	641	750	975	1238	1491	1780	2023	320	<3	
51-70............................	564	1301	(30.3)	731	867	1093	1288	1493	1756	1958	320	<3	
71 and over....................	347	1306	(37.9)	718	891	1089	1272	1494	1796	2007	320	<3	
50 and over..................	911	1302	(27.2)	721	875	1095	1287	1493	1766	1972	320	<3	
19 and over...............	1513	1295	(19.6)	673	796	1040	1268	1498	1776	2003	320	<3	
Females:													
1-3................................	139	719	(51.8)	312*	371*	485	660	859	1016*	1116*	120	<3	
4-8................................	254	769	(35.8)	415*	473	592	746	958	1121	1209*	160	<3	
9-13..............................	156	835	(45.8)	401*	462*	590	786	1036	1220*	1337*	250	<3	
14-18............................	82	1053	(95.5)	512*	601*	774	1016	1259	1498*	1682*	330	<3	
19-30............................	201	1174	(40.9)	524*	613	846	1136	1417	1886	2087*	320	<3	
31-50............................	545	1177	(40.5)	529	633	852	1095	1327	1759	2101	320	<3	
19-50..........................	746	1176	(36.0)	527	627	851	1104	1349	1811	2095	320	<3	
51-70............................	628	1264	(45.7)	608	753	997	1170	1379	1795	2057	320	<3	
71 and over....................	379	1202	(30.5)	550	744	980	1142	1324	1643	1931	320	<3	
50 and over..................	1007	1246	(32.1)	588	746	992	1162	1363	1758	2032	320	<3	
19 and over...............	1753	1213	(25.0)	548	672	937	1142	1356	1779	2060	320	<3	
All individuals 1 and over..	4634	1167	(17.5)	534	640	874	1129	1363	1683	1943		<3	

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Folate measured in Dietary Folate Equivalents (DFE).
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

USERS OF SUPPLEMENTS CONTAINING FOLIC ACID: Folic acid (µg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Total intake		----- Percentiles of Total Usual Intake -----								Above UL	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	UL	%	SE
Males:													
1-3................................	166	343	(16.9)	145*	174*	237	331	454	554*	604*	300	58	(5.2)
4-8................................	311	413	(18.0)	207*	240	310	404	521	616	673*	400	51	(4.3)
9-13..............................	162	454	(21.5)	203*	240*	319	426	547	650*	713*	600	16	(2.9)
14-18............................	98	494	(33.3)	221*	265*	351	483	608	722*	797*	800	5*	(2.1)
19-30............................	178	598	(38.5)	243*	286	390	551	687	833	976*	1000	5*	(1.6)
31-50............................	424	587	(18.5)	224	286	418	562	687	843	998	1000	5	(1.0)
19-50..........................	602	591	(11.6)	230	285	406	560	690	841	993	1000	5	(0.8)
51-70............................	564	609	(16.2)	285	360	499	602	708	861	987	1000	5	(0.9)
71 and over....................	347	646	(21.5)	305	405	529	623	735	901	1032	1000	6	(1.4)
50 and over.................	911	619	(14.0)	287	369	508	609	716	871	999	1000	5	(0.8)
19 and over...............	1513	605	(9.7)	251	315	463	588	705	858	1002	1000	5	(0.7)
Females:													
1-3................................	139	358	(30.4)	128*	160*	222	319	434	526*	573*	300	55	(5.1)
4-8................................	254	375	(20.3)	175*	208	273	358	484	576	621*	400	39	(5.5)
9-13..............................	156	400	(24.2)	163*	196*	265	378	523	624*	686*	600	13	(3.8)
14-18............................	82	519	(57.8)	221*	267*	360	494	630	756*	860*	800	7*	(4.0)
19-30............................	201	576	(25.9)	200*	247	381	555	708	992	1102*	1000	9	(2.1)
31-50............................	545	569	(22.5)	198	254	373	520	637	909	1094	1000	7	(1.3)
19-50..........................	746	571	(20.8)	196	252	375	528	653	944	1100	1000	8	(1.1)
51-70............................	628	612	(25.4)	235	318	471	558	667	924	1072	1000	7	(1.1)
71 and over....................	379	604	(16.5)	220	332	482	567	663	852	1021	1000	5	(1.0)
50 and over.................	1007	609	(17.7)	229	317	474	560	667	908	1063	1000	7	(0.8)
19 and over...............	1753	591	(14.1)	207	278	438	547	659	923	1079	1000	7	(0.8)
All individuals 1 and over..	4634	559	(9.3)	209	268	393	538	654	828	994		13	(0.5)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method. Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.

* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.

Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

USERS OF SUPPLEMENTS CONTAINING VITAMIN D: Vitamin D (D2+D3) (µg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Total intake		----- Percentiles of Total Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	203	12.7	(0.47)	5.2*	6.5	9.0	12.5	16.1	19.6	21.8*	10	32	(3.6)	63	<3	
4-8................................	335	13.5	(1.10)	5.4*	6.5	8.7	11.9	15.2	18.3	20.8*	10	35	(3.4)	75	<3	
9-13..............................	178	11.6	(0.49)	4.5*	5.4	7.6	10.8	14.5	17.8	20.1*	10	44	(4.5)	100	<3	
14-18............................	98	14.7	(1.83)	5.5*	6.7*	9.0	12.6	17.1	22.7*	29.0*	10	32	(6.9)	100	<3	
19-30............................	175	13.0	(0.76)	4.8*	5.9	8.4	11.9	15.3	19.7	24.5*	10	36	(4.4)	100	<3	
31-50............................	433	16.8	(1.16)	5.6	7.3	10.9	14.4	18.5	25.7	34.3	10	21	(2.0)	100	<3	
19-50..........................	608	15.6	(0.84)	5.4	6.8	9.9	13.6	17.5	23.7	30.2	10	26	(1.9)	100	<3	
51-70............................	600	25.8	(2.82)	7.3	9.6	13.5	17.1	24.1	39.2	57.3	10	11	(1.2)	100	<3	
71 and over....................	390	21.0	(0.92)	8.8	11.4	13.8	16.7	22.7	34.3	46.5	10	7	(1.1)	100	<3	
50 and over..................	990	24.5	(2.11)	7.6	10.0	13.7	17.1	23.6	37.9	55.4	10	10	(0.9)	100	<3	
19 and over................	1598	20.2	(1.23)	6.1	7.8	11.8	15.4	20.5	31.1	45.1	10	18	(1.1)	100	<3	
Females:																
1-3................................	165	14.2	(0.89)	5.6*	6.7*	9.2	13.0	16.6	20.7*	25.2*	10	30	(3.1)	63	<3	
4-8................................	269	10.8	(0.69)	4.7*	5.6	7.5	10.1	13.4	16.0	17.6*	10	49	(5.7)	75	<3	
9-13..............................	163	11.0	(0.58)	3.7*	4.6*	6.5	9.9	14.1	17.2*	19.9*	10	51	(4.7)	100	<3	
14-18............................	90	11.9	(1.19)	4.8*	5.7*	8.0	11.7	15.2	18.8*	22.4*	10	39	(7.3)	100	<3	
19-30............................	205	14.9	(0.70)	4.5*	5.7	9.3	13.7	19.4	28.4	31.9*	10	28	(3.7)	100	<3	
31-50............................	601	25.9	(6.13)	5.2	6.8	10.4	14.7	23.4	31.5	46.0	10	23	(2.2)	100	<3	
19-50..........................	806	22.9	(4.63)	4.9	6.5	10.1	14.3	22.9	30.0	39.0	10	24	(1.9)	100	<3	
51-70............................	776	27.6	(3.04)	7.3	10.0	14.0	21.0	29.3	41.9	54.6	10	10	(0.9)	100	<3	
71 and over....................	482	24.3	(0.99)	6.1	8.6	13.3	19.4	29.5	43.6	54.3	10	13	(1.2)	100	<3	
50 and over..................	1258	26.6	(2.16)	6.9	9.6	13.8	20.6	29.3	42.4	54.7	10	11	(0.8)	100	<3	
19 and over................	2064	25.0	(2.29)	5.6	7.6	12.2	17.0	26.6	37.8	50.4	10	17	(1.0)	100	<3	
All individuals 1 and over..	5163	20.8	(1.13)	5.5	7.2	10.9	15.1	22.2	32.5	44.2	10	21	(0.8)		<3	

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Vitamin D dietary intake estimates reflect the sum of only vitamin D2 and vitamin D3; 25(OH)D values are not provided by USDA SR.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.

Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

USERS OF SUPPLEMENTS CONTAINING CALCIUM: Calcium (mg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Total intake		----- Percentiles of Total Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	86	1119	(68.9)	595*	692*	872	1101	1362	1607*	1789*	500	<3		2500	<3	
4-8................................	153	1131	(60.0)	693*	780*	925	1109	1315	1529*	1672*	800	12	(4.3)	2500	<3	
9-13..............................	100	1359	(197.6)	698*	789*	953	1170	1428	1678*	1849*	1100	42	(10.0)	3000	<3	
14-18............................	114	1486	(62.2)	881*	987*	1211	1480	1794	2128*	2398*	1100	17	(4.1)	3000	<3	
19-30............................	247	1532	(85.9)	799*	917	1136	1444	1802	2199	2469*	800	5*	(1.7)	2500	5*	(1.6)
31-50............................	575	1425	(41.3)	781	886	1099	1378	1721	2090	2358	800	6	(1.2)	2500	4	(0.9)
19-50..........................	822	1460	(36.6)	782	896	1114	1403	1749	2136	2413	800	6	(1.0)	2500	4	(0.7)
51-70............................	688	1427	(41.7)	709	821	1037	1342	1742	2215	2554	800	9	(1.1)	2000	15	(1.9)
71 and over...................	422	1252	(35.6)	657	744	913	1152	1471	1866	2168	1000	34	(2.8)	2000	7	(1.2)
50 and over.................	1110	1381	(33.7)	690	798	1004	1297	1671	2129	2456		15	(1.2)	2000	13	(1.4)
19 and over...............	1932	1423	(26.7)	741	848	1061	1355	1719	2138	2445		9	(0.8)		9	(0.9)
Females:																
1-3................................	71	1131	(91.7)	581*	668*	830	1039	1280	1546*	1705*	500	<3		2500	<3	
4-8................................	141	974	(45.3)	573*	640*	774	945	1144	1356*	1495*	800	28	(7.3)	2500	<3	
9-13..............................	112	1168	(67.3)	651*	730*	869	1054	1273	1506*	1656*	1100	56	(9.6)	3000	<3	
14-18............................	94	1118	(97.3)	636*	718*	888	1111	1360	1612*	1781*	1100	49	(8.7)	3000	<3	
19-30............................	253	1231	(59.8)	707*	797	965	1192	1465	1790	2022*	800	10	(3.7)	2500	<3	
31-50............................	730	1305	(36.4)	656	755	957	1232	1580	1989	2279	800	13	(1.9)			
19-50..........................	983	1284	(36.1)	670	769	960	1221	1548	1933	2203	800	12	(1.7)			
51-70............................	871	1569	(33.4)	728	849	1104	1474	1949	2413	2736	1000	18	(1.5)			
71 and over...................	545	1426	(39.7)	614	729	968	1331	1801	2235	2502	1000	27	(2.4)			
50 and over.................	1416	1527	(27.8)	682	803	1058	1432	1910	2363	2674	1000	21	(1.3)			
19 and over...............	2399	1413	(28.3)	677	784	1003	1318	1743	2213	2509		17	(1.2)		13	(1.0)
All individuals 1 and over..	5202	1389	(19.8)	696	803	1015	1307	1683	2116	2418		15	(0.9)		9	(0.6)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
Supplement intake includes antacids.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.
DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

USERS OF SUPPLEMENTS CONTAINING IRON: Iron (mg/day): Mean intake and percentiles of TOTAL usual intake from food, beverages, AND DIETARY SUPPLEMENTS by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Total intake		----- Percentiles of Total Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	94	22.6	(2.08)	9.7*	11.5*	15.5	21.0	27.1	31.2*	33.7*	3	<3		40	<3	
4-8................................	141	28.1	(1.93)	15.2*	17.1*	21.1	26.9	31.3	34.3*	37.0*	4.1	<3		40	4*	(2.6)
9-13..............................	76	27.5	(1.54)	14.4*	16.2*	20.6	26.5	31.8	35.9*	38.5*	5.9	<3		40	3*	(2.2)
14-18............................	67	26.5	(1.29)	15.8*	17.9*	22.1*	27.4	32.9*	38.3*	42.8*	7.7	<3		45	3*	(1.6)
19-30............................	106	30.2	(3.07)	14.6*	16.6*	20.7	26.4	33.0	40.2*	47.6*	6	<3		45	6*	(4.0)
31-50............................	234	33.3	(1.37)	16.6*	19.7	25.8	32.8	38.9	45.4	50.8*	6	<3		45	11	(1.8)
19-50..........................	340	32.2	(1.03)	15.7	18.2	23.5	30.6	37.4	44.0	49.6	6	<3		45	9	(1.5)
51-70............................	228	35.5	(2.23)	16.8*	19.5	25.9	32.5	38.5	45.4	53.4*	6	<3		45	10	(2.6)
71 and over....................	143	41.3	(3.18)	17.9*	21.8*	28.1	33.3	40.3	76.8*	87.3*	6	<3		45	18	(3.3)
50 and over.................	371	37.2	(1.88)	16.8	20.1	26.6	33.0	39.0	47.6	78.0	6	<3		45	12	(2.0)
19 and over...............	711	34.2	(1.03)	16.3	18.8	24.5	31.7	38.0	45.3	54.4	6	<3		45	10	(1.4)
Females:																
1-3................................	64	22.7	(2.81)	8.8*	10.1*	13.6*	20.4	25.9*	29.4*	32.2*	3	<3		40	4*	(2.0)
4-8................................	124	23.4	(1.47)	12.3*	14.1*	17.9	24.0	29.0	32.4*	34.9*	4.1	<3		40	<3	
9-13..............................	82	24.6	(1.90)	11.9*	13.3*	17.1	24.0	29.7	33.9*	38.4*	5.7	<3		40	5*	(2.4)
14-18............................	62	26.9*	(2.01)	14.4*	16.5*	21.0*	27.4	33.3*	38.5*	42.2*	7.9	<3		45	3*	(1.7)
19-30............................	175	31.7	(1.61)	14.9*	17.4	24.1	30.2	37.0	44.8	54.8*	8.1	<3		45	10	(2.7)
31-50............................	470	30.5	(0.94)	14.1	16.4	21.6	28.6	33.8	40.9	56.9	8.1	<3		45	7	(1.1)
19-50..........................	645	30.9	(0.82)	14.2	16.6	22.1	29.1	34.6	42.6	56.6	8.1	<3		45	8	(1.1)
51-70............................	363	33.2	(1.94)	13.0	15.6	21.9	29.0	34.4	51.5	81.7	5	<3		45	11	(2.1)
71 and over....................	195	34.2	(1.35)	12.4*	15.8	25.1	29.8	35.1	63.5	78.9*	5	<3		45	13	(2.4)
50 and over.................	558	33.5	(1.39)	12.8	15.6	22.6	29.2	34.6	55.6	80.6	5	<3		45	12	(1.4)
19 and over...............	1203	32.0	(0.89)	13.6	16.2	22.3	29.2	34.6	44.2	73.9		<3		45	10	(0.9)
All individuals 1 and over..	2624	31.4	(0.55)	13.9	16.5	22.1	29.0	35.0	42.7	58.5		<3			8	(0.5)

NOTES: Mean intake estimated directly from day 1 dietary recall and 30-day supplement questionnaire. Usual intake distribution from dietary sources estimated using National Cancer Institute Method.
Mean daily intake from supplements added to usual intake from dietary sources to produce total usual nutrient intakes. Standard errors of percentiles presented in a separate table.
EAR comparisons by probabilty method for groups.
* Estimate may be less reliable than others due to small sample size. Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Appendix E-2.6: Usual Intake Distributions for Non-supplement Users for Folate, Folic Acid, Vitamin D, Calcium, and Iron, 2007-2010, by Age/Gender Groups

Usual Intake from Food and Beverages 2007-2010 Compared To Dietary Reference Intakes -- nonusers of supplements containing the specific nutrient

Nonusers of supplements containing the specific nutrients

Prepared by the Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture.

3/2014

NONUSERS OF SUPPLEMENTS CONTAINING FOLIC ACID: Folate (μg DFE/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----								Below EAR	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE
Males:													
1-3................................	600	370	(14.9)	194	224	281	353	440	528	587	120	<3	
4-8................................	686	520	(17.2)	316	351	416	500	599	700	770	160	<3	
9-13..............................	680	561	(24.6)	324	369	452	558	685	813	901	250	<3	
14-18............................	703	625	(29.7)	322	372	470	604	770	946	1063	330	6	(2.2)
19-30............................	926	632	(19.4)	358	410	509	635	781	934	1036	320	<3	
31-50............................	1371	626	(20.8)	321	371	467	595	749	911	1025	320	5	(1.1)
19-50..........................	2297	628	(15.5)	334	385	482	609	761	919	1026	320	4	(0.8)
51-70............................	1187	552	(13.3)	300	343	426	536	668	805	898	320	7	(1.4)
71 and over....................	552	519	(14.0)	254	297	379	493	635	789	898	320	14	(2.0)
50 and over.................	1739	545	(11.3)	287	330	414	525	659	802	898	320	9	(1.2)
19 and over...............	4036	601	(11.6)	315	363	457	579	725	881	986	320	5	(0.7)
Females:													
1-3................................	569	366	(12.3)	189	217	270	341	429	524	589	120	<3	
4-8................................	633	482	(14.3)	281	314	374	455	550	646	716	160	<3	
9-13..............................	707	515	(20.4)	293	333	406	505	630	762	853	250	<3	
14-18............................	623	472	(24.6)	227	268	342	446	573	705	794	330	22	(5.1)
19-30............................	828	450	(12.0)	269	301	361	440	531	621	683	320	14	(4.1)
31-50............................	1350	452	(14.6)	239	275	345	437	548	666	747	320	19	(2.8)
19-50..........................	2178	452	(11.0)	249	284	351	439	543	652	726	320	17	(2.2)
51-70............................	1092	432	(14.7)	231	266	332	418	526	636	715	320	22	(2.6)
71 and over....................	572	435	(11.9)	213	249	317	413	533	663	755	320	26	(2.2)
50 and over.................	1664	433	(11.1)	224	259	327	418	528	647	727	320	23	(2.0)
19 and over...............	3842	445	(8.2)	238	273	341	431	538	651	728	320	20	(1.8)
All individuals 1 and over..	13079	519	(6.7)	258	300	383	496	633	780	879		10	(0.7)

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
Folate measured in Dietary Folate Equivalents (DFE).
Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

NONUSERS OF SUPPLEMENTS CONTAINING FOLIC ACID: Folic acid (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----								Above UL	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	UL	%	SE
Males:													
1-3................................	600	147	(7.6)	59	73	100	136	181	228	260	300	<3	
4-8................................	686	222	(9.7)	119	136	168	211	262	315	350	400	<3	
9-13..............................	680	229	(11.9)	113	135	176	232	298	367	414	600	<3	
14-18............................	703	257	(16.3)	113	136	184	250	332	418	475	800	<3	
19-30............................	926	233	(8.7)	110	133	176	235	306	383	436	1000	<3	
31-50............................	1371	221	(9.8)	82	103	145	205	281	363	421	1000	<3	
19-50..........................	2297	226	(7.0)	92	113	156	216	291	371	427	1000	<3	
51-70............................	1187	180	(6.3)	65	83	119	171	238	310	360	1000	<3	
71 and over...................	552	189	(7.0)	67	86	124	179	249	326	381	1000	<3	
50 and over.................	1739	182	(5.2)	65	83	120	173	239	313	364	1000	<3	
19 and over...............	4036	211	(4.8)	81	101	142	200	273	354	409	1000	<3	
Females:													
1-3................................	569	146	(5.8)	63	76	101	136	177	221	251	300	<3	
4-8................................	633	206	(7.7)	104	121	151	193	241	289	324	400	<3	
9-13..............................	707	218	(12.0)	105	125	161	212	274	340	384	600	<3	
14-18............................	623	193	(12.3)	78	96	130	179	240	305	349	800	<3	
19-30............................	828	168	(5.8)	84	99	127	165	211	257	290	1000	<3	
31-50............................	1350	157	(7.2)	65	80	110	153	207	265	307	1000	<3	
19-50..........................	2178	161	(5.0)	71	86	116	158	210	266	305	1000	<3	
51-70............................	1092	141	(7.0)	50	64	93	135	190	250	293	1000	<3	
71 and over...................	572	157	(6.3)	51	66	99	147	211	283	334	1000	<3	
50 and over.................	1664	146	(5.4)	50	64	94	139	196	260	306	1000	<3	
19 and over...............	3842	156	(3.9)	61	76	107	151	206	266	309	1000	<3	
All individuals 1 and over..	13079	191	(2.9)	72	90	127	181	248	323	375		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.

Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

NONUSERS OF SUPPLEMENTS CONTAINING VITAMIN D: Vitamin D (D2+D3) (μg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----								Below EAR			Above UL	
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	563	7.7	(0.38)	2.5	3.3	4.9	7.2	9.9	12.6	14.3	10	76	(2.9)	63	<3	
4-8................................	662	6.1	(0.23)	2.6	3.2	4.4	5.9	7.7	9.5	10.6	10	93	(2.1)	75	<3	
9-13..............................	664	6.1	(0.35)	2.3	2.9	4.1	5.6	7.6	9.6	11.0	10	92	(1.9)	100	<3	
14-18............................	703	6.1	(0.31)	2.1	2.7	3.9	5.7	7.9	10.4	12.0	10	88	(2.6)	100	<3	
19-30............................	929	5.0	(0.16)	1.5	2.0	3.0	4.6	6.7	9.3	11.1	10	92	(1.2)	100	<3	
31-50............................	1362	5.4	(0.34)	1.7	2.2	3.2	4.7	6.7	9.1	10.9	10	93	(2.0)	100	<3	
19-50..........................	2291	5.2	(0.22)	1.6	2.1	3.1	4.6	6.7	9.1	10.9	10	93	(1.4)	100	<3	
51-70............................	1151	5.0	(0.24)	1.6	2.0	3.0	4.5	6.5	9.0	10.7	10	93	(1.3)	100	<3	
71 and over....................	509	5.2	(0.33)	1.8	2.3	3.2	4.7	6.6	8.8	10.4	10	94	(1.5)	100	<3	
50 and over.................	1660	5.1	(0.20)	1.6	2.1	3.0	4.5	6.5	8.9	10.6	10	94	(1.0)	100	<3	
19 and over...............	3951	5.2	(0.17)	1.6	2.1	3.1	4.6	6.6	9.1	10.8	10	93	(0.9)	100	<3	
Females:																
1-3................................	543	7.9	(0.28)	2.9	3.7	5.2	7.3	9.8	12.3	14.0	10	77	(2.8)	63	<3	
4-8................................	618	5.8	(0.25)	2.5	3.1	4.1	5.6	7.2	8.8	9.9	10	95	(1.4)	75	<3	
9-13..............................	700	4.7	(0.18)	1.7	2.2	3.1	4.5	6.2	8.0	9.2	10	>97		100	<3	
14-18............................	615	3.6	(0.22)	1.3	1.6	2.3	3.4	4.8	6.4	7.6	10	>97		100	<3	
19-30............................	824	3.7	(0.16)	1.3	1.6	2.3	3.2	4.5	5.9	6.9	10	>97		100	<3	
31-50............................	1294	3.9	(0.16)	1.4	1.8	2.5	3.4	4.8	6.2	7.3	10	>97		100	<3	
19-50..........................	2118	3.8	(0.12)	1.4	1.7	2.4	3.4	4.6	6.1	7.2	10	>97		100	<3	
51-70............................	944	4.0	(0.25)	1.2	1.5	2.2	3.3	4.9	6.7	8.0	10	>97		100	<3	
71 and over....................	469	4.0	(0.21)	1.1	1.5	2.3	3.5	5.1	7.0	8.3	10	>97		100	<3	
50 and over.................	1413	4.0	(0.20)	1.1	1.5	2.2	3.4	5.0	6.8	8.1	10	>97		100	<3	
19 and over...............	3531	3.9	(0.10)	1.3	1.6	2.3	3.4	4.8	6.4	7.5	10	>97		100	<3	
All individuals 1 and over..	12550	4.9	(0.09)	1.5	1.9	2.8	4.3	6.2	8.4	10.1	10	95	(0.4)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
Vitamin D dietary intake estimates reflect the sum of only vitamin D2 and vitamin D3; 25(OH)D values are not provided by USDA SR.
Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

NONUSERS OF SUPPLEMENTS CONTAINING CALCIUM: Calcium (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	680	1071	(45.4)	533	630	809	1033	1287	1537	1697	500	4	(1.7)	2500	<3	
4-8................................	844	1005	(23.5)	586	661	803	983	1186	1388	1521	800	25	(3.2)	2500	<3	
9-13..............................	742	1107	(46.8)	636	726	886	1088	1327	1570	1732	1100	51	(5.1)	3000	<3	
14-18............................	687	1218	(42.7)	653	748	930	1162	1440	1717	1895	1100	43	(4.4)	3000	<3	
19-30............................	857	1136	(32.8)	564	660	845	1089	1383	1695	1907	800	21	(2.8)	2500	<3	
31-50............................	1220	1084	(34.9)	555	642	809	1030	1297	1576	1771	800	24	(2.5)	2500	<3	
19-50..........................	2077	1105	(27.2)	558	648	822	1050	1326	1619	1815	800	23	(2.2)	2500	<3	
51-70............................	1063	974	(25.3)	448	528	690	909	1183	1479	1682	800	38	(2.9)	2000	<3	
71 and over....................	477	812	(28.3)	430	496	620	786	982	1190	1331	1000	77	(3.7)	2000	<3	
50 and over.................	1540	938	(21.2)	441	517	669	877	1132	1411	1602		46	(2.5)	2000	<3	
19 and over...............	3617	1050	(19.4)	506	593	762	988	1265	1566	1766		31	(1.7)		<3	
Females:																
1-3................................	637	1034	(29.8)	534	623	786	997	1245	1494	1658	500	4	(1.2)	2500	<3	
4-8................................	746	945	(28.9)	539	613	746	921	1119	1315	1454	800	33	(3.4)	2500	<3	
9-13..............................	751	923	(27.9)	546	619	748	916	1113	1310	1444	1100	74	(4.4)	3000	<3	
14-18............................	611	851	(25.0)	444	516	647	820	1025	1230	1370	1100	82	(3.7)	3000	<3	
19-30............................	776	865	(24.0)	496	562	679	831	1007	1184	1299	800	45	(4.4)	2500	<3	
31-50............................	1165	825	(26.8)	403	471	604	778	985	1203	1354	800	53	(3.0)	2500	<3	
19-50..........................	1941	842	(20.1)	434	502	632	801	998	1204	1341	800	50	(2.6)	2500	<3	
51-70............................	849	764	(26.3)	386	448	569	727	921	1120	1259	1000	82	(2.2)	2000	<3	
71 and over....................	406	731	(20.7)	351	415	533	690	883	1083	1214	1000	85	(1.9)	2000	<3	
50 and over.................	1255	755	(18.9)	374	436	556	719	911	1118	1253	1000	83	(1.6)	2000	<3	
19 and over...............	3196	813	(17.5)	409	475	602	769	968	1173	1312		62	(2.0)		<3	
All individuals 1 and over..	12511	964	(12.2)	469	549	703	912	1162	1429	1610		44	(1.2)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
Supplement intake includes antacids.
Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

NONUSERS OF SUPPLEMENTS CONTAINING IRON: Iron (mg/day): Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States, 2007-2010

		Day 1		----- Percentiles of Usual Intake -----							Below EAR			Above UL		
	N	Mean	SE	5th	10th	25th	50th	75th	90th	95th	EAR	%	SE	UL	%	SE
Males:																
1-3................................	672	10.5	(0.32)	5.3	6.2	7.9	10.0	12.6	15.2	17.0	3	<3		40	<3	
4-8................................	856	12.8	(0.27)	8.9	9.7	11.0	12.7	14.6	16.4	17.7	4.1	<3		40	<3	
9-13..............................	766	15.3	(0.40)	9.8	10.8	12.8	15.2	17.9	20.6	22.4	5.9	<3		40	<3	
14-18............................	734	17.2	(0.46)	10.3	11.5	13.9	16.9	20.6	24.4	26.9	7.7	<3		45	<3	
19-30............................	998	17.5	(0.49)	9.8	11.2	13.9	17.3	21.2	25.2	27.9	6	<3		45	<3	
31-50............................	1561	17.7	(0.38)	9.7	11.1	13.7	17.2	21.3	25.6	28.5	6	<3		45	<3	
19-50..........................	2559	17.7	(0.32)	9.6	11.1	13.8	17.2	21.3	25.5	28.3	6	<3		45	<3	
51-70............................	1523	16.5	(0.33)	9.3	10.6	13.1	16.3	20.1	24.0	26.6	6	<3		45	<3	
71 and over....................	756	15.8	(0.37)	8.4	9.6	12.0	15.3	19.3	23.6	26.5	6	<3		45	<3	
50 and over.................	2279	16.4	(0.28)	9.1	10.4	12.8	16.1	19.9	23.9	26.6	6	<3		45	<3	
19 and over...............	4838	17.2	(0.23)	9.4	10.8	13.4	16.8	20.8	24.9	27.7	6	<3		45	<3	
Females:																
1-3................................	644	9.6	(0.26)	5.2	6.0	7.3	9.2	11.3	13.6	15.1	3	<3		40	<3	
4-8................................	763	12.3	(0.38)	7.3	8.2	9.8	11.9	14.3	16.8	18.6	4.1	<3		40	<3	
9-13..............................	781	13.8	(0.37)	8.7	9.7	11.4	13.6	16.2	18.8	20.6	5.7	<3		40	<3	
14-18............................	643	12.7	(0.56)	6.7	7.7	9.5	12.0	14.9	17.8	19.7	7.9	17	(3.1)	45	<3	
19-30............................	854	12.7	(0.34)	7.5	8.4	10.1	12.3	14.9	17.7	19.5	8.1	17	(2.0)	45	<3	
31-50............................	1425	12.6	(0.29)	7.4	8.3	10.2	12.4	15.1	17.8	19.6	8.1	17	(1.8)	45	<3	
19-50..........................	2279	12.7	(0.24)	7.4	8.3	10.1	12.4	15.0	17.7	19.6	8.1	17	(1.4)	45	<3	
51-70............................	1357	12.8	(0.29)	7.2	8.2	10.0	12.3	15.1	18.1	20.1	5	<3		45	<3	
71 and over....................	756	12.4	(0.36)	6.6	7.6	9.4	11.9	14.8	17.9	20.0	5	<3		45	<3	
50 and over.................	2113	12.7	(0.23)	7.0	7.9	9.8	12.2	15.0	18.1	20.1	5	<3		45	<3	
19 and over...............	4392	12.7	(0.20)	7.2	8.1	10.0	12.3	15.1	17.9	19.8		11	(0.9)	45	<3	
All individuals 1 and over..	15089	14.6	(0.13)	7.6	8.8	11.0	14.0	17.7	21.5	24.1		5	(0.3)		<3	

NOTES: Mean intake estimated directly from the day 1 dietary recall. Usual intake distribution estimated using the National Cancer Institute Method. Standard errors of percentiles presented in a separate table.
EAR comparisons by probabilty method for groups.
Breast-fed children, pregnant or lactating females, and individuals with incomplete dietary supplement data excluded.

DATA SOURCE: What We Eat in America, NHANES 2007-2010 dietary intake data and NHANES 2007-2010 30-day supplement questionnaire data.
Prepared by Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. 3/2014

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories

The food categories below describe reassignment of the 150 specific What We Eat in America (WWEIA) Food Categories to Major Food Categories (n=9) and Subcategories (n=32) as requested by the DGAC for analyses of contributions of food category intake to energy, nutrient, and food group intakes.

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
DAIRY			
	LOWFAT MILK/YOGURT		
		1006	Milk, lowfat
		1008	Milk, nonfat
		1206	Flavored milk, lowfat
		1208	Flavored milk, nonfat
		1804	Yogurt, lowfat and nonfat
		1404	Milk substitutes
	HIGHER FAT MILK/YOGURT		
		1002	Milk, whole
		1004	Milk, reduced fat
		1202	Flavored milk, whole
		1204	Flavored milk, reduced fat
		1402	Milk shakes and other dairy drinks
		1802	Yogurt, whole and reduced fat
	CHEESE		
		1602	Cheese
		1604	Cottage/ricotta cheese
PROTEIN FOODS			
	MEATS (Not incl. Deli and Mixed Dishes)		
		2002	Beef, excludes ground
		2004	Ground beef
		2006	Pork
		2008	Lamb, goat, game
		2010	Liver and organ meats
	DELI/CURED PRODUCTS (Meat and Poultry)		
		2602	Cold cuts and cured meats
		2604	Bacon
		2606	Frankfurters
		2608	Sausages
	POULTRY (Not incl. Deli and Mixed Dishes)		
		2202	Chicken, whole pieces
		2204	Chicken patties, nuggets and tenders
		2206	Turkey, duck, other poultry

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
	SEAFOOD (Not incl. Mixed Dishes)		
		2402	Fish
		2404	Shellfish
	EGGS		
		2502	Eggs and omelets
	NUTS, SEEDS, AND SOY		
		2804	Nuts and seeds
		2806	Processed soy products
MIXED DISHES			
	PIZZA		
		3602	Pizza
	BURGERS AND SANDWICHES (Incl. Tacos and Burritos)		
		3702	Burgers (single code)
		3704	Chicken/turkey sandwiches (single code)
		3706	Egg/breakfast sandwiches (single code)
		3708	Other sandwiches (single code+ combination codes)*
		3502	Burritos and tacos
	MEAT, POULTRY, SEAFOOD MIXED DISHES		
		3002	Meat mixed dishes
		3004	Poultry mixed dishes
		3006	Seafood mixed dishes
		3404	Stir-fry and soy-based sauce mixtures
	RICE, PASTA, AND OTHER GRAIN-BASED MIXED DISHES		
		3202	Rice mixed dishes
		3204	Pasta mixed dishes, excludes macaroni and cheese
		3206	Macaroni and cheese
		3208	Turnovers and other grain-based items
		3402	Fried rice and lo/chow mein
		3406	Egg rolls, dumplings, sushi
		3506	Other Mexican mixed dishes
	SOUPS		
		3802	Soups
GRAINS			
	RICE AND PASTA		
		4002	Rice
		4004	Pasta, noodles, cooked grains

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
	YEAST BREADS AND TORTILLAS		
		4202	Yeast breads
		4204	Rolls and buns
		4206	Bagels and English muffins
		4208	Tortillas
	QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)		
		4402	Biscuits, muffins, quick breads
		4404	Pancakes, waffles, French toast
	BREAKFAST CEREALS AND BARS		
		4602	Ready-to-eat cereal, higher sugar (>21.2g/100g)
		4604	Ready-to-eat cereal, lower sugar (≤21.2g/100g)
		4802	Oatmeal
		4804	Grits and other cooked cereals
		5402	Cereal bars
		5404	Nutrition bars
SNACKS AND SWEETS			
	CHIPS, CRACKERS, AND SAVORY SNACKS		
		5002	Potato chips
		5004	Tortilla, corn, other chips
		5006	Popcorn
		5008	Pretzels/snack mix
		5202	Crackers, excludes saltines
		5204	Saltine crackers
		3504	Nachos
	DESSERTS AND SWEET SNACKS		
		5502	Cakes and pies
		5504	Cookies and brownies
		5506	Doughnuts, sweet rolls, pastries
		5802	Ice cream and frozen dairy desserts
		5804	Pudding
		5806	Gelatins, ices, sorbets
	CANDIES AND SUGARS		
		5702	Candy containing chocolate
		5704	Candy not containing chocolate
		8802	Sugars and honey
		8804	Sugar substitutes
		8806	Jams, syrups, toppings

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
FRUITS AND 100% FRUIT JUICE			
	FRUIT (Non-juice)		
		6002	Apples
		6004	Bananas
		6006	Grapes
		6008	Peaches and nectarines
		6010	Berries
		6012	Citrus fruits
		6014	Melons
		6016	Dried fruits
		6018	Other fruits and fruit salads
	100% FRUIT JUICE		
		7002	Citrus juice
		7004	Apple juice
		7006	Other fruit juice
VEGETABLES			
	VEGETABLES (Incl. Beans and Peas, not Starchy)		
		6402	Tomatoes
		6404	Carrots
		6406	Other red and orange vegetables
		6408	Dark green vegetables, excludes lettuce
		6410	Lettuce and lettuce salads (incl. combination codes)*
		6412	String beans
		6414	Onions
		8410	Pasta sauces, tomato-based
		6420	Other vegetables and combinations
		6422	Vegetable mixed dishes
		7008	Vegetable juice
		2802	Beans, peas, legumes
	STARCHY VEGETABLES		
		6416	Corn
		6418	Other starchy vegetables
		6802	White potatoes, baked or boiled
		6804	French fries and other fried white potatoes
		6806	Mashed potatoes and white potato mixtures

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
BEVERAGES (Not Incl. Milk and 100% Fruit Juice)			
	SUGAR-SWEETENED AND DIET BEVERAGES		
		7102	Diet soft drinks
		7104	Diet sport and energy drinks
		7106	Other diet drinks
		7202	Soft drinks
		7204	Fruit drinks
		7206	Sport and energy drinks
		7208	Nutritional beverages
		7802	Flavored or carbonated water
	COFFEE AND TEA		
		7302	Coffee
		7304	Tea
	ALCOHOLIC BEVERAGES		
		7502	Beer
		7504	Wine
		7506	Liquor and cocktails
	WATERS		
		7702	Tap water
		7704	Bottled water
		7804	Enhanced or fortified water
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS			
	CONDIMENTS AND GRAVIES		
		8402	Tomato-based condiments
		8404	Soy-based condiments
		8406	Mustard and other condiments
		8408	Olives, pickles, pickled vegetables
		8412	Dips, gravies, other sauces
	SPREADS		
		8002	Butter and animal fats
		8004	Margarine
		8006	Cream cheese, sour cream, whipped cream
		8008	Cream and cream substitutes
	SALAD DRESSINGS		
		8010	Mayonnaise
		8012	Salad dressings and vegetable oils

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
ALL BEVERAGES	NOTE: For beverage intake analyses, a new grouping was created that includes all current beverages, 100% fruit juices, vegetable juices, and milk (plain and flavored):		
	LOWFAT MILK		
		1006	Milk, lowfat
		1008	Milk, nonfat
		1206	Flavored milk, lowfat
		1208	Flavored milk, nonfat
		1404	Milk substitutes
	HIGHER FAT MILK		
		1002	Milk, whole
		1004	Milk, reduced fat
		1202	Flavored milk, whole
		1204	Flavored milk, reduced fat
		1402	Milk shakes and other dairy drinks
	100% FRUIT JUICE-VEGETABLE JUICE		
		7002	Citrus juice
		7004	Apple juice
		7006	Other fruit juice
		7008	Vegetable juice
	SUGAR-SWEETENED AND DIET BEVERAGES		
		7102	Diet soft drinks
		7104	Diet sport and energy drinks
		7106	Other diet drinks
		7202	Soft drinks
		7204	Fruit drinks
		7206	Sport and energy drinks
		7208	Nutritional beverages
		7802	Flavored or carbonated water
	COFFEE AND TEA		
		7302	Coffee
		7304	Tea
	ALCOHOLIC BEVERAGES		
		7502	Beer
		7504	Wine
		7506	Liquor and cocktails

Appendix E-2.7: Major Categories and Subcategories used in DGAC Analyses of WWEIA Food Categories, continued

DGAC Major Category	DGAC Subcategory	WWEIA Food Category #	WWEIA Food Category Description
	WATERS		
		7702	Tap water
		7704	Bottled water
		7804	Enhanced or fortified water

*The percents of total intake from WWEIA categories were reanalyzed at the request of the DGAC to include all foods reported separately, but consumed as part of a sandwich-type combination, in category #3708 and all foods reported separately but reported consumed as part of a salad-type combination, in category # 6410. These single foods consumed in combination were no longer counted under their respective original categories.

The following WWEIA food categories are not included in the analysis, therefore, totals may not equal 100%:

9002	Baby food: cereals
9004	Baby food: fruit
9006	Baby food: vegetable
9008	Baby food: meat and dinners
9010	Baby food: yogurt
9012	Baby food: snacks and sweets
9202	Baby juice
9204	Baby water
9402	Formula, ready-to-feed
9404	Formula, prepared from powder
9406	Formula, prepared from concentrate
9999	Not included in a food category

Appendix E-2.8: Percent of total food group intake, 2009-10 for the U.S. population ages 2 years and older, from WWEIA Food Categories

These data are estimates of the percent of USDA Food Pattern food group intake from WWEIA Food Categories, regrouped into DGAC major categories and subcategories as described elsewhere, for individuals 2 years and older based on the day 1 dietary recalls from What We Eat in America, NHANES 2009-2010. Breastfed children have been excluded. The sample size is 9,042.

	Percent of total consumption from each major food category and subcategory						
	Total Vegetables	Total Fruits	Total Grains	Total Dairy	Total Protein Foods	Whole grains	Refined grains
DGAC Major category	%	%	%	%	%	%	%
DAIRY	0.0	0.4	0.2	53.9	0.0	0.0	0.2
PROTEIN FOODS	0.5	0.2	2.7	1.6	48.7	0.3	3.0
MIXED DISHES	30.6	0.5	44.7	29.6	45.2	19.5	48.2
GRAINS	0.2	1.1	32.6	2.0	1.2	60.0	28.9
SNACKS AND SWEETS	5.3	3.2	19.0	5.8	2.1	19.4	19.0
FRUITS+FRUIT JUICE	0.1	88.6	0.0	0.0	0.0	0.0	0.0
VEGETABLES	58.9	1.0	0.6	3.0	2.4	0.3	0.6
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	4.3	0.1	0.1	2.8	0.1	0.0	0.1
BEVERAGES (not incl. milk and 100% fruit juice)	0.1	4.7	0.0	1.0	0.1	0.0	0.0
Total*	100.0	100.0	99.9	99.7	99.7	99.6	100.0
DGAC Subcategory	%	%	%	%	%	%	%
LOWFAT MILK/YOGURT	0.0	0.3	0.0	18.5	0.0	0.0	0.0
HIGHER FAT MILK/YOGURT	0.0	0.1	0.0	25.4	0.0	0.0	0.0
CHEESE	0.0	0.0	0.2	10.0	0.0	0.0	0.2
MEATS (Not incl. Deli and Mixed Dishes)	0.0	0.0	0.1	0.0	10.7	0.0	0.1
DELI/CURED PRODUCTS (Meat and Poultry)	0.0	0.0	0.0	0.0	4.7	0.0	0.0
POULTRY (Not incl. Deli and Mixed Dishes)	0.1	0.0	1.8	0.1	14.5	0.0	2.1
SEAFOOD (Not incl. Mixed Dishes)	0.0	0.1	0.6	0.0	6.7	0.0	0.7
EGGS	0.4	0.0	0.0	1.5	5.1	0.0	0.0
NUTS, SEEDS, AND SOY	0.1	0.1	0.0	0.0	7.0	0.3	0.0
PIZZA	2.3	0.1	8.6	9.1	1.1	0.0	9.7
BURGERS, TACOS, AND SANDWICHES	8.8	0.3	23.1	13.8	26.4	17.7	23.9
MEAT, POULTRY, SEAFOOD MIXED DISHES	7.7	0.1	2.2	1.3	12.6	0.0	2.5
RICE, PASTA, AND OTHER GRAIN-BASED MIXED DISHES	7.3	0.1	9.4	4.7	3.3	1.8	10.4
SOUPS	4.5	0.0	1.4	0.7	1.7	0.0	1.6
RICE AND PASTA	0.0	0.0	4.2	0.0	0.0	4.6	4.2
YEAST BREADS AND TORTILLAS	0.0	0.1	17.0	0.2	0.0	16.8	17.0
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	0.1	0.3	4.8	0.7	0.5	1.7	5.3
BREAKFAST CEREALS AND BARS	0.1	0.7	6.6	1.0	0.6	36.9	2.5
CHIPS, CRACKERS, AND SAVORY SNACKS	5.1	0.0	10.1	0.5	0.3	18.6	8.9
DESSERTS AND SWEET SNACKS	0.2	1.7	8.9	4.0	0.9	0.8	10.1
CANDIES AND SUGARS	0.0	1.6	0.0	1.3	0.9	0.0	0.1

Appendix E-2.8: Percent of total food group intake, 2009-10 for the U.S. population ages 2 years and older, continued

	Percent of total consumption from each major food category and subcategory						
	Total Vegetables	Total Fruits	Total Grains	Total Dairy	Total Protein Foods	Whole grains	Refined grains
DGAC Subcategory, continued	%	%	%	%	%	%	%
FRUIT (non-juice)	0.0	60.0	0.0	0.0	0.0	0.0	0.0
100% FRUIT JUICE	0.1	28.7	0.0	0.0	0.0	0.0	0.0
VEGETABLES (Incl. Beans and Peas, not Starchy)	39.5	1.0	0.5	1.6	2.3	0.3	0.5
STARCHY VEGETABLES	19.5	0.0	0.1	1.4	0.1	0.0	0.1
SUGAR-SWEETENED AND DIET BEVERAGES	0.0	4.3	0.0	0.8	0.1	0.0	0.0
COFFEE AND TEA	0.0	0.0	0.0	2.0	0.0	0.0	0.0
ALCOHOLIC BEVERAGES	0.0	0.5	0.0	0.0	0.0	0.0	0.0
WATERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONDIMENTS AND GRAVIES	4.3	0.1	0.1	0.8	0.1	0.0	0.1
SPREADS	0.0	0.0	0.0	0.2	0.0	0.0	0.0
SALAD DRESSINGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total*	100.0	100.0	99.9	99.7	99.7	99.6	100.0

*Totals are less than 100% because results do not include baby foods and infant formulas

	Percent of total consumption from each major food category and subcategory							
	Milk	Cheese	Red meat	Cured meat	Added sugars	Solid fats	Empty calories	Oils
DGAC Major category	%	%	%	%	%	%	%	%
DAIRY	76.4	23.6	0.0	0.0	3.8	10.4	7.3	0.5
PROTEIN FOODS	1.3	2.2	39.6	27.8	0.6	14.0	7.6	15.4
MIXED DISHES	3.4	65.7	59.0	70.7	5.8	35.6	21.4	29.3
GRAINS	3.4	0.2	0.0	0.0	7.8	4.5	6.1	6.0
SNACKS AND SWEETS	9.0	1.1	0.3	0.0	31.2	22.7	26.7	19.6
FRUITS+FRUIT JUICE	0.0	0.0	0.0	0.0	0.8	0.0	0.4	0.0
VEGETABLES	1.1	5.5	1.0	1.5	1.1	4.7	3.0	23.4
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	4.6	1.6	0.0	0.0	2.0	7.1	4.7	5.7
BEVERAGES (not incl. milk and 100% fruit juice)	0.6	0.0	0.0	0.0	46.5	0.8	22.5	0.2
Total*	99.7	100.0	100.0	100.0	99.6	99.9	99.7	99.9
DGAC Subcategory	%	%	%	%	%	%	%	%
LOWFAT MILK/YOGURT	29.9	0.0	0.0	0.0	1.7	0.5	1.1	0.2
HIGHER FAT MILK/YOGURT	46.5	0.0	0.0	0.0	2.1	5.8	4.1	0.0
CHEESE	0.0	23.6	0.0	0.0	0.0	4.2	2.2	0.3
MEATS (Not incl. Deli and Mixed Dishes)	0.0	0.0	39.5	0.1	0.1	2.5	1.4	0.2
DELI/CURED PRODUCTS (Meat and Poultry)	0.0	0.0	0.0	25.9	0.1	4.0	2.2	0.1
POULTRY (Not incl. Deli and Mixed Dishes)	0.1	0.0	0.0	0.0	0.2	3.2	1.8	3.7
SEAFOOD (Not incl. Mixed Dishes)	0.1	0.0	0.0	0.0	0.1	1.1	0.6	1.2
EGGS	1.1	2.1	0.0	1.8	0.0	3.1	1.6	1.8

Appendix E-2.8: Percent of total food group intake, 2009-10 for the U.S. population ages 2 years and older, continued

	Percent of total consumption from each major food category and subcategory							
	Milk	Cheese	Red meat	Cured meat	Added sugars	Solid fats	Empty calories	Oils
DGAC Subcategory, continued	%	%	%	%	%	%	%	%
NUTS, SEEDS, AND SOY	0.0	0.0	0.0	0.0	0.1	0.0	0.1	8.4
PIZZA	0.0	21.6	0.2	5.2	0.8	7.8	4.5	2.7
BURGERS, TACOS, AND SANDWICHES	0.4	32.2	32.0	60.0	4.1	17.4	11.1	15.3
MEAT, POULTRY, SEAFOOD MIXED DISHES	1.1	1.7	18.3	3.8	0.4	3.8	2.2	4.3
RICE, PASTA AND OTHER GRAIN-BASED MIXED DISHES	1.2	9.6	6.2	0.9	0.5	5.5	3.1	5.8
SOUPS	0.8	0.6	2.3	0.7	0.1	1.1	0.6	1.2
RICE AND PASTA	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.8
YEAST BREADS AND TORTILLAS	0.3	0.1	0.0	0.0	1.0	1.1	1.1	2.4
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	1.3	0.1	0.0	0.0	1.7	2.6	2.2	1.5
BREAKFAST CEREALS AND BARS	1.7	0.1	0.0	0.0	5.1	0.6	2.7	1.3
CHIPS, CRACKERS, AND SAVORY SNACKS	0.1	1.0	0.3	0.0	0.4	2.7	1.6	15.3
DESSERTS AND SWEET SNACKS	6.5	0.0	0.0	0.0	18.9	17.1	18.0	3.2
CANDIES AND SUGARS	2.4	0.0	0.0	0.0	11.8	2.9	7.1	1.1
FRUIT (non-juice)	0.0	0.0	0.0	0.0	0.8	0.0	0.4	0.0
100% FRUIT JUICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEGETABLES (Incl. Beans and Peas, not Starchy)	0.3	3.3	1.0	1.4	1.0	2.3	1.7	12.2
STARCHY VEGETABLES	0.9	2.2	0.0	0.2	0.1	2.4	1.3	11.2
SUGAR-SWEETENED AND DIET BEVERAGES**	0.9	0.0	0.0	0.0	38.8	0.3	18.6	0.1
COFFEE AND TEA	3.7	0.0	0.0	0.0	6.7	0.5	3.4	0.0
ALCOHOLIC BEVERAGES	0.0	0.0	0.0	0.0	0.8	0.0	0.4	0.0
WATERS	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0
CONDIMENTS AND GRAVIES	0.2	1.6	0.0	0.0	0.9	0.9	0.9	1.3
SPREADS	0.4	0.0	0.0	0.0	1.0	6.2	3.7	1.4
SALAD DRESSINGS	0.0	0.0	0.0	0.0	0.1	0.0	0.1	3.0
Total*	99.7	100.0	100.0	100.0	99.6	99.9	99.7	99.9

*Totals less than 100% because results do not include baby foods and infant formulas

**Additional breakdown for SUGAR-SWEETENED AND DIET BEVERAGES

	% of Added sugars consumption
Diet soft drinks	0.0
Diet sport and energy drinks	0.0
Other diet drinks	0.0
Soft drinks	25.1
Fruit drinks	10.6
Sport and energy drinks	2.6
Nutritional beverages	0.2
Flavored or carbonated water	0.2

Appendix E-2.9: Percent of total energy and nutrient intake, 2009-10 for the U.S. population ages 2 years and older

These data are estimates of the percent of total energy and nutrient intake from WWEIA Food Categories, regrouped into DGAC major categories and subcategories as described elsewhere, for individuals 2 years and older based on the day 1 dietary recalls from What We Eat in America, NHANES 2009-2010. Breastfed children have been excluded. The sample size is 9,042.

	Percent of total consumption from each major food category and subcategory							
	Energy	Sodium	Saturated Fat	Caffeine	Dietary Fiber	Calcium	Potas-sium	Vitamin D
DGAC Major category	%	%	%	%	%	%	%	%
DAIRY	6.69	4.86	12.55	**0.26**	1.20	29.82	11.96	45.50
PROTEIN FOODS	11.00	14.06	15.03	0.00	3.96	3.77	10.49	18.96
MIXED DISHES	28.82	43.47	36.29	0.00	27.85	28.84	24.38	15.74
GRAINS	10.61	10.66	3.87	0.07	18.49	8.55	5.14	8.23
SNACKS AND SWEETS	16.17	8.09	17.87	1.41	11.87	6.85	7.84	1.72
FRUITS+FRUIT JUICE	4.57	0.14	0.27	0.00	12.92	4.68	11.03	2.52
VEGETABLES	7.67	10.65	6.45	0.00	20.97	5.21	15.38	2.59
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	2.34	4.63	6.56	0.02	1.46	1.32	1.99	1.10
BEVERAGES (Not incl. Milk and 100% Fruit Juice)	11.83	3.21	1.01	98.19	0.91	10.03	11.43	2.82
Total*	99.70	99.77	99.90	99.95	99.64	99.04	99.62	99.19
DGAC Subcategory								
LOWFAT MILK/YOGURT	1.94	1.15	1.27	0.07	0.27	10.65	5.15	17.41
HIGHER FAT MILK/YOGURT	3.46	1.69	6.92	0.19	0.86	13.36	6.37	26.07
CHEESE	1.29	2.02	4.36	0.00	0.08	5.81	0.45	2.02
MEATS (Not incl. Deli and Mixed Dishes)	2.12	2.10	3.33	0.00	0.05	0.34	2.43	1.52
DELI/CURED PRODUCTS (Meat and Poultry)	1.32	3.18	2.85	0.00	0.04	0.21	1.22	1.37
POULTRY (Not incl. Deli and Mixed Dishes)	3.31	4.41	3.33	0.00	0.54	0.45	2.89	0.69
SEAFOOD (Not incl. Mixed Dishes)	1.09	2.00	0.81	0.00	0.22	0.53	1.40	9.36
EGGS	1.51	1.72	3.11	0.00	0.11	1.58	1.07	6.03
NUTS, SEEDS, AND SOY	1.66	0.64	1.61	0.00	3.00	0.66	1.48	0.00
PIZZA	4.27	5.76	6.34	0.00	4.24	5.42	2.22	0.15
BURGERS, TACOS, AND SANDWICHES	13.82	20.68	19.01	0.00	11.15	16.07	10.83	9.26
MEAT, POULTRY, SEAFOOD MIXED DISHES	3.91	6.07	4.35	0.00	3.59	2.11	4.65	2.78
RICE, PASTA, AND OTHER GRAIN-BASED MIXED DISHES	5.48	6.89	5.28	0.00	6.73	4.30	4.35	2.80
SOUPS	1.34	4.07	1.31	0.00	2.15	0.93	2.32	0.76
RICE AND PASTA	1.48	2.23	0.22	0.00	1.13	0.23	0.33	0.03
YEAST BREADS AND TORTILLAS	3.75	3.69	1.28	0.00	6.48	2.79	1.65	0.09
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	1.93	2.14	1.23	0.04	1.88	1.64	0.76	0.65
BREAKFAST CEREALS AND BARS	3.45	2.60	1.13	0.03	8.99	3.89	2.39	7.45
CHIPS, CRACKERS, AND SAVORY SNACKS	4.61	4.03	3.33	0.00	5.78	1.53	3.40	0.10
DESSERTS AND SWEET SNACKS	8.50	3.67	11.57	0.75	4.77	4.58	3.53	1.60

Appendix E-2.9: Percent of total energy and nutrient intake, 2009-10 for the U.S. population ages 2 years and older, continued

	Percent of total consumption from each major food category and subcategory, continued							
	Energy	Sodium	Saturated Fat	Caffeine	Dietary Fiber	Calcium	Potas-sium	Vitamin D
CANDIES AND SUGARS	3.06	0.40	2.97	0.66	1.32	0.74	0.91	0.02
FRUIT (non-juice)	2.73	0.06	0.21	**0.00**	11.71	0.99	6.68	0.00
100% FRUIT JUICE	1.84	0.08	0.05	0.00	1.21	3.68	4.35	2.52
VEGETABLES (Incl. Beans and Peas, not Starchy)	3.84	6.54	3.50	0.00	14.16	3.82	8.57	1.44
STARCHY VEGETABLES	3.83	4.11	2.95	0.00	6.82	1.39	6.80	1.15
SUGAR-SWEETENED AND DIET BEVERAGES	6.51	1.56	0.30	18.14	0.75	2.25	2.67	0.70
COFFEE AND TEA	1.44	0.45	0.69	79.92	0.12	1.71	6.99	2.12
ALCOHOLIC BEVERAGES	3.84	0.27	0.03	0.13	0.04	0.64	1.75	0.01
WATERS	0.03	0.93	0.00	0.00	0.00	5.44	0.01	0.00
CONDIMENTS AND GRAVIES	0.68	3.63	1.05	0.00	1.33	0.83	1.48	0.23
SPREADS	1.34	0.61	5.10	0.02	0.09	0.45	0.48	0.86
SALAD DRESSINGS	0.31	0.39	0.40	0.00	0.04	0.04	0.03	0.02
Total*	99.70	99.77	99.90	99.95	99.64	99.04	99.62	99.19

*Totals less than 100% because results do not include baby foods and infant formulas

BEVERAGES ANALYSIS CATEGORIES	Energy
	%
All Foods	81.18
Beverages:	
Milk and milk drinks-lowfat	1.43
Milk and milk drinks-whole or reduced fat	3.38
100% fruit or vegetable juice	1.88
Sweetened beverages*	6.51
Coffee and tea	1.44
Alcoholic beverages	3.84
Waters, including "enhanced" or "fortified"	0.03
*Breakdown of sweetened beverages category	
Diet soft drinks	0.07
Diet sport and energy drinks	0.00
Other diet drinks	0.02
Soft drinks	3.81
Fruit drinks	2.00
Sport and energy drinks	0.44
Nutritional beverages	0.13
Flavored or carbonated water	0.03

Appendix E-2.10: Percent of total energy intake, 2009-10, for age/sex groups of the U.S. population from WWEIA Food Categories

These data are estimates of the percent of total energy intake from WWEIA Food Categories, regrouped into DGAC major categories and subcategories as described elsewhere, for 2 years and older by age/sex group, based on the day 1 dietary recalls from What We Eat in America, NHANES 2009-2010. Breastfed children have been excluded. The overall sample size is 9,042.

	MALES							
	2+yrs	2-5yrs	6-11yrs	12-19yrs	20-40yrs	41-50yrs	51-70yrs	71+yrs
Major category	% of total energy consumption							
DAIRY	6.29	17.01	11.93	7.52	4.67	4.63	5.73	5.64
PROTEIN FOODS	11.48	9.48	9.25	9.18	11.01	13.25	12.83	13.11
MIXED DISHES	30.18	23.85	28.77	34.57	31.99	29.08	29.15	23.03
GRAINS	9.94	10.87	12.01	9.47	9.78	9.44	8.82	14.65
SNACKS AND SWEETS	15.24	17.65	19.75	17.07	13.11	14.66	15.57	17.37
FRUITS+FRUIT JUICE	4.13	9.20	4.66	3.59	3.44	3.56	4.20	6.62
VEGETABLES	7.18	5.32	4.66	5.02	6.92	8.18	8.72	8.93
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	2.03	1.06	1.78	1.27	1.72	2.65	2.49	2.98
BEVERAGES (Not incl. Milk and 100% Fruit Juice)	13.25	4.97	7.07	12.17	16.94	14.36	12.21	7.61
Total*	99.72	99.40	99.88	99.87	99.59	99.82	99.71	99.94
Subcategory								
LOWFAT MILK/YOGURT	1.66	3.77	3.51	2.13	0.96	1.35	1.62	2.08
HIGHER FAT MILK/YOGURT	3.44	11.41	7.52	4.30	2.50	2.06	2.81	2.87
CHEESE	1.19	1.83	0.90	1.09	1.22	1.23	1.29	0.69
MEATS (Not incl. Deli and Mixed Dishes)	2.41	0.86	1.16	1.66	2.58	3.41	2.55	2.25
DELI/CURED PRODUCTS (Meat and Poultry)	1.42	1.59	1.25	1.15	1.22	1.72	1.58	1.79
POULTRY (Not incl. Deli and Mixed Dishes)	3.39	3.97	4.36	3.73	3.66	2.70	3.08	2.51
SEAFOOD (Not incl. Mixed Dishes)	1.10	0.43	0.58	0.39	0.78	1.55	1.81	1.69
EGGS	1.58	1.64	1.31	1.22	1.60	1.65	1.66	1.99
NUTS, SEEDS, AND SOY	1.58	0.99	0.58	1.04	1.17	2.22	2.16	2.87
PIZZA	4.96	2.58	5.59	7.44	6.18	3.83	3.84	0.58
BURGERS, TACOS, AND SANDWICHES	15.11	11.00	13.54	15.88	15.68	14.96	15.76	12.51
MEAT, POULTRY, SEAFOOD MIXED DISHES	3.91	2.78	1.85	3.99	4.32	4.25	3.65	4.67
RICE, PASTA AND OTHER GRAIN-BASED MIXED DISHES	4.97	6.19	6.62	6.29	4.70	5.22	4.10	3.79
SOUPS	1.23	1.30	1.16	0.97	1.10	0.82	1.80	1.47
RICE AND PASTA	1.50	1.02	1.20	1.59	2.12	1.30	0.84	1.40
YEAST BREADS AND TORTILLAS	3.54	2.87	3.23	3.10	3.31	4.34	3.53	4.60
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	1.83	2.30	3.37	1.95	1.57	1.17	1.75	2.99
BREAKFAST CEREALS AND BARS	3.07	4.68	4.20	2.83	2.78	2.63	2.70	5.65
CHIPS, CRACKERS, AND SAVORY SNACKS	4.42	6.22	6.19	6.06	4.18	4.48	3.47	2.61
DESSERTS AND SWEET SNACKS	8.15	8.18	9.90	8.50	6.68	7.23	9.45	11.54
CANDY AND SUGARS	2.67	3.25	3.67	2.52	2.25	2.96	2.65	3.22
FRUIT (non-juice)	2.36	4.83	2.62	1.79	1.58	2.37	2.79	4.51
100% FRUIT JUICE	1.77	4.37	2.05	1.80	1.86	1.18	1.41	2.10
VEGETABLES (Incl. Beans and Peas, not Starchy)	3.40	2.08	1.35	1.84	3.25	4.26	4.20	5.61
STARCHY VEGETABLES	3.78	3.24	3.32	3.18	3.67	3.92	4.52	3.32

Appendix E-2.10: Percent of total energy intake, 2009-10, for age/sex groups of the U.S. population from WWEIA Food Categories, continued

	MALES							
	2+yrs	2-5yrs	6-11yrs	12-19yrs	20-40yrs	41-50yrs	51-70yrs	71+yrs
	% of Energy consumption							
SUGAR-SWEETENED AND DIET BEVERAGES**	6.82	4.77	6.37	10.26	8.67	6.06	4.19	2.94
COFFEE AND TEA	1.33	0.20	0.65	1.14	1.37	1.60	1.73	0.80
ALCOHOLIC BEVERAGES	5.04	0.00	0.00	0.66	6.83	6.68	6.26	3.86
WATERS	0.05	0.00	0.05	0.11	0.07	0.02	0.03	0.01
CONDIMENTS AND GRAVIES	0.61	0.49	0.66	0.52	0.71	0.60	0.57	0.43
SPREADS	1.12	0.50	0.77	0.54	0.78	1.51	1.62	2.30
SALAD DRESSINGS	0.29	0.07	0.34	0.21	0.23	0.54	0.29	0.25
Total*	99.72	99.40	99.88	99.87	99.59	99.82	99.71	99.94
*Does not include baby foods and infant formulas								
**Additional breakdown for SUGAR-SWEETENED AND DIET BEVERAGES:								
Diet soft drinks	0.06	0.00	0.01	0.02	0.06	0.08	0.10	0.04
Diet sport and energy drinks	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Other diet drinks	0.01	0.03	0.00	0.01	0.01	0.01	0.02	0.00
Soft drinks	4.15	0.92	2.80	6.65	5.61	4.04	2.30	1.62
Fruit drinks	1.82	3.51	2.99	2.29	1.87	1.38	1.32	1.01
Sport and energy drinks	0.58	0.29	0.32	1.16	0.88	0.45	0.18	0.02
Nutritional beverages	0.15	0.00	0.23	0.05	0.17	0.09	0.21	0.19
Flavored or carbonated water	0.05	0.01	0.01	0.07	0.06	0.01	0.05	0.07

Appendix E-2.10. Percent of total energy intake, 2009-10, for age/sex groups of the U.S. population, continued

	FEMALES							
	2+yrs	2-5yrs	6-11yrs	12-19yrs	20-40yrs	41-50yrs	51-70yrs	71+yrs
Major category	**% of total energy consumption**							
DAIRY	7.21	18.82	11.58	7.70	5.74	5.94	6.00	7.12
PROTEIN FOODS	10.39	10.53	8.41	9.60	10.22	10.71	11.62	10.04
MIXED DISHES	27.07	21.65	26.66	30.39	29.55	26.76	24.40	24.27
GRAINS	11.48	11.34	12.94	10.70	10.73	10.96	12.02	13.53
SNACKS AND SWEETS	17.37	17.55	21.84	19.23	14.91	16.66	17.67	19.77
FRUITS+FRUIT JUICE	5.13	8.92	5.20	3.76	4.40	4.84	5.59	7.02
VEGETABLES	8.31	5.23	5.13	6.04	8.70	8.80	9.93	9.63
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	2.73	1.34	1.67	2.01	2.48	3.43	3.55	2.97
BEVERAGES (Not incl. Milk and 100% Fruit Juice)	10.09	4.26	6.46	10.57	13.12	11.41	8.91	5.56
Total*	99.78	99.64	99.87	100.00	99.85	99.51	99.69	99.90
Subcategory	**% of total energy consumption**							
LOWFAT MILK/YOGURT	2.31	3.84	2.86	1.76	1.93	2.14	2.46	3.08
HIGHER FAT MILK/YOGURT	3.48	12.30	7.34	4.73	2.46	2.54	2.00	2.68
CHEESE	1.43	2.68	1.38	1.21	1.35	1.26	1.55	1.37
MEATS (Not incl. Deli and Mixed Dishes)	1.75	0.67	1.09	1.43	1.55	2.44	1.99	2.17
DELI/CURED PRODUCTS (Meat and Poultry)	1.19	2.25	1.19	1.00	1.17	1.08	1.22	1.11
POULTRY (Not incl. Deli and Mixed Dishes)	3.20	4.54	4.26	4.15	3.10	3.04	2.63	2.25
SEAFOOD (Not incl. Mixed Dishes)	1.06	0.46	0.49	0.55	1.09	0.93	1.60	1.42
EGGS	1.43	1.83	0.98	1.24	1.72	1.37	1.38	1.08
NUTS, SEEDS, AND SOY	1.76	0.79	0.40	1.23	1.60	1.86	2.80	2.02
PIZZA	3.38	2.63	5.20	5.23	4.16	2.12	2.46	1.37
BURGERS, TACOS, AND SANDWICHES	12.16	7.80	11.71	12.99	14.24	11.95	10.23	11.69
MEAT, POULTRY, SEAFOOD MIXED DISHES	3.92	2.61	1.84	2.59	3.23	4.80	5.55	5.04
RICE, PASTA AND OTHER GRAIN-BASED MIXED DISHES	6.14	7.55	6.56	8.80	6.30	6.41	4.58	4.19
SOUPS	1.47	1.06	1.34	0.78	1.61	1.49	1.58	1.99
RICE AND PASTA	1.45	1.35	1.49	1.24	1.39	1.84	1.47	1.23
YEAST BREADS AND TORTILLAS	4.02	2.98	4.11	3.63	3.87	4.31	4.23	4.50
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	2.07	1.98	3.39	2.45	1.58	1.72	2.13	2.53
BREAKFAST CEREALS AND BARS	3.94	5.02	3.94	3.38	3.89	3.09	4.20	5.27
CHIPS, CRACKERS, AND SAVORY SNACKS	4.85	4.81	6.52	6.25	4.84	4.40	4.29	3.61
DESSERTS AND SWEET SNACKS	8.96	9.84	11.52	9.21	6.98	8.46	9.33	12.78
CANDY AND SUGARS	3.56	2.90	3.80	3.77	3.08	3.79	4.05	3.38
FRUIT (non-juice)	3.21	4.38	3.19	1.83	2.36	3.43	4.10	4.85
100% FRUIT JUICE	1.92	4.54	2.00	1.94	2.04	1.40	1.49	2.17
VEGETABLES (Incl. Beans and Peas, not Starchy)	4.41	1.75	2.03	2.45	4.24	4.98	6.25	5.64
STARCHY VEGETABLES	3.89	3.48	3.10	3.59	4.46	3.82	3.68	3.99
SUGAR-SWEETENED AND DIET BEVERAGES**	6.11	3.99	6.09	8.52	7.68	6.49	3.92	3.22
COFFEE AND TEA	1.59	0.26	0.32	1.48	2.09	1.61	1.88	1.06

Appendix E-2.10. Percent of total energy intake, 2009-10, for age/sex groups of the U.S. population, continued

	FEMALES							
	2+yrs	2-5yrs	6-11yrs	12-19yrs	20-40yrs	41-50yrs	51-70yrs	71+yrs
ALCOHOLIC BEVERAGES	2.28	0.00	0.00	0.44	3.22	3.14	3.03	1.26
WATERS	0.11	0.00	0.05	0.13	0.13	0.18	0.08	0.01
CONDIMENTS AND GRAVIES	0.76	0.42	0.70	0.78	0.73	1.11	0.75	0.50
SPREADS	1.63	0.68	0.74	1.04	1.40	1.88	2.39	2.17
SALAD DRESSINGS	0.34	0.23	0.23	0.20	0.35	0.44	0.41	0.29
Total*	99.78	99.64	99.87	100.00	99.85	99.51	99.69	99.90

*Does not include baby foods and infant formulas

****Additional breakdown for SUGAR-SWEETENED AND DIET BEVERAGES:**

					% of Energy consumption			
Diet soft drinks	0.08	0.00	0.01	0.03	0.08	0.12	0.13	0.04
Diet sport and energy drinks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other diet drinks	0.02	0.01	0.01	0.02	0.01	0.02	0.04	0.01
Soft drinks	3.38	1.08	2.58	4.44	4.87	4.09	1.73	1.45
Fruit drinks	2.24	2.75	3.25	3.47	2.21	1.84	1.89	1.02
Sport and energy drinks	0.26	0.11	0.23	0.53	0.43	0.17	0.07	0.05
Nutritional beverages	0.11	0.01	0.00	0.02	0.05	0.23	0.05	0.60
Flavored or carbonated water	0.02	0.03	0.01	0.00	0.02	0.01	0.02	0.05

Appendix E-2.11: Percent of total energy intake, 2009-2010, for racial/ethnic groups of the U.S. population, from WWEIA Food Categories

These data are estimates of the percent of total energy intake from WWEIA Food Categories, regrouped into DGAC major categories and subcategories as described elsewhere, fors 2 years and older by racial/ethnic group, based on the day 1 dietary recalls from What We Eat in America, NHANES 2009-2010. Breastfed children have been excluded. The overall sample size is 9,042.

	Non-Hispanic White, MF ages 2+	Non-Hispanic Black, MF ages 2+	Hispanic, MF ages 2+
Major category		**% of total energy consumption**	
DAIRY	6.69	4.42	7.04
PROTEIN FOODS	11.00	14.60	12.20
MIXED DISHES	29.26	9.20	27.29
GRAINS	10.61	27.06	13.13
SNACKS AND SWEETS	16.17	17.52	13.50
FRUITS+FRUIT JUICE	4.57	4.97	5.54
VEGETABLES	7.67	7.36	7.00
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	2.34	1.69	1.72
BEVERAGES (Not incl. Milk and 100% Fruit Juice)	11.83	12.95	12.28
Total*	99.71	99.78	99.69
Subcategory		**% of total energy consumption**	
LOWFAT MILK/YOGURT	2.34	0.77	1.31
HIGHER FAT MILK/YOGURT	3.29	2.85	4.44
CHEESE	1.43	0.79	1.29
MEATS (Not incl. Deli and Mixed Dishes)	1.89	2.62	2.83
DELI/CURED PRODUCTS (Meat and Poultry)	1.37	1.76	0.89
POULTRY (Not incl. Deli and Mixed Dishes)	2.60	6.33	4.17
SEAFOOD (Not incl. Mixed Dishes)	1.09	1.12	0.88
EGGS	1.29	1.67	2.56
NUTS, SEEDS, AND SOY	1.98	1.09	0.87
PIZZA	4.67	3.26	3.53
BURGERS, TACOS, AND SANDWICHES	14.63	14.06	11.68
MEAT, POULTRY, SEAFOOD MIXED DISHES	3.97	3.27	3.12
RICE, PASTA AND OTHER GRAIN-BASED MIXED DISHES	4.99	5.70	6.45
SOUPS	1.00	0.77	2.52
RICE AND PASTA	0.86	1.48	1.77
YEAST BREADS AND TORTILLAS	3.19	2.24	7.23
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	2.06	2.31	1.36
BREAKFAST CEREALS AND BARS	3.67	3.18	2.76
CHIPS, CRACKERS, AND SAVORY SNACKS	4.87	5.01	3.57
DESSERTS AND SWEET SNACKS	8.76	9.16	7.65
CANDY AND SUGARS	3.13	3.35	2.27
FRUIT (non-juice)	2.76	2.03	2.83
100% FRUIT JUICE	1.45	2.94	2.72
VEGETABLES (Incl. Beans and Peas, not Starchy)	3.99	3.08	3.97
STARCHY VEGETABLES	3.95	4.28	3.03
SUGAR-SWEETENED AND DIET BEVERAGES	6.00	7.89	8.05
COFFEE AND TEA	1.54	1.37	1.28
ALCOHOLIC BEVERAGES	4.25	3.68	2.94
WATERS	0.05	0.01	0.01
CONDIMENTS AND GRAVIES	0.74	0.47	0.59
SPREADS	1.55	0.93	0.87
SALAD DRESSINGS	0.33	0.29	0.26
Total*	99.71	99.78	99.69

*Does not include baby foods and infant formulas

Appendix E-2.12: Percent of total energy intake, 2009-2010, for age/income groups of the U.S. population, from WWEIA Food Categories

These data are estimates of the percent of total energy intake from WWEIA Food Categories, regrouped into DGAC major categories and subcategories as described elsewhere, for 2 years and older by age/income group, based on the day 1 dietary recalls from What We Eat in America, NHANES 2009-2010. Breastfed children have been excluded. The overall sample size is 9,042.

	Income less than or equal to 185% of the Poverty Index Ratio				Income greater than 185% of the Poverty Index Ratio			
	MF 2-11	MF 12-19	MF 20+	MF 2+	MF 2-11	MF 12-19	MF 20+	MF 2+
Major category	**% of total energy consumption**							
DAIRY	13.69	7.85	5.49	7.10	14.35	7.27	5.52	6.51
PROTEIN FOODS	9.92	8.72	11.54	10.90	8.27	9.95	11.47	11.02
MIXED DISHES	27.12	31.50	28.10	28.40	25.30	33.72	29.22	29.31
GRAINS	10.36	9.45	10.69	10.47	13.17	10.29	10.14	10.44
SNACKS AND SWEETS	18.65	18.11	14.43	15.59	20.89	17.85	15.78	16.46
FRUITS+FRUIT JUICE	6.15	3.71	4.36	4.55	6.39	3.47	4.38	4.47
VEGETABLES	5.49	5.84	8.09	7.38	4.41	5.20	8.54	7.82
CONDIMENTS, GRAVIES, SPREADS, SALAD DRESSINGS	1.41	1.61	2.12	1.94	1.70	1.43	2.86	2.60
BEVERAGES (Not incl. Milk and 100% Fruit Juice)	6.89	13.17	14.95	13.44	5.33	10.73	11.80	11.09
Total*	99.68	99.96	99.76	99.77	99.81	99.92	99.71	99.74
Subcategory	**% of total energy consumption**							
LOWFAT MILK/YOGURT	2.40	1.23	1.08	1.31	4.45	2.56	2.05	2.32
HIGHER FAT MILK/YOGURT	9.88	5.34	3.29	4.60	8.26	3.62	2.05	2.79
CHEESE	1.41	1.28	1.13	1.19	1.64	1.09	1.42	1.40
MEATS (Not incl. Deli and Mixed Dishes)	1.28	1.72	2.63	2.29	0.75	1.49	2.22	2.01
DELI/CURED PRODUCTS (Meat and Poultry)	1.57	0.80	1.45	1.38	1.24	1.49	1.29	1.31
POULTRY (Not incl. Deli and Mixed Dishes)	4.71	4.06	3.51	3.78	3.91	3.96	2.83	3.05
SEAFOOD (Not incl. Mixed Dishes)	0.33	0.28	1.08	0.85	0.45	0.59	1.34	1.18
EGGS	1.61	1.17	1.63	1.57	1.02	1.22	1.52	1.44
NUTS, SEEDS, AND SOY	0.43	0.70	1.23	1.03	0.91	1.20	2.28	2.04
PIZZA	5.07	5.99	2.84	3.62	3.99	7.20	4.39	4.64
BURGERS, TACOS, AND SANDWICHES	12.32	14.63	14.33	14.05	11.31	14.95	14.04	13.88
MEAT, POULTRY, SEAFOOD MIXED DISHES	1.95	2.51	3.94	3.43	2.29	3.96	4.59	4.31
RICE, PASTA AND OTHER GRAIN-BASED MIXED DISHES	6.23	7.33	5.31	5.73	6.94	6.95	4.95	5.33
SOUPS	1.55	1.04	1.68	1.57	0.77	0.67	1.25	1.15
RICE AND PASTA	1.19	1.23	1.79	1.62	1.02	1.34	1.27	1.26
YEAST BREADS AND TORTILLAS	2.80	3.29	4.20	3.86	3.91	3.38	3.56	3.58
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	1.99	1.84	1.81	1.84	3.95	2.44	1.72	2.00
BREAKFAST CEREALS AND BARS	4.38	3.08	2.90	3.15	4.28	3.14	3.59	3.61
CHIPS, CRACKERS, AND SAVORY SNACKS	5.38	6.74	3.84	4.47	6.68	5.65	4.43	4.76

Appendix E-2.12: Percent of total energy intake, 2009-2010, for age/income groups of the U.S. population, from WWEIA Food Categories, continued

	Income less than or equal to 185% of the Poverty Index Ratio				Income greater than 185% of the Poverty Index Ratio			
	MF 2-11	MF 12-19	MF 20+	MF 2+	MF 2-11	MF 12-19	MF 20+	MF 2+
DESSERTS AND SWEET SNACKS	10.11	8.35	7.58	8.08	10.10	9.01	8.37	8.60
CANDY AND SUGARS	3.16	3.01	3.02	3.04	4.11	3.19	2.98	3.11
FRUIT (non-juice)	3.20	1.57	2.26	2.32	3.66	1.91	2.97	2.92
100% FRUIT JUICE	2.95	2.14	2.10	2.24	2.73	1.57	1.41	1.55
VEGETABLES (Incl. Beans and Peas, not Starchy)	1.78	2.13	3.80	3.26	1.63	2.13	4.65	4.11
STARCHY VEGETABLES	3.72	3.71	4.29	4.12	2.78	3.06	3.90	3.71
SUGAR-SWEETENED AND DIET BEVERAGES**	6.39	10.99	8.64	8.60	4.96	8.96	4.91	5.33
COFFEE AND TEA	0.45	1.17	1.79	1.49	0.34	1.36	1.53	1.40
ALCOHOLIC BEVERAGES	0.00	0.84	4.46	3.28	0.00	0.30	5.26	4.27
WATERS	0.04	0.17	0.05	0.07	0.02	0.11	0.09	0.09
CONDIMENTS AND GRAVIES	0.63	0.86	0.62	0.66	0.60	0.48	0.76	0.72
SPREADS	0.52	0.46	1.27	1.04	0.86	0.77	1.67	1.51
SALAD DRESSINGS	0.27	0.28	0.23	0.24	0.23	0.18	0.42	0.38
Total*	99.68	99.96	99.76	99.77	99.81	99.92	99.71	99.74

*Does not include baby foods and infant formulas

****Additional breakdown for SUGAR-SWEETENED AND DIET BEVERAGES:**

	% of total energy consumption							
Diet soft drinks	0.00	0.01	0.05	0.04	0.01	0.05	0.11	0.09
Diet sport and energy drinks	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Other diet drinks	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Soft drinks	2.42	7.05	5.75	5.40	1.89	5.04	2.82	2.96
Fruit drinks	3.68	3.15	2.13	2.51	2.61	2.64	1.43	1.66
Sport and energy drinks	0.24	0.71	0.45	0.46	0.29	1.11	0.36	0.43
Nutritional beverages	0.03	0.03	0.23	0.17	0.14	0.05	0.12	0.12
Flavored or carbonated water	0.01	0.03	0.01	0.01	0.01	0.05	0.05	0.05

Appendix E-2.13: Percent of total energy intake obtained from major points of purchase and location of eating

Data from NHANES 2003-04, 2005-06, 2007-08, 2009-10, day 1 reliable intakes, population 2+
Calculated as percent of the total calories obtained from each point of purchase and
from each eating location

	2003-04	2005-06	2007-08	2009-10
Point of purchase				
Store	65%	65%	67%	69%
Restaurant	10%	10%	10%	8%
Quick serve restaurant	17%	16%	14%	14%
School/day care	2%	2%	2%	2%
Other	6%	8%	7%	7%
Don't know/missing	0%	0%	0%	0%
Eating location				
at home	63%	63%	65%	67%
away from home	37%	37%	35%	33%
Don't know/missing	0%	0%	0%	0%
Point of purchase by eating location				
Store, at home	54%	57%	56%	58%
Store, not at home	12%	12%	11%	11%
Restaurant, at home	1%	2%	2%	2%
Restaurant, not at home	9%	9%	8%	7%
Quick serve restaurant, at home	6%	6%	5%	5%
Quick serve restaurant, not at home	11%	11%	9%	9%
school/day care, at home	0%	0%	0%	0%
school/day care, not at home	2%	2%	2%	2%
other, at home	2%	0%	2%	2%
other, not at home	4%	0%	5%	5%

Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase

Data from NHANES 2003-04, 2005-06, 2007-08, 2009-10, day 1 reliable intakes, population 2+
Calculated as mean nutrient or food group intake per person from each point of purchase,
divided by calories/1000 from that source (missing food sources not replaced with zero)

Point of purchase	**2003-04**	**2005-06**	**2007-08**	**2009-10**
	SODIUM (mg/1000 kcal)			
Store	1459	1467	1492	1579
Restaurant	1881	1956	2017	1936
Quick serve restaurant	1742	1807	1798	1884
School/day care	1613	1653	1677	1667
Other	1467	1590	1574	1595
	SATURATED FAT (g/1000 kcal)			
Store	12.05	12.39	12.07	11.79
Restaurant	12.62	12.92	13.41	13.24
Quick serve restaurant	14.48	14.76	14.90	13.87
School/day care	14.74	14.09	14.08	13.65
Other	12.56	13.08	13.02	12.29
	FIBER (g/1000 kcal)			
Store	7.15	7.38	7.82	8.33
Restaurant	5.95	6.46	6.40	6.18
Quick serve restaurant	5.64	5.86	5.66	6.16
School/day care	6.81	6.67	7.31	7.61
Other	7.10	6.95	7.38	7.56
	CALCIUM (mg/1000 kcal)			
Store	454	483	484	524
Restaurant	299	309	321	355
Quick serve restaurant	365	361	374	404
School/day care	654	614	654	722
Other	292	375	385	365
	POTASSIUM (mg/1000kcal)			
Store	1276	1301	1288	1351
Restaurant	1091	1113	1144	1097
Quick serve restaurant	929	922	916	974
School/day care	1301	1282	1312	1309
Other	1193	1184	1179	1227
	TOTAL FRUIT (whole + juice) (cup eq/1000 kcal)			
Store	0.59	0.59	0.62	0.64
Restaurant	0.13	0.11	0.11	0.13
Quick serve restaurant	0.10	0.07	0.09	0.10
School/day care	0.60	0.62	0.67	0.77
Other	0.52	0.41	0.56	0.56
	TOTAL VEGETABLES (cup eq/1000 kcal)			
Store	0.60	0.59	0.61	0.64
Restaurant	1.01	0.97	1.00	0.90
Quick serve restaurant	0.76	0.74	0.66	0.68
School/day care	0.55	0.54	0.52	0.41
Other	0.81	0.88	0.82	0.88

Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase, continued

Point of purchase	2003-04	2005-06	2007-08	2009-10
	DARK GREEN VEGETABLES (cup eq/1000 kcal)			
Store	0.04	0.05	0.05	0.06
Restaurant	0.07	0.08	0.09	0.09
Quick serve restaurant	0.02	0.02	0.03	0.03
School/day care	0.01	0.02	0.01	0.02
Other	0.05	0.08	0.07	0.07
	RED AND ORANGE VEGETABLES (cup eq/1000 kcal)			
Store	n/a	0.16	0.16	0.16
Restaurant	n/a	0.23	0.23	0.20
Quick serve restaurant	n/a	0.22	0.17	0.17
School/day care	n/a	0.19	0.17	0.14
Other	n/a	0.23	0.22	0.22
	STARCHY VEGETABLES (cup eq/1000 kcal)			
Store	0.20	0.18	0.20	0.19
Restaurant	0.23	0.24	0.26	0.24
Quick serve restaurant	0.24	0.22	0.23	0.23
School/day care	0.16	0.17	0.21	0.12
Other	0.22	0.23	0.25	0.25
	OTHER VEGETABLES (cup eq/1000 kcal)			
Store	0.20	0.20	0.20	0.22
Restaurant	0.44	0.42	0.42	0.38
Quick serve restaurant	0.26	0.28	0.23	0.25
School/day care	0.16	0.16	0.13	0.12
Other	0.32	0.33	0.27	0.35
	TOTAL GRAINS (ounce eq/1000 kcal)			
Store	3.06	2.99	3.01	3.10
Restaurant	2.88	3.10	2.93	2.93
Quick serve restaurant	3.81	3.83	3.59	3.73
School/day care	3.26	3.27	3.15	3.63
Other	2.68	2.78	2.80	2.71
	WHOLE GRAINS (ounce eq/1000 kcal)			
Store	0.37	0.43	0.42	0.50
Restaurant	0.07	0.07	0.10	0.09
Quick serve restaurant	0.06	0.08	0.07	0.08
School/day care	0.11	0.13	0.17	0.17
Other	0.15	0.16	0.14	0.17
	REFINED GRAINS (ounce eq/1000 kcal)			
Store	2.69	2.56	2.60	2.60
Restaurant	2.81	3.03	2.83	2.84
Quick serve restaurant	3.74	3.75	3.51	3.66
School/day care	3.15	3.15	2.98	3.46
Other	2.53	2.62	2.66	2.54

Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase, continued

Point of purchase	2003-04	2005-06	2007-08	2009-10
	TOTAL DAIRY (cup eq/1000 kcal)			
Store	0.88	0.92	0.88	0.95
Restaurant	0.50	0.49	0.53	0.61
Quick serve restaurant	0.72	0.70	0.72	0.77
School/day care	1.80	1.69	1.72	1.95
Other	0.40	0.60	0.59	0.53
	MILK (cup eq/1000 kcal)			
Store	0.62	0.62	0.58	0.59
Restaurant	0.10	0.11	0.12	0.11
Quick serve restaurant	0.10	0.14	0.12	0.13
School/day care	1.28	1.24	1.27	1.35
Other	0.21	0.33	0.27	0.26
	CHEESE (cup eq/1000 kcal)			
Store	0.23	0.26	0.26	0.32
Restaurant	0.39	0.37	0.41	0.49
Quick serve restaurant	0.61	0.56	0.59	0.63
School/day care	0.50	0.41	0.44	0.58
Other	0.19	0.25	0.30	0.25
	TOTAL PROTEIN FOODS (oz eq/1000 kcal)			
Store	2.36	2.51	2.53	2.62
Restaurant	3.45	3.47	3.69	3.54
Quick serve restaurant	2.64	2.84	2.84	3.01
School/day care	1.83	1.92	2.10	1.79
Other	2.95	3.03	2.75	2.95
	RED MEATS (oz eq/1000 kcal)			
Store	0.69	0.65	0.66	0.64
Restaurant	1.32	1.12	1.12	1.03
Quick serve restaurant	1.06	1.06	0.95	0.89
School/day care	0.71	0.45	0.50	0.56
Other	0.98	0.89	0.80	1.02
	ADDED SUGARS (tsp/1000 kcal)			
Store	10.31	9.79	9.84	9.16
Restaurant	6.80	6.01	5.24	6.15
Quick serve restaurant	8.41	7.75	8.27	7.65
School/day care	7.13	7.53	7.11	6.80
Other	10.06	10.07	10.48	10.17

Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase, continued

Point of purchase	**2003-04**	**2005-06**	**2007-08**	**2009-10**
	SOLID FATS (g/1000 kcal)			
Store	19.72	17.98	17.66	16.70
Restaurant	22.39	19.03	20.02	20.11
Quick serve restaurant	28.21	23.08	23.22	21.96
School/day care	25.99	21.83	20.89	21.43
Other	22.06	21.56	21.52	19.23
	OILS (g/1000 kcal)			
Store	8.57	9.15	9.14	9.65
Restaurant	10.21	13.68	13.52	12.96
Quick serve restaurant	8.57	12.15	12.67	12.49
School/day care	6.92	9.06	10.10	7.34
Other	9.68	9.94	8.67	11.05

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase

Data from NHANES 2003-04, 2005-06, 2007-08, 2009-10, day 1 reliable intakes, population 2+
Calculated as mean nutrient or food group intake per person from each point of purchase, divided by calories/1000 from that source (missing food sources not replaced with zero)

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
		SODIUM (mg/1000 kcal)			
2-5	Store	1404	1404	1415	1451
2-5	Full service restaurant	2383	1856	2225	2167
2-5	Quick serve restaurant	1635	1616	1582	1660
2-5	School/day care	1472	1494	1448	1537
6-11	Store	1432	1531	1476	1566
6-11	Full service restaurant	1948	1656	1873	1808
6-11	Quick serve restaurant	1638	1629	1526	1763
6-11	School/day care	1607	1620	1631	1580
12-19	Store	1420	1443	1528	1583
12-19	Full service restaurant	1926	2058	2084	1740
12-19	Quick serve restaurant	1694	1702	1764	1788
12-19	School/day care	1657	1685	1772	1795
20-40	Store	1454	1482	1474	1565
20-40	Full service restaurant	1825	1898	1952	1819
20-40	Quick serve restaurant	1734	1799	1801	1885
41-50	Store	1405	1405	1478	1590
41-50	Full service restaurant	1761	1964	2111	2132
41-50	Quick serve restaurant	1738	1935	1845	1909
51-70	Store	1540	1486	1525	1606
51-70	Full service restaurant	1979	2013	1991	2033
51-70	Quick serve restaurant	1883	1917	1901	1999
71+	Store	1502	1483	1511	1614
71+	Full service restaurant	2144	2200	2215	2068
71+	Quick serve restaurant	1874	1756	1963	1974
		SATURATED FAT (g/1000 kcal)			
2-5	Store	13.20	12.72	13.18	13.17
2-5	Full service restaurant	11.96	14.55	14.03	13.39
2-5	Quick serve restaurant	14.46	14.00	15.19	12.59
2-5	School/day care	14.94	12.82	12.80	13.10
6-11	Store	12.56	13.01	12.74	12.15
6-11	Full service restaurant	14.45	14.80	12.52	13.21
6-11	Quick serve restaurant	13.99	15.19	15.18	13.70
6-11	School/day care	14.67	14.94	14.04	13.44
12-19	Store	12.02	12.36	12.15	11.86
12-19	Full service restaurant	14.21	13.73	14.37	14.51
12-19	Quick serve restaurant	14.38	14.61	14.77	13.93
12-19	School/day care	14.28	13.97	14.47	14.23
20-40	Store	11.66	12.18	11.42	11.17
20-40	Full service restaurant	12.34	12.44	12.38	12.79

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase, continued

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
		SATURATED FAT (g/1000 kcal)			
20-40	Quick serve restaurant	14.28	14.83	14.90	13.85
41-50	Store	12.12	12.02	12.36	11.78
41-50	Full service restaurant	11.32	12.67	14.29	12.33
41-50	Quick serve restaurant	14.78	14.66	14.56	13.81
51-70	Store	12.16	12.63	12.29	12.16
51-70	Full service restaurant	13.29	12.84	13.95	13.90
51-70	Quick serve restaurant	15.09	14.79	14.97	14.17
71+	Store	12.04	12.60	11.92	11.87
71+	Full service restaurant	13.09	14.30	13.63	13.97
71+	Quick serve restaurant	15.00	14.68	16.19	14.14
		TOTAL FRUIT (cup eq/1000 kcal)			
2-5	Store	1.00	1.03	1.07	1.06
2-5	Full service restaurant	0.23	0.14	0.05	0.30
2-5	Quick serve restaurant	0.06	0.11	0.34	0.15
2-5	School/day care	0.98	1.13	1.14	1.00
6-11	Store	0.55	0.61	0.67	0.65
6-11	Full service restaurant	0.09	0.17	0.17	0.18
6-11	Quick serve restaurant	0.04	0.08	0.14	0.14
6-11	School/day care	0.65	0.59	0.68	0.90
12-19	Store	0.53	0.53	0.55	0.53
12-19	Full service restaurant	0.11	0.10	0.11	0.12
12-19	Quick serve restaurant	0.09	0.05	0.05	0.09
12-19	School/day care	0.44	0.52	0.43	0.53
20-40	Store	0.47	0.46	0.55	0.55
20-40	Full service restaurant	0.10	0.09	0.13	0.14
20-40	Quick serve restaurant	0.12	0.07	0.08	0.09
41-50	Store	0.60	0.58	0.48	0.61
41-50	Full service restaurant	0.12	0.09	0.06	0.11
41-50	Quick serve restaurant	0.11	0.08	0.07	0.11
51-70	Store	0.65	0.67	0.67	0.69
51-70	Full service restaurant	0.24	0.12	0.11	0.10
51-70	Quick serve restaurant	0.09	0.09	0.12	0.12
71+	Store	0.81	0.80	0.80	0.84
71+	Full service restaurant	0.08	0.24	0.14	0.06
71+	Quick serve restaurant	0.17	0.09	0.05	0.14
		TOTAL VEGETABLES (cup eq/1000 kcal)			
2-5	Store	0.40	0.42	0.43	0.38
2-5	Full service restaurant	0.99	0.67	0.94	0.73
2-5	Quick serve restaurant	0.83	0.71	0.52	0.64
2-5	School/day care	0.50	0.50	0.51	0.47
6-11	Store	0.44	0.39	0.41	0.40
6-11	Full service restaurant	0.71	0.57	0.59	0.57
6-11	Quick serve restaurant	0.61	0.56	0.52	0.59

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase, continued

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
		TOTAL VEGETABLES (cup eq/1000 kcal)			
6-11	School/day care	0.46	0.47	0.47	0.33
12-19	Store	0.46	0.43	0.44	0.47
12-19	Full service restaurant	0.75	0.80	0.88	0.64
12-19	Quick serve restaurant	0.66	0.64	0.58	0.54
12-19	School/day care	0.59	0.59	0.52	0.44
20-40	Store	0.60	0.59	0.59	0.60
20-40	Full service restaurant	1.00	0.93	0.92	0.81
20-40	Quick serve restaurant	0.77	0.76	0.69	0.67
41-50	Store	0.62	0.59	0.63	0.74
41-50	Full service restaurant	0.83	0.94	1.02	0.98
41-50	Quick serve restaurant	0.80	0.79	0.66	0.68
51-70	Store	0.75	0.72	0.77	0.79
51-70	Full service restaurant	1.35	1.17	1.14	1.06
51-70	Quick serve restaurant	0.83	0.79	0.77	0.84
71+	Store	0.73	0.75	0.78	0.80
71+	Full service restaurant	1.20	1.29	1.29	1.22
71+	Quick serve restaurant	1.09	0.71	0.66	0.69
		TOTAL DAIRY (cup eq/1000 kcal)			
2-5	Store	1.50	1.49	1.54	1.65
2-5	Full service restaurant	0.42	1.17	1.05	1.28
2-5	Quick serve restaurant	0.69	0.83	0.98	0.74
2-5	School/day care	2.08	1.69	1.85	1.96
6-11	Store	1.13	1.13	0.99	1.17
6-11	Full service restaurant	1.09	0.75	0.66	0.94
6-11	Quick serve restaurant	0.76	0.82	0.90	0.85
6-11	School/day care	2.09	2.17	1.97	2.17
12-19	Store	1.00	0.98	1.02	1.05
12-19	Full service restaurant	0.67	0.61	0.69	0.75
12-19	Quick serve restaurant	0.78	0.76	0.75	0.75
12-19	School/day care	1.53	1.30	1.45	1.75
20-40	Store	0.84	0.88	0.79	0.88
20-40	Full service restaurant	0.50	0.49	0.51	0.63
20-40	Quick serve restaurant	0.70	0.69	0.74	0.79
41-50	Store	0.66	0.87	0.77	0.86
41-50	Full service restaurant	0.44	0.42	0.53	0.44
41-50	Quick serve restaurant	0.78	0.72	0.72	0.77
51-70	Store	0.75	0.81	0.84	0.87
51-70	Full service restaurant	0.39	0.44	0.47	0.56
51-70	Quick serve restaurant	0.68	0.63	0.51	0.76
71+	Store	0.90	0.93	0.88	0.91
71+	Full service restaurant	0.39	0.38	0.49	0.49
71+	Quick serve restaurant	0.43	0.52	0.71	0.52

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase, continued

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
		TOTAL PROTEIN FOODS (oz eq/1000 kcal)			
2-5	Store	1.62	1.83	1.89	1.92
2-5	Full service restaurant	3.56	1.50	2.50	2.48
2-5	Quick serve restaurant	2.24	2.14	2.06	2.26
2-5	School/day care	1.45	1.57	1.73	1.38
6-11	Store	1.85	1.95	2.08	2.00
6-11	Full service restaurant	2.13	2.18	3.00	2.75
6-11	Quick serve restaurant	1.96	2.21	2.10	2.46
6-11	School/day care	1.87	1.68	1.96	1.66
12-19	Store	2.06	2.11	2.13	2.28
12-19	Full service restaurant	2.96	3.29	3.76	2.98
12-19	Quick serve restaurant	2.33	2.36	2.57	2.81
12-19	School/day care	1.76	2.24	2.35	2.07
20-40	Store	2.34	2.67	2.62	2.65
20-40	Full service restaurant	3.56	3.27	3.34	3.33
20-40	Quick serve restaurant	2.65	2.84	2.78	2.89
41-50	Store	2.44	2.62	2.75	2.90
41-50	Full service restaurant	3.27	4.29	3.94	3.81
41-50	Quick serve restaurant	2.76	3.11	3.07	3.29
51-70	Store	2.89	2.77	2.73	2.86
51-70	Full service restaurant	3.77	3.44	4.12	3.94
51-70	Quick serve restaurant	3.08	3.40	3.39	3.37
71+	Store	2.45	2.45	2.55	2.66
71+	Full service restaurant	3.84	4.17	3.70	4.14
71+	Quick serve restaurant	3.91	3.39	3.31	3.98
		WHOLE GRAINS (oz eq/1000 kcal)			
2-5	Store	0.31	0.38	0.37	0.55
2-5	Full service restaurant	0.04	0.06	0.04	0.02
2-5	Quick serve restaurant	0.04	0.04	0.06	0.07
2-5	School/day care	0.15	0.25	0.17	0.25
6-11	Store	0.35	0.34	0.38	0.46
6-11	Full service restaurant	0.03	0.01	0.01	0.06
6-11	Quick serve restaurant	0.07	0.08	0.03	0.03
6-11	School/day care	0.15	0.13	0.18	0.16
12-19	Store	0.24	0.29	0.37	0.36
12-19	Full service restaurant	0.05	0.04	0.03	0.08
12-19	Quick serve restaurant	0.06	0.04	0.06	0.06
12-19	School/day care	0.05	0.08	0.08	0.14
20-40	Store	0.31	0.36	0.35	0.47
20-40	Full service restaurant	0.03	0.04	0.14	0.07
20-40	Quick serve restaurant	0.05	0.07	0.05	0.07
41-50	Store	0.33	0.51	0.34	0.48
41-50	Full service restaurant	0.09	0.04	0.06	0.14
41-50	Quick serve restaurant	0.11	0.11	0.10	0.15

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase, continued

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
		WHOLE GRAINS (oz eq/1000 kcal)			
51-70	Store	0.50	0.53	0.54	0.58
51-70	Full service restaurant	0.14	0.15	0.10	0.11
51-70	Quick serve restaurant	0.07	0.09	0.13	0.05
71+	Store	0.63	0.65	0.63	0.65
71+	Full service restaurant	0.17	0.11	0.11	0.11
71+	Quick serve restaurant	0.02	0.33	0.10	0.12
		REFINED GRAINS (oz eq/1000 kcal)			
2-5	Store	2.67	2.48	2.52	2.50
2-5	Full service restaurant	3.61	4.13	2.82	3.17
2-5	Quick serve restaurant	3.49	3.13	3.14	3.00
2-5	School/day care	2.71	3.37	3.07	3.30
6-11	Store	2.94	3.14	2.96	3.29
6-11	Full service restaurant	3.62	3.61	3.43	3.22
6-11	Quick serve restaurant	3.79	3.41	3.17	3.27
6-11	School/day care	3.09	2.93	2.91	3.37
12-19	Store	2.96	2.88	3.08	3.12
12-19	Full service restaurant	3.28	3.41	3.01	3.00
12-19	Quick serve restaurant	3.85	3.91	3.63	3.75
12-19	School/day care	3.36	3.41	3.13	3.57
20-40	Store	2.71	2.50	2.62	2.62
20-40	Full service restaurant	2.72	3.09	2.93	2.68
20-40	Quick serve restaurant	3.78	3.79	3.58	3.80
41-50	Store	2.42	2.36	2.43	2.44
41-50	Full service restaurant	2.63	2.59	2.82	3.10
41-50	Quick serve restaurant	3.63	3.66	3.68	3.45
51-70	Store	2.57	2.39	2.36	2.27
51-70	Full service restaurant	2.70	2.99	2.56	2.83
51-70	Quick serve restaurant	3.74	3.76	3.31	3.64
71+	Store	2.75	2.45	2.55	2.50
71+	Full service restaurant	2.95	2.46	2.86	2.76
71+	Quick serve restaurant	3.42	3.06	3.41	3.80
		SOLID FATS (g/1000 kcal)			
2-5	Store	22.67	18.22	19.06	18.50
2-5	Full service restaurant	20.31	22.35	19.60	19.41
2-5	Quick serve restaurant	29.91	19.46	21.94	21.03
2-5	School/day care	27.65	19.18	19.20	19.62
6-11	Store	21.56	19.53	19.12	17.99
6-11	Full service restaurant	26.93	23.01	18.35	19.33
6-11	Quick serve restaurant	27.37	22.33	22.89	21.72
6-11	School/day care	25.48	22.14	21.03	20.89
12-19	Store	19.37	18.37	18.14	16.92
12-19	Full service restaurant	25.18	20.64	21.41	22.72
12-19	Quick serve restaurant	27.94	23.69	23.66	22.27

Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 kcal from each point of purchase, continued

Age Group (yrs)	Point of Purchase	2003-04	2005-06	2007-08	2009-10
			SOLID FATS (g/1000 kcal)		
12-19	School/day care	25.36	22.24	21.43	23.06
20-40	Store	19.08	17.60	16.47	15.68
20-40	Full service restaurant	21.39	18.68	18.27	19.30
20-40	Quick serve restaurant	27.60	23.20	22.84	22.00
41-50	Store	19.52	16.95	18.02	16.80
41-50	Full service restaurant	21.36	17.96	21.35	17.88
41-50	Quick serve restaurant	28.55	23.01	22.81	20.61
51-70	Store	19.59	18.16	18.00	17.01
51-70	Full service restaurant	23.01	18.43	20.90	21.54
51-70	Quick serve restaurant	29.93	22.88	24.01	22.78
71+	Store	19.88	18.71	17.60	17.03
71+	Full service restaurant	24.15	21.44	22.01	22.52
71+	Quick serve restaurant	29.03	22.97	26.82	24.14
			ADDED SUGARS (tsp/1000 kcal)		
2-5	Store	9.39	8.89	8.60	8.10
2-5	Full service restaurant	5.98	7.77	8.43	6.82
2-5	Quick serve restaurant	7.11	8.52	7.64	8.15
2-5	School/day care	6.75	6.19	6.64	6.32
6-11	Store	11.76	10.14	11.14	9.74
6-11	Full service restaurant	9.28	10.73	9.83	9.75
6-11	Quick serve restaurant	9.89	9.28	10.84	9.14
6-11	School/day care	6.99	7.44	6.85	7.12
12-19	Store	12.49	12.64	11.28	11.43
12-19	Full service restaurant	8.70	7.84	7.54	10.76
12-19	Quick serve restaurant	9.42	9.13	9.93	8.15
12-19	School/day care	7.69	7.36	7.80	6.86
20-40	Store	11.24	10.04	10.64	9.82
20-40	Full service restaurant	7.33	5.96	4.99	6.32
20-40	Quick serve restaurant	8.73	7.47	8.73	7.89
41-50	Store	10.20	9.72	10.29	8.86
41-50	Full service restaurant	6.21	4.95	4.76	5.87
41-50	Quick serve restaurant	7.89	7.05	6.81	7.32
51-70	Store	8.14	8.20	8.26	8.07
51-70	Full service restaurant	5.44	5.34	4.57	4.46
51-70	Quick serve restaurant	6.77	6.64	6.28	6.59
71+	Store	7.74	7.73	7.49	7.08
71+	Full service restaurant	4.81	5.57	4.56	5.04
71+	Quick serve restaurant	6.07	7.84	6.45	6.01

Appendix E-2.16: Body Mass Index (BMI), 2009-2012[1, 2, 3] Adults 20 y and over, age adusted

		Body Mass Index (BMI) category							
	Sample size	*BMI <18.5*	*SE*	*18.5≤ BMI <25*	*SE*	*25≤ BMI <30*	*SE*	*BMI ≥30*	*SE*
		%		*%*		*%*		*%*	
20 y and over	11107	1.8	0.2	29.6	0.9	33.3	0.8	35.3	0.8
Gender									
Men	5474	0.9	0.1	26.5	1.1	38.1	0.9	34.5	1.1
Women	5633	2.6	0.3	32.6	1	28.8	1.1	36	1
Age, y									
20-39 y	3765	2.2	0.2	36.8	1.8	29.5	1.2	31.5	1.3
40-59 y	3732	1.5	0.3	24.5	1	35.9	1.2	38	1
≥60 y	3610	1.4	0.2	25.4	1.1	35.7	1.1	37.5	1.3
Race-Hispanic origin[4]									
Non-Hispanic white	4741	1.8	0.2	31.2	1.2	33.5	1.1	33.4	1.1
Non-Hispanic black	2438	1.9	0.3	21.7	0.9	27.7	1.1	48.7	1.4
Hispanic	2719	0.7	0.2	21	1	37.5	1.2	40.8	1.2
Race-Hispanic origin by gender[4]									
Men, Non-Hispanic white	2356	0.6	0.2	26.7	1.5	38.4	1.1	34.3	1.3
Men, Non-Hispanic black	1199	1.9	0.4	28.5	1.1	31.7	1.5	37.9	1.5
Men, Hispanic	1317	**	-	19.4	1.4	41.5	1.5	38.5	1.5
Women, Non-Hispanic white	2385	3	0.5	35.7	1.4	28.8	1.7	32.5	1.5
Women, Non-Hispanic black	1239	1.9	0.4	16.2	1.2	24.5	1.4	57.5	1.7
Women, Hispanic	1402	*0.8	0.2	22.7	1.1	33.5	1.4	43	1.5

[1] Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared rounded to one decimal place.

[2] Estimates age-adjusted to the year 2000 standard population using 3 age groups: 20–39 yrs, 40–59 yrs, and 60 yrs and over, and weighted.

[3] All pregnant women excluded from analysis.

[4] Participants with a race-Hispanic origin categorized as “other” are included in overall estimates but are not separately reported.

NOTES: SE, standard error; * Relative Standard Error >30 but less than 40; ** Relative Standard Error>40; - Data not available.

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.17: Body Mass Index (BMI), 2009-2012,[1] Children and Adolescents 2 - 19 yrs, age adjusted

		Body mass index (BMI)[1] Category			
	Sample Size	*<5th percentile*	*5th-84th percentile*	*85th-94th percentile*	*≥95th percentile*
		% (standard error)	*% (standard error)*	*% (standard error)*	*% (standard error)*
Total	6763	3.4(0.3)	64.8(0.8)	14.9(0.6)	16.9(0.6)
Sex					
Boys	3490	3.8(0.6)	63.7 (1.0)	14.9(0.8)	17.6(0.9)
Girls	3273	3.1(0.4)	65.9 (1.3)	14.9(0.8)	16.1(0.7)
Age (years)					
2 - 5 y	1774	3.1(0.4)	72.1(1.5)	14.5(1.3)	10.2(0.9)
6 -11 y	2481	3.9(0.5)	62.7(1.1)	15.5(0.8)	17.9(0.9)
12 -19 Y	2508	3.2(0.5)	62.7(1.2)	14.6(0.8)	19.4(1.1)
Race-Hispanic Origin[2]					
Non-Hispanic white	1870	3.6(0.6)	68.2(1.2)	14.1(1.0)	14.0(1.0)
Non-Hispanic black	1690	2.9(0.5)	60.0(1.4)	14.9(0.7)	22.1(1.2)
Hispanic	2373	2.6(0.4)	58.4(0.9)	17.2(0.7)	21.8(0.6)
Race-Hispanic Origin By Sex					
Boys					
Non-Hispanic white	972	4.3(1.2)	66.8(1.6)	14.5(1.5)	14.4(1.5)
Non-Hispanic black	867	3.2(0.6)	61.2(1.8)	13.6(1.1)	21.9(1.4)
Hispanic	1241	2.7(0.6)	57.1(1.3)	16.4(0.9)	23.7(1.0)
Girls					
Non-Hispanic white	898	2.9(0.5)	69.8(1.9)	13.7(1.4)	13.6(1.2)
Non-Hispanic black	823	2.6(0.6)	58.7(2.0)	16.3(1.3)	22.3(2.0)
Hispanic	1132	2.6(0.3)	59.7(1.2)	18.0(0.9)	19.8(1.1)

[1] Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place.
BMI percentiles based on the 2000 CDC Growth Charts using sex- and age-specific definitions.

[2] Race-Hispanic origin classified as “other” not separately reported but included in overall estimates

NOTE: Analyses based on age at the time of exam and exclude pregnant women

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.

Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.18: Total Cholesterol ≥240 and High Density Lipoprotein Cholesterol (HDL) <40, 2009-2012[1,2] Adults 20 y and over, age adjusted

	Sample Size	*Total cholesterol ≥240*		*HDL-C <40*	
		%	*Stnd Error*	*%*	*Stnd Error*
20 y and over, total	10495	12.8	0.5	19.6	0.8
Men	5194	11.6	0.6	28.9	1
Women	5301	13.8	0.6	10.6	0.7
Age, y					
20-39 y	3542	7	0.5	21.2	1.1
40-59 y	3537	18	0.8	20.2	1
≥60 y	3416	14.6	0.9	15.7	1.2
Race-Hispanic origin[3]					
Non-Hispanic white	4585	13.2	0.7	19.4	0.9
Non-Hispanic black	2189	9.9	0.7	14.7	0.9
Hispanic	2596	14.1	0.8	23.6	1.1
Body Mass index[4] (BMI) kg/m²					
18.5-24.9 kg/m²	2907	12.1	0.8	8.5	0.7
25-29.9 kg/m²	3441	15.2	1	18.8	1
≥30 kg/m²	3849	11.7	0.6	30.2	1.3
Waist Circumference, cm					
Men ≤102 cm, Women ≤ 88 cm	4483	12.1	0.8	13.7	0.8
Men >102 cm, Women >88cm	5511	13.4	0.6	24.9	1.1
Race-Hispanic origin by sex[3]					
Men, Non-Hispanic white	2297	11.5	0.7	28.7	1.3
Men, Non-Hispanic black	1070	8.8	0.9	20	1.3
Men, Hispanic	1259	14.8	1.2	33.8	1.4
Women, Non-Hispanic white	2288	14.7	0.8	10.3	1
Women, Non-Hispanic black	1119	10.8	1.1	10.5	1
Women, Hispanic	1337	13	1	13.2	1.3
BMI[4] kg/m² by sex					
Men, 18.5-24.9 kg/m²	1392	9.7	1.1	14.2	1
Men, 25-29.9 kg/m²	1928	13.7	1	26.8	1.7
Men, ≥30 kg/m²	1746	10.9	0.9	42.2	1.7
Women, 18.5-24.9 kg/m²	1515	13.6	1.1	4.3	0.7
Women, 25-29.9 kg/m²	1513	16.7	1.4	8.6	0.9
Women, ≥30 kg/m²	2103	12.3	0.8	18.9	1.4
Waist circumference, cm by sex					
Men ≤102 cm	2849	12	1	20.4	1.1
Men >102 cm	2124	11.3	1	40.3	1.6
Women ≤ 88 cm	1634	12.1	1.1	3.6	0.5
Women >88cm	3387	14.9	0.7	14.9	1

1 Estimates age-adjusted to yr 2000 standard population using 3 age grps: 20–39 yrs, 40-59 yrs, 60 yrs+, and weighted.

[2] All pregnant women excluded from analysis.

[3] Participants with race-Hispanic origin categorized as “other” included in overall estimates but not separately reported.

4 Body mass index (BMI) calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. Participants with BM <18.5 included in overall estimates but not separately reported.

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.19: Low Density Lipoprotein Cholesterol (LDL-C)≥160 and Triglycerides ≥200, NHANES 2009-2012[1, 2] Adults 20 y and over, age adjusted

	Sample Size	*LDL-C ≥160*		*Sample Size*	*Triglycerides ≥200*	
		%	*SE*		*%*	*SE*
20 y and over, total	4745	10.2	0.5	4832	11.6	0.8
Men	2286	9.7	0.7	2346	14.8	1.1
Women	2459	10.5	0.6	2486	8.3	0.8
Age, y						
20-39 y	1591	7	0.7	1614	8.4	1
40-59 y	1619	13.7	1.1	1660	14.6	1.3
≥60 y	1535	10.1	1	1558	12.2	1.3
Race-Hispanic origin[3]						
Non-Hispanic white	2046	10	0.8	2095	11.6	1.1
Non-Hispanic black	934	10.7	0.9	940	5.7	0.8
Hispanic	1244	10.4	1	1271	15.8	1.1
Body Mass index[4] (BMI) kg/m^2						
18.5-24.9 kg/m^2	1321	8	0.8	1329	4.8	0.7
25-29.9 kg/m^2	1548	12	1.2	1585	12	0.8
≥30 kg/m^2	1751	11.2	0.8	1791	17.2	1.6
Waist Circumference (cm)						
Men ≤102 cm, Women	2046	8	0.9	2073	7.6	0.8
Men >102 cm, Women	2553	12.1	0.9	2609	14.8	1.3
Race-Hispanic origin by gender[3]						
Men, Non-Hispanic whi	989	9	1	1022	14.1	1.4
Men, Non-Hispanic blac	429	10.5	1.1	433	8	1.2
Men, Hispanic	603	12.7	1.4	623	21.2	1.5
Women, Non-Hispanic	1057	10.7	1	1073	9	1
Women, Non-Hispanic	505	10.8	1.6	507	3.9	0.9
Women, Hispanic	641	7.8	1	648	10.1	1.2
BMI[4] kg/m^2 by gender						
Men, 18.5-24.9 kg/m^2	608	8.3	1.3	613	7	1.4
Men, 25-29.9 kg/m^2	839	11	1.5	867	15.6	1.4
Men, ≥30 kg/m^2	786	10.2	1.1	812	20.2	1.9
Women, 18.5-24.9 kg/n	713	7.7	0.9	716	3.2	0.7
Women, 25-29.9 kg/m^2	709	12.8	1.5	718	7	1.1
Women, ≥30 kg/m^2	965	11.9	1.2	979	14.2	1.9
Waist circumference, cm by gender						
Men ≤102 cm	1264	9.3	0.9	1289	10.8	1.2
Men >102 cm	959	11	1.3	992	20.4	2
Women ≤ 88 cm	782	5.9	1.2	784	2.4	0.6
Women >88cm	1594	12.8	0.9	1617	11.2	1.2

1 Estimates age-adjusted to yr 2000 standard population using 3 age grps: 20–39 yrs, 40-59 yrs, 60 yrs+, and weighted.

2 All pregnant women excluded from analysis.

3Participants with race-Hispanic origin categorized as “other” included in overall estimates but not separately reported.

4 Body mass index (BMI) calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. Participants with BM <18.5 included in overall estimates but not separately reported.

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.20: High Blood Pressure (Hypertension), NHANES 2009 -2012[1,2], Adults 18 y and over, age adjusted

	Sample Size	Hypertension[3] (%)	Standard Error
18 y and over, all	11422	29.1	0.6
Men	5694	29.8	0.8
Women	5728	28.3	0.6
Age, y			
18-39 y	4154	7.1	0.4
40-59 y	3634	31.7	1.2
≥60 y	3634	66.3	1.3
Race-Hispanic Origin[4]			
Non-Hispanic white	4847	27.9	0.7
Non-Hispanic black	2546	41.5	0.9
Hispanic	2819	26.1	0.9
Body Mass index[5] (BMI) kg/m^2			
18.5-24.9 kg/m^2	3300	20	1.1
25-29.9 kg/m^2	3666	26.4	0.8
≥30 kg/m^2	4105	39.2	0.8
Waist Circumference (cm)			
Men ≤102 cm, Women ≤ 88 cm	5025	21.2	0.9
Men >102 cm, Women >88cm	5824	34.6	0.6
Race-Hispanic origin[4] by gender			
Men, Non-Hispanic white	2438	28.9	1.1
Men, Non-Hispanic black	1260	40.5	1.1
Men, Hispanic	1387	26.2	1.4
Women, Non-Hispanic white	2403	26.8	0.8
Women, Non-Hispanic black	1286	42.1	1.3
Women, Hispanic	1432	25.8	0.8
BMI[5] (kg/m^2) by gender			
Men, 18.5-24.9 kg/m^2	1621	20.1	1.2
Men, 25-29.9 kg/m^2	2067	28.1	1.3
Men, ≥30 kg/m^2	1860	39.1	1.2
Women, 18.5-24.9 kg/m^2	1679	19.9	1.3
Women, 25-29.9 kg/m^2	1599	24.3	1
Women, ≥30 kg/m^2	2245	39.2	1
Waist circumference (cm) by gender			
Men ≤102 cm	3203	23.3	1
Men >102 cm	2244	37.2	1
Women ≤ 88 cm	1822	17.8	1.3
Women >88cm	3580	32.9	0.7

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Appendix E-2.20: High Blood Pressure (Hypertension), NHANES 2009 -2012[1,2], Adults 18 y and over, age adjusted, continued

[1] Estimates age-adjusted to the year 2000 standard population using 3 age groups: 20–39 yrs, 40–59 yrs, and 60 y weighted.

[2] All pregnant women excluded from analysis.

[3] Hypertension is defined as having measured systolic pressure of at least 140 mm Hg or diastolic pressure of at le Hg and/or taking antihypertensive medication. Estimates are based on the average of up to 3 measurements.

[4] Participants with a race-Hispanic origin categorized as “other” are included in overall estimates but are not separ reported.

[5] Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to on place. Participants with BM <18.5 are included in overall estimates but are not separately reported.

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

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Appendix E-2.21: Total Diabetes, 2009-2012[1,2] Adults 20 y and over, age adjusted

	Sample Size	*Total diabetes [3] , %*	*Standard Error*
20 y and over, total	4889	12.3	0.8
Men	2368	14	1
Women	2521	10.8	0.8
Age, y			
20-39 y	1629	3.2	0.5
40-59 y	1680	13.5	1.3
≥60 y	1580	26	1.7
Race-Hispanic origin[4]			
Non-Hispanic white	2113	9.8	0.8
Non-Hispanic black	959	18.4	1.3
Hispanic	1283	19.3	1.5
Body Mass index[5] (BMI) kg/m^2			
18.5-24.9 kg/m^2	1346	5.5	0.8
25-29.9 kg/m^2	1597	9	0.9
≥30 kg/m^2	1817	20.3	1.2
Waist Circumference, cm			
Men ≤102 cm, Women ≤	2094	6	0.9
Men >102 cm, Women >	2643	16.2	0.9
Race-Hispanic origin by gender[4]			
Men, Non-Hispanic white	1028	11.7	1.3
Men, Non-Hispanic black	442	18.8	1.8
Men, Hispanic	627	21	1.7
Women, Non-Hispanic wh	1085	8	0.9
Women, Non-Hispanic bla	517	18.1	1.5
Women, Hispanic	656	17.6	1.9
BMI[5], kg/m^2 by gender			
Men, 18.5-24.9 kg/m^2	621	8.8	1.6
Men, 25-29.9 kg/m^2	869	10	1.3
Men, ≥30 kg/m^2	823	21.6	1.6
Women, 18.5-24.9 kg/m^2	725	3.2	0.7
Women, 25-29.9 kg/m^2	728	7.8	0.8
Women, ≥30 kg/m^2	994	19.2	1.1
Waist circumference, cm by gender			
Men ≤102 cm	1300	8.3	1.2
Men >102 cm	1003	19.6	1.3
Women ≤ 88 cm	794	2.6	0.6
Women >88cm	1640	13.9	0.9

[1] Estimates age-adjusted to year 2000 standard population using 3 age groups: 20–39 yrs, 40–59 yrs, and 60 yrs+, and weighted.

[2] All pregnant women excluded from analysis.

[3] Total diabetes is the sum of self-reported diabetes and undiagnosed diabetes. Diagnosed diabetes was obtained by self-report and excludes women who reported having diabetes only during pregnancy. Undiagnosed diabetes is defined as fasting plasma glucose (FPG) of at least 126 mg/dL or a hemoglobin A1c of at least 6.5% and no reported physician diagnosis. Respondents had fasted for at least 8 hours and less than 24 hours. The definition of undiagnosed diabetes was based on recommendations from the American Diabetes Association. For more information, see Standards of medical care in diabetes – 2010. Diabetes Care 2010: 33 (suppl 1): S11-S61.

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Appendix E-2.21: Total Diabetes, 2009-2012[1,2] Adults 20 y and over, age adjusted, continued

[4] Participants with a race-Hispanic origin categorized as "other" are included in overall estimates but are not separately reported.

[5] Body mass index (BMI) calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. Participants with BM <18.5 included in overall estimates but not separately reported.

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.22: Total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and non-HDL-C, children ages 6-19 yrs, NHANES 2009-2012

	Sample Size	*TC≥ 200 mg/dL* [1]	*HDL-C<40 mg/dL* [1]	*Non-HDL-C ≥145 mg/dL* [1]
		%(standard error)	**%(standard error)**	**%(standard error)**
Total	4208	8.0(0.7)	13.4(0.8)	9.3(0.8)
Sex				
Boys	2180	7.0(0.8)	15.1(0.8)	9.1(0.8)
Girls	2028	9.0(1.0)	11.5(1.2)	9.4(1.1)
Age (years)				
6 to 8	925	6.3(1.0)	9.8(1.1)	6.1(1.1)
9 to 11	1004	8.3(1.0)	10.1(1.4)	8.8(0.9)
12 to 15	1125	7.0(1.1)	12.2(1.2)	7.5(1.3)
16 to 19	1154	9.8(1.2)	18.9(1.5)	13.3(1.4)
Race/Hispanic Origin[2]				
Non-Hispanic white	1142	8.0(1.1)	13.8(1.1)	9.1(1.3)
Non-Hispanic black	1050	8.7(0.9)	8.4(1.1)	8.6(0.7)
Hispanic	1532	7.2(0.7)	16.2(1.1)	10.4(0.7)
Body mass index (BMI)[3]				
5th-84th percentile	2497	6.9(0.7)	7.7(0.6)	6.8(0.8)
85th-94th percentile	670	7.1(1.2)	16.4(2.3)	9.2(1.4)
≥95th percentile	876	11.3(1.5)	30.5(2.5)	18.0(1.9)
Race/Hispanic Origin by Sex				
Boys				
Non-Hispanic white	607	6.2(1.2)	14.6(1.1)	8.4(1.3)
Non-Hispanic black	521	9.1(1.7)	9.8(1.5)	9.5(1.5)
Hispanic	804	7.1(1.0)	19.7(1.8)	11.1(1.1)
Girls				
Non-Hispanic white	535	10.0(1.7)	12.9(2.1)	9.8(1.7)
Non-Hispanic black	529	8.3(1.2)	6.9(1.1)	7.7(1.0)
Hispanic	728	7.4(1.0)	12.5(0.9)	9.6(1.1)
Weight Status by Sex				
Boys				
5th-84th percentile	1287	5.1(0.7)	8.8(1.1)	5.8(0.9)
85th-94th percentile	335	5.3(1.4)	16.9(3.2)	7.5(1.4)
≥95th percentile	469	13.2(2.4)	35.1(2.6)	21.6(3.1)
Girls				
5th-84th percentile	1210	8.7(1.1)	6.5(0.9)	7.8(1.3)
85th-94th percentile	335	9.1(2.1)	15.8(2.6)	10.9(2.2)
≥95th percentile	407	9.1(1.9)	25.5(3.7)	14.1(2.2)

1 Cut-point criteria based on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents

2 Race-Hispanic origin classified as “other” not separately reported by included in overall estimates

3 Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place.

Notes continue on p. 2

Appendix E-2.22: Total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and non-HDL-C, children ages 6-19 yrs, NHANES 2009-2012, continued

BMI percentiles based on 2000 CDC Growth Charts. BMI classified as <5th percentile not separately reported but included in overall estimates

* Relative standard error (RSE)≥30 but < 40; ** RSE≥40

NOTE: Analyses based on age at exam and exclude pregnant adolescents

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics,
Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Apendix E-2.23: Low density lipoprotein cholesterol (LDL-C) and triglycerides among adolescents ages 12-19 yrs, NHANES 2009 -2012

	Sample Size	*Triglycerides ≥130 mg/dL* [1]	*LDL-C ≥130 mg/dL* [1,2]
		% (standard error)	**% (standard error)**
Total	1065	10.9(1.0)	7.3(1.0)
Boys	557	13.4(1.8)	7.1(1.3)
Girls	508	8.4(2.0)	7.4(1.4)
Age (years)			
12 to 15	528	9.0(1.2)	5.7(1.4)
16 to 19	537	13.0(1.8)	8.9(1.4)
Race-Hispanic Origin[3]			
Non-Hispanic white	308	10.3(1.6)	7.8(1.6)
Non-Hispanic black	273	5.8(1.4)	8.7(1.5)
Hispanic	360	16.1(2.4)	4.4(1.3)
Body Mass Index (BMI)[4]			
5th-84th percentile	630	6.5(1.2)	6.7(1.4)
85th-94th percentile	183	11.4(2.7)	8.0(2.1)
≥95th percentile	201	24.1(3.4)	6.8(1.8)
Race-Hispanic Origin by Sex			
Boys--Non-Hispanic white	165	12.0(2.4)	7.6(2.0)
Boys--Non-Hispanic black	144	8.4(2.1)	7.5(2.7)*
Boys--Hispanic	181	19.4(3.4)	4.7(1.5)*
Girls--Non-Hispanic white	143	8.5(3.3)*	8.0(2.2)
Girls-Non-Hispanic black	129	3.3(1.2)*	9.9(2.7)
Girls-Hispanic	179	12.7(2.7)	4.2(1.6)*
Weight Status by Sex			
Boys-5th-84th percentile	326	5.8(1.4)	6.1(2.0)*
Boys-85th-94th percentile	89	11.6(2.9)	7.5(2.7)*
Boys-≥95th percentile	115	38.6(5.0)	8.8(3.0)*
Girls-5th-84th percentile	304	7.2(2.5)*	7.3(1.8)
Girls-85th-94th percentile	94	11.2(4.4)*	**
Girls-≥95th percentile	86	7.9(2.4)	4.6(1.8)*

[1] Cut-point criteria based on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents

[2] LDL-C calculated using the Friedewald equation (which is valid when triglyceride <400 mg/dL)

[3] Race-Hispanic origin classified as “other” not separately reported by included in overall estimates

[4] Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. BMI percentiles based on the 2000 CDC Growth Charts. BMI classified as <5th percentile not separately reported but included in overall estimates

* Relative standard error (RSE)≥30 but < 40; ** RSE≥40

NOTE: Analyses based on age at exam and exclude pregnant adolescents

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.
Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.24: Prevalence of high and borderline high blood pressure (BP), children and adolescents, Ages 8-17 years, NHANES 2009-2012

	Sample Size	*High BP*	Borderline high BP[1]
		% (standard error)	% (standard error)
Total	3361	1.7(0.2)	8.3(0.7)
Boys	1720	1.7(0.4)	12.0(1.3)
Girls	1641	1.6(0.2)	4.6(0.8)
Age (years)			
8 to 12	1808	1.8(0.4)	3.8(0.7)
13-17	1553	1.5(0.4)	12.4(1.1)
Race/Hispanic Origin[2]			
NH white	936	1.4(0.3)	7.2(0.9)
NH black	836	2.3(0.5)	12.1(1.3)
Hispanic	1179	1.8(0.6)*	8.5(1.4)
Body Mass Index (BMI)[3]			
5th-84th percentile	2016	1.4(0.3)	5.4(0.8)
85th-94th percentile	545	**	10.9(1.6)
≥95th percentile	704	1.8(0.6)*	16.2(1.8)
Race-Hispanic Origin by Sex			
Boys			
NH white	478	**	10.8(1.8)
NH black	417	2.5(0.7)	16.6(2.0)
Hispanic	614	**	12.7(2.3)
Girls			
NH white	458	1.8(0.4)	3.8(1.1)
NH black	419	**	7.5(1.6)
Hispanic	565	1.5(0.6)*	4.3(1.0)
BMI by Sex			
Boys			
5th-84th percentile	1021	1.8(0.5)	8.6(1.5)
85th-94th percentile	267	**	16.3(2.8)
≥95th percentile	376	1.8(0.6)*	20.1(3.0)
Girls			
5th-84th percentile	995	1.0(0.3)	2.4(0.8)*
85th-94th percentile	278	**	5.3(1.2)
≥95th percentile	328	**	12.0(2.7)

1- Borderline high BP defined as a systolic or diastolic BP ≥90th percentile but <95th percentile or BP levels ≥120/80 mm Hg. High BP defined as a systolic or diastolic BP ≥95th percentile. Definitions based on the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescent. Estimates are based on the average of up to 3 measurements.

2- Race-Hispanic origin classified as “other” not separately reported by included in overall estimates

3- Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. BMI percentiles based on the 2000 CDC Growth Charts

NOTE: Analyses based on age at exam and exclude pregnant adolescents

* Relative standard error (RSE)≥30 but < 40; ** RSE≥40

DATA SOURCE: National Health and Nutrition Examination Survey (NHANES) 2009-2012.

Prepared by the Division of Health and Nutrition Examination Surveys, National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Appendix E-2.25: Average Healthy Eating Index-2010 scores for Americans ages 2 years and older (NHANES 2009-2010)

	Average HEI scores by age group and by sex*										
HEI-2010 components	2 -3 y	4-8 y	9-13 y	14-18 y	19-30 y	31-50 y	51-70 y	>=71 y	>=2 Yrs	All Males	All Females
	n=477	n=958	n=887	n=802	n=1242	n=1979	n=1771	n=926	n=9042	n=4501	n=4541
▲ Adequacy (higher score indicates higher consumption)											
Total Fruit (of 5 pts total)	5.0	4.6	3.2	2.8	2.6	2.8	3.5	4.6	3.3	2.9	3.8
Percent	100	92	64	56	52	56	70	92	66	58	76
Whole Fruit (5 pts)	5.0	4.2	3.0	2.5	2.0	3.0	3.7	4.9	3.3	2.8	3.7
Percent	100	84	60	50	40	60	74	98	66	56	74
Total Vegetables (5 pts)	2.1	2.0	2.1	2.5	2.9	3.5	4.0	4.0	3.3	3.0	3.5
Percent	42	40	42	50	58	70	80	80	66	60	70
Greens and Beans (5 pts)	1.0	0.9	1.2	0.9	1.8	2.5	3.4	3.0	2.3	1.9	2.8
Percent	20	18	24	18	36	50	68	60	46	38	56
Whole grains (10 pts)	3.3	2.6	2.0	1.8	1.7	2.7	3.0	3.6	2.5	2.3	2.8
Percent	33	26	20	18	17	27	30	36	25	23	28
Dairy (10 pts)	10.0	10.0	8.9	7.7	6.4	6.2	6.3	6.4	6.9	6.7	7.2
Percent	100	100	89	77	64	62	63	64	69	67	72
Total Protein Foods (5 pts)	3.9	4.0	4.2	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Percent	78	80	84	96	100	100	100	100	100	100	100
Seafood/Plant Proteins (5 pts)	3.0	2.2	2.5	2.5	3.3	4.8	5.0	5.0	4.2	4.0	4.4
Percent	60	44	50	50	66	96	100	100	84	80	88
Fatty Acids (10 pts)	2.2	2.8	3.1	3.8	4.3	4.4	4.5	4.8	4.1	4.1	4.2
Percent	22	28	31	38	43	44	45	48	41	41	42
▼ Moderation (higher score indicates lower consumption)											
Refined Grains (10 pts)	7.5	5.1	3.6	4.3	5.6	6.5	7.2	6.9	6.1	6.1	6.0
Percent	75	51	36	43	56	65	72	69	61	61	60
Sodium (10 pts)	5.8	5.0	4.4	3.6	3.9	3.6	3.2	3.6	3.7	3.7	3.8
Percent	58	50	44	36	39	36	32	36	37	37	38
Empty Calories (20 pts)	13.7	11.6	10.5	10.6	11.1	12.3	12.9	13.9	12.1	11.8	12.3
Percent	69	58	53	53	56	62	65	70	61	59	62
Total HEI-2010 Score (100 pts)	**62.5**	**54.9**	**48.7**	**47.8**	**50.5**	**57.4**	**61.6**	**65.8**	**56.6**	**54.4**	**59.5**
Overall Percent	**63**	**55**	**49**	**48**	**51**	**57**	**62**	**66**	**57**	**54**	**60**

*HEI-2010 scores estimated based on day 1 dietary recalls, National Health and Nutrition Examination Survey (NHANES) 2009-2010.
Intakes of energy, fatty acids, sodium, and alcohol calculated using the Food and Nutrient Database for Dietary Studies, version 5.0.
Food group intakes for 2009-10 were calculated using the Food Patterns Equivalents Database, 2009-2010.

DATA SOURCE: What We Eat in America, National Health and Nutrition Examination Survey (NHANES) 2009-2010
Prepared by the Center for Nutrition Policy and Promotion, U.S. Department of Agriculture.

Appendix E2.26: Evidence Portfolio

Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes

What is the relationship between dietary patterns and risk of cardiovascular disease?

Conclusion Statement: The DGAC concurs with the conclusions of the NEL Dietary Patterns Systematic Review Project and AHA/ACC *Guideline on Lifestyle Management to Reduce Cardiovascular Risk* that strong and consistent evidence demonstrates that dietary patterns associated with decreased risk of CVD are characterized by higher consumption of vegetables, fruits, whole grains, low-fat dairy, and seafood, and lower consumption of red and processed meat, and lower intakes of refined grains, and sugar-sweetened foods and beverages relative to less healthy patterns. Regular consumption of nuts and legumes and moderate consumption of alcohol also are shown to be components of a beneficial dietary pattern in most studies. Randomized dietary intervention studies have demonstrated that healthy dietary patterns exert clinically meaningful impact on cardiovascular risk factors, including blood lipids and blood pressure. Additionally, research that includes specific nutrients in their description of dietary patterns indicate that patterns that are lower in saturated fat, cholesterol, and sodium and richer in fiber, potassium, and unsaturated fats are beneficial for reducing cardiovascular disease risk.

DGAC Grade: Strong

Review of Evidence

The DGAC examined research compiled in the NEL Dietary Patterns Systematic Review Project,[1] which included 55 articles summarizing evidence from 52 prospective cohort studies and 7 RCTs, and the 2013 AHA/ACC *Guideline on Lifestyle Management to Reduce Cardiovascular Risk* and associated NHLBI Lifestyle Report,[2] which included primarily RCTs. The Committee drew additional evidence and effect size estimates from six published systematic reviews/meta-analyses published since 2008 that included one or more studies not covered in the NEL or NHLBI Lifestyle reports.[3-8] In total, 142 articles were considered in these reports, of which 35 were included in two or more reviews. Little evidence on the contribution of dietary patterns to CVD risk factors in the pediatric populations was available, and that which was published was not systematically reviewed.

Most evidence examining hard disease endpoints comes from large, prospective cohort studies in adults using a priori scores to rank individuals with respect to adherence to dietary patterns of interest. Though the observational design allows the necessary duration of follow-up to observe CVD endpoints, comparison across studies was difficult because of different methods for deriving scores and different versions of scores measuring adherence to the same dietary pattern. In the Mediterranean dietary indices and the AHEI scores, moderate alcohol was included as a “positive” component (associated with potential benefits). Red and processed meats were “negative” (potentially detrimental) components in the Mediterranean scores, AHEI scores, and DASH. Certain scores also included sugars or sugar-sweetened beverages as negative components. Poultry was considered as a positive component in the original AHEI. Total high-fat dairy was a negative component in the Mediterranean diet scores, but dairy was a positive component when meeting recommended intakes for the HEI-2005, and low-fat dairy was positive in the DASH scores. As the NEL systematic review points out, several components of scores associated with decreased CVD risk recurred in multiple dietary patterns and were associated as part of scores and as individual components with reduced CVD risk. These included consumption of vegetables, fruits, whole grains, nuts, legumes, unsaturated fats, and fish.

The NHLBI Lifestyle Report summarized the evidence from two RCTs of the DASH dietary pattern and two trials testing DASH variations with differing levels of sodium or macronutrients. The diet provided to participants in standard DASH intervention trials was high in vegetables, fruits, low-fat dairy products, whole grains, poultry, fish, and nuts. It also was low in sweets, sugar-sweetened beverages, and reduced in (or lower in) red and processed meats. The DASH dietary pattern is high in fiber and potassium and low in sodium, saturated fat, total fat, and cholesterol. It is rich in potassium, magnesium, and calcium, as well as protein and fiber.

In contrast to the patterns described above, vegetarian diets were defined by what they excluded. Variations included: vegan (no meat, fish, eggs, or dairy); lacto-ovo vegetarian (includes eggs and dairy, but no fish or meat), and pesco vegetarian (includes fish, but no meat) diets. The content of these diets varied substantially, though they tended to emphasize plant based foods, especially fruits and vegetables, legumes, nuts, and whole grains.

Dietary Patterns and Blood Pressure (BP)

DASH or DASH-style Dietary Patterns

The NEL systematic review and AHA/ACC Lifestyle Guideline conclude that strong and consistent evidence from RCTs demonstrates that compared to a dietary pattern that is relatively high in saturated fat and sodium and low in vegetables and fruits, the DASH-style dietary pattern reduced BP by approximately 6/3 mmHg (systolic blood pressure/diastolic blood pressure) across subgroups defined by sex, race, age, and hypertension status. The DASH trial provided all food to participants for 8 weeks. Fat intake was relatively low at 26 percent of energy (7 percent each monounsaturated and saturated, 10 percent polyunsaturated), compared to 36 percent in the control group. Carbohydrates accounted for 57 percent of energy and protein for 18 percent. Sodium was stable at 3,000 mg/day and body weight did not change. Variations of the DASH diet also lowered blood pressure: in the OmniHeart Trial, compared to the standard DASH, replacing 10 percent of calories from carbohydrate with either the same calorie content of protein or with unsaturated fat (8 percent MUFA and 2 percent PUFA) lowered systolic BP by 1 mmHg. Among adults with BP 140–159/90–95 mmHg, these substitutions lowered systolic BP by 3 mmHg relative to standard DASH.[1,2]

Observational evidence summarized in the NEL report included one cohort showing that increased DASH score was associated with small, but decreased levels of systolic and diastolic BP over time;[9] two others cohorts showed no relationship between DASH scores and risk of hypertension.[10, 11]

Mediterranean-Style Dietary Patterns

Several RCTs provide limited to moderate evidence on the benefits of a Mediterranean-style diet for reducing blood pressure. The AHA/ACC Lifestyle Guideline conclude that consuming a Mediterranean dietary pattern instead of a lower-fat dietary pattern had beneficial effects on blood pressure. The NHLBI Lifestyle Report reviewed two RCTs of free-living middle-aged or older adults (with type 2 diabetes or at least three CVD risk factors) in which a Mediterranean diet intervention reduced BP by 6–7/2–3 mmHg.[12, 13] The report also reviewed one observational study of healthy younger adults. Higher adherence to a Mediterranean-style diet, as measured through a Mediterranean score, was associated with a decrease in BP of 2–3/1–2 mmHg.[14]

Vegetarian Dietary Patterns

Evidence for the blood pressure benefits of vegetarian dietary patterns is more limited, but moderately consistent trends appear to exist. A recent meta-analysis of seven RCTs found that consumption of vegetarian diets was associated with a reduction in mean systolic blood pressure (-4.8 mm Hg; 95% CI = -6.6 to -3.1; p<0.01) and diastolic blood pressure (-2.2 mm Hg; 95% CI = -3.5 to -1.0) compared with the consumption of omnivorous diets.[8] The AHA/ACC Lifestyle Guideline did not find sufficient evidence to examine vegetarian dietary patterns, and the NEL systematic review summarized only three studies comparing blood pressure outcomes in lacto-ovo vegetarian diets versus non-vegetarian diets in which meat and fish were consumed. Of the two studies, one was a large prospective cohort that found no association with blood pressure,[15] and the other was a RCT among individuals with hypertension that demonstrated a decrease in systolic blood pressure, but not diastolic blood pressure.[16] The more recent EPIC-Oxford cohort found lower systolic, but not diastolic blood pressure compared to the findings of Crowe, 2013.[17]

Other Dietary Patterns

As summarized in the NEL systematic review, adherence to the *2005 Dietary Guidelines for Americans* was related to lower blood pressure in one study of healthy young adults. Zamora et al reported 20-year findings from the CARDIA study including 4,381 Black and White young adults.[18] Participants in the highest (vs. lowest) quartile of adherence to the 2005 Dietary Guidelines had significantly less increase in systolic and diastolic blood pressure over time.

Dietary Patterns and Blood Lipids

DASH or DASH-style Dietary Patterns

As reviewed in the NHLBI Lifestyle Report, RCTs of the DASH diet show favorable effects on low-density lipoprotein cholesterol (LDL-C) and total cholesterol: high-density lipoprotein cholesterol (total-C: HDL-C) ratio, and no effect on triglycerides (TG). Benefits were seen with a variety of different macronutrient compositions, though they were enhanced when some carbohydrates in the standard DASH pattern were replaced with protein or unsaturated fat. In the standard DASH, when food was supplied to adults with a total cholesterol level of less than 260 mg/dL and LDL-C less than 160 mg/dL, and body weight was kept stable, the DASH dietary pattern compared to the control diet decreased LDL-C by 11 mg/dL, decreased HDL-C by 4 mg/dL, and had no effect on TG. The OmniHeart trial tested the DASH dietary pattern with different macronutrient compositions among adults with average baseline LDL-C 130 mg/dL, HDL-C 50 mg/dL, and TG 100 mg/dL. Modifying the DASH diet by replacing 10 percent of calories from carbohydrate with 10 percent of calories from protein decreased LDL-C by 3 mg/dL, decreased HDL-C by 1 mg/dL, and decreased TG by 16 mg/dL compared to the DASH dietary pattern. Replacing 10 percent of calories from carbohydrate with 10 percent of calories from unsaturated fat (8 percent MUFA and 2 percent PUFA) decreased LDL-C similarly, increased HDL-C by 1 mg/dL, and decreased TG by 10 mg/dL compared to the DASH dietary pattern.[2]

Mediterranean-style Dietary Patterns

As with blood pressure, few trials have evaluated the effects of Mediterranean dietary patterns on blood lipids. According to the AHA/ACC Lifestyle Guideline, consuming a Mediterranean-style diet (compared to minimal or no dietary advice) resulted in no consistent effect on plasma LDL-C, HDL-C, and TG. In part, this was due to substantial differences in dietary interventions conducted among free-living middle aged or older adults with or without CVD or at high risk for CVD.[2] In the PREDIMED trial (reviewed in both the NHLBI Lifestyle and NEL reports), both treatment groups (Mediterranean diet +olive oil or +nuts) had favorable changes in HDL-C, total-C: HDL-C ratio and TG when compared to the control group, which received minimal advice to follow a lower-fat diet.[12] One of the prospective cohort studies reviewed by the NEL showed each one-point increase in alternate Mediterranean diet score assessed in adolescence and early adulthood was associated with a -6.19 (-10.44, -1.55) mg/dL lower total cholesterol in adulthood but no significant effects on HDL-C.[19] Of other observational cohorts reviewed, one reported adherence to a Mediterranean diet was associated with favorable changes in HDL-C and TG,[20] and another found no associations between adherence to a Mediterranean diet and blood lipids.[21]

Vegetarian Dietary Patterns

The NEL systematic review included three articles on vegetarian patterns that measured blood pressure or blood lipids.[15-17] One study reported decreased total-C[15] and another reported decreased non-HDL-C in vegetarian versus non-vegetarian participants.[17]

Other Dietary Patterns

Of note, adherence to the *2005 Dietary Guidelines for Americans* also was related to higher HDL-C levels in a cohort of Black and White young adults.[18]

Dietary Patterns and Cardiovascular Disease Outcomes

The NHLBI Lifestyle review did not include any trials examining the evidence of particular dietary patterns with CVD outcomes. Overall, the NEL systematic review found that individuals whose diets mirrored the dietary patterns of interest (typically compared with diets having lower scores) was associated with lower CVD incidence and mortality in 14 out of 17 studies. The studies were predominantly observational, but included some trial evidence, and they typically assessed dietary intakes through self-report. The effect sizes varied substantially, with the decrease in risk of CVD ranging from 22 to 59 percent for increased adherence to various Mediterranean-style dietary patterns and from 20 to 44 percent for increased adherence to a U.S. Dietary Guidelines-related pattern (e.g., HEI or AHEI and updates). The majority of studies that assessed coronary heart disease (CHD) incidence or mortality also reported a favorable association between adherence to a healthy dietary pattern and CHD risk. The lower CHD risk ranged from 29 to 61 percent for greater adherence to Mediterranean-style dietary patterns, from 24 to 31 percent for greater adherence to a U.S. Dietary Guidelines-related pattern, and from 14 to 27 percent for greater adherence to DASH. Similarly, the majority of studies assessing stroke incidence or mortality reported favorable associations, with the lower stroke risk ranging from 13 to 53 percent for greater adherence to a Mediterranean-style dietary pattern and from 14 to 60 percent for greater adherence to a U.S. Dietary Guidelines-related pattern.[1]

Mediterranean-style Dietary Patterns

To gather additional information on dietary patterns and CVD outcomes, the DGAC consulted two meta-analyses,[4, 7] which included many of the same observational prospective cohort studies as one another and as the NEL systematic review. These meta-analyses each reported summary estimates across studies as a 10 percent reduction in risk of CVD (fatal or nonfatal clinical CVD event) per 2-increment increase in adherence to the Mediterranean-style diet. The NEL report also included results from the largest Mediterranean diet trial, PREDIMED, which found that a Mediterranean diet (plus extra virgin olive oil or nuts) had favorable effects in high-risk participants compared to the control group who were advised to reduce dietary fat intake. An approximately 30 percent decrease in risk of major CVD events (a composite endpoint including myocardial infarction, stroke, and deaths) was observed and the trial was stopped early for meeting benefit requirements.[1, 22] According to food questionnaires measuring adherence to the assigned diet by the end of follow-up, the intervention groups had significantly increased consumption of fish and legumes and non-significant reductions in refined grains and red meat from baseline, in addition to increased intake of supplemental foods (olive oil or nuts depending on the intervention arm), compared to the control group.

DASH-style Dietary Patterns

A recent meta-analysis[6] of six prospective cohort studies with CVD endpoints assessed DASH-style diet through the Fung et al. method,[23] which assigns points based on population-specific quintiles of eight DASH dietary pattern components: fruits, vegetables, nuts and legumes, whole grains, low-fat dairy, sodium, red and processed meats, and sweetened beverages. This meta-analysis reported that greater adherence to a DASH-style diet significantly reduced CVD

(Relative Risk [RR]=0.80; 95% CI = 0.74 to 0.86), CHD (RR=0.79; 95% CI = 0.71 to 0.88), and stroke (RR=0.81; 95% CI = 0.72 to 0.92). All of the studies meta-analyzed also were included the NEL's evidence base for the DASH-style diet.

Vegetarian Dietary Patterns

The NEL systematic review concluded that evidence for the effects of vegetarian dietary patterns on cardiovascular endpoints is limited. Most of this evidence was from prospective cohort studies; four out of six studies suggested that a vegetarian dietary pattern was associated with reduced incidence of ischemic heart disease (IHD) or CVD mortality. A meta-analysis of seven studies related to CVD mortality and vegetarian diet[3] (including two of the studies from the NEL systematic review) found that mortality from IHD was significantly lower in vegetarians than in non-vegetarians (RR=0.71; 95% CI = 0.56 to 0.87). The authors estimated a 16 percent lower mortality from circulatory diseases (RR=0.84; 95% CI = 0.54 to 1.14) and a 12 percent lower mortality from cerebrovascular disease (RR=0.88; 95% CI = 0.70 to 1.06) in vegetarians compared to non-vegetarians.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between dietary patterns and risk of cardiovascular disease

Question/ Purpose **AMSTAR Rating***	**Dietary Patterns and Outcomes**	**Included Studies** (Number and Study Design)**	**Evidence/ Conclusion Statement from Existing Report/ SR/ MA**
NEL Dietary Patterns Systematic Review Project, 2014			
Overarching Finding/ Recommendation: Dietary patterns associated with decreased risk of cardiovascular disease were characterized by regular consumption of fruits, vegetables, whole grains, low-fat dairy and fish, and were low in red and processed meat and sugar-sweetened foods and drinks. Regular consumption of nuts and legumes and moderate consumption of alcohol were also shown to be beneficial in most studies. Additionally, research that included specific nutrients in their description of dietary patterns indicated that patterns that were low in saturated fat, cholesterol, and sodium and rich in fiber and potassium may be beneficial for reducing cardiovascular disease risk.			
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using an index or score, and risk of cardiovascular disease?	Dietary pattern assessed using index/score methodology HTN, BP, TG, LDL-C, HDL-C, incidence of CVD, CVD-related death, MI, stroke	55 52 PCS (from 36 cohorts); 3 RCT	There is strong and consistent evidence that in healthy adults increased adherence to dietary patterns scoring high in fruits, vegetables, whole grains, nuts, legumes, unsaturated oils, low-fat dairy, poultry and fish; low in red and processed meat, high-fat dairy, and sugar-sweetened foods and drinks; and moderate in alcohol is associated with decreased risk of fatal and non-fatal cardiovascular diseases, including coronary heart disease and stroke. (Strong)
Are prevailing patterns of dietary intake in a population, assessed using cluster or factor analyses, related to the risk of cardiovascular	Dietary pattern assessed using factor or cluster analysis HTN, BP, TG, LDL-C, HDL-C, incidence of CVD, CVD-related	22 22 PCS (from 18 cohorts)	Limited evidence from epidemiological studies indicates that dietary patterns, assessed using cluster or factor analysis, characterized by vegetables, fruits, whole grains, fish, and low-fat dairy products are associated with decreased risk of cardiovascular disease in adults. Evidence of a relationship between dietary patterns characterized by red and processed meat, sugar-sweetened foods and drinks, and fried foods and an increased risk of cardiovascular disease is limited and less consistent. (Limited)

disease?	death, MI, stroke		
What combinations of food intake, assessed using reduced rank regression, explain the most variation in risk of cardiovascular disease?	Dietary pattern assessed using reduced rank regression HTN, BP, TG, LDL-C, HDL-C, incidence of CVD, CVD-related death, MI, stroke	4 4 PCS	Insufficient evidence, due to a small number of studies, was available to examine the relationship between dietary patterns derived using reduced rank regression and risk of cardiovascular disease. The disparate nature of the methods used made it difficult to compare results, and therefore, no conclusions were drawn. (Grade not Assignable)
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using methods other than index/ score, cluster or factor, or reduced rank regression analyses, and risk of cardiovascular disease?	Dietary pattern assessed using methodologies other than index, factor, cluster, or reduced rank regression analyses HTN, BP, TG, LDL-C, HDL-C, incidence of CVD, CVD-related death, MI, stroke	20 14 RCT (from 8 trials) 6 PCS	There is strong and consistent evidence that consumption of a DASH diet results in reduced blood pressure in adults with above optimal blood pressure, up to and including stage 1 hypertension. A dietary pattern consistent with the DASH diet is rich in fruits, vegetables, low-fat dairy, fish, whole grains, fiber, potassium and other minerals at recommended levels, and low in red and processed meat, sugar-sweetened foods and drinks, saturated fat, cholesterol, and sodium. There is limited evidence that adherence to vegetarian diets is associated with decreased death from ischemic heart disease, with the association being stronger in men than in women. (Strong – DASH and BP; Limited – Vegetarian and IHD)
Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group, (National Heart, Lung, and Blood Institute, 2013) **ACC/AHA Guideline on Lifestyle Management to Reduce Cardiovascular Risk (Eckel, 2013)**			
Overarching Finding/ Recommendation: Advise adults who would benefit from LDL-C or BP lowering to: • Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy products, poultry, fish, legumes, non-tropical vegetable oils and nuts; and limits intake of sweets, sugar-sweetened beverages and red meats. • Adapt this dietary pattern to appropriate calorie requirements, personal and cultural food preferences, and nutrition therapy for other medical conditions (including diabetes mellitus). • Achieve this pattern by following plans such as the DASH dietary pattern, the USDA Food Pattern, or the AHA Diet.			
Among adults, what is the effect of dietary patterns and/or macronutrient composition on CVD risk factors, when compared to no treatment or to other types of interventions?	Mediterranean BP	4 1 PCS; 3 RCT	Counseling to eat a Mediterranean-style dietary pattern compared to minimal advice to consume a low-fat dietary pattern, in free-living middle-aged or older adults (with type 2 DM or at least three CVD risk factors) decreased BP by 6–7/2–3 mmHg. In an observational study of healthy younger adults, adherence to a Mediterranean-style dietary pattern was associated with decreased BP 2–3/1–2 mmHg. (Low)
	Mediterranean Lipids		Counseling to eat a Mediterranean-style dietary pattern compared to minimal or no dietary advice, in free-living middle aged or older adults (with or without CVD or at high risk for CVD) resulted in no consistent effect on plasma LDL-C, HDL-C, and TG; in part due to substantial differences and limitations in the studies. (Low)
	DASH BP	6 citations 2 RCT	When all food was supplied to adults with blood pressure 120–159/80–95 mmHg and both body weight and sodium intake were kept stable, the DASH dietary pattern, when compared to a typical American diet of the 1990s, decreased BP 5–6/3 mmHg. (High)
	DASH		When food was supplied to adults with a total cholesterol level <260 mg/dL, LDL-C <160 mg/dL, and body weight was

	Lipids		kept stable, the DASH dietary pattern, when compared to a typical American diet of the 1990s, decreased LDL-C by 11 mg/dL, decreased HDL-C by 4 mg/dL, and no effect on TG. (High)
	DASH BP in subpopulations		When food was supplied to adults with BP 120–159/80–95 mmHg and body weight was kept stable, the DASH dietary pattern, when compared with the typical American diet of the 1990s, decreased BP in women and men, African American and non-African Americans, older and younger adults, and hypertensive and non-hypertensive adults. (High)
	DASH Lipids in subpopulations		When all food was supplied to adults with a total cholesterol level <260 mg/dL, LDL-C <160 mg/dL, and body weight was kept stable, the DASH dietary pattern, as compared to a typical American diet of the 1990s, decreased LDL-C and decreased HDL-C similarly in subgroups: African American and non-African American, and hypertensive and non-hypertensive. (Low)
	DASH variation BP	1 1 RCT	In adults with BP of 120–159/80–95 mmHg, modifying the DASH dietary pattern by replacing 10% of calories from CHO with the same amount of either protein or unsaturated fat (8% MUFA and 2% PUFA) lowered systolic BP by 1 mmHg compared to the DASH dietary pattern. Among adults with BP 140–159/90–95 mmHg, these replacements lowered systolic BP by 3 mmHg relative to DASH. (Moderate)
	DASH variation Lipids		In adults with average baseline LDL-C 130 mg/dL, HDL-C 50 mg/dL, and TG 100 mg/dL, modifying the DASH dietary pattern by replacing 10% of calories from CHO with 10% of calories from protein decreased LDL-C by 3 mg/dL, decreased HDL-C by 1 mg/dL, and decreased TG by 16 mg/dL compared to the DASH dietary pattern. Replacing 10% of calories from CHO with 10% of calories from unsaturated fat (8% MUFA and 2% PUFA) decreased LDL-C similarly, increased HDL-C by 1 mg/dL, and decreased TG by 10 mg/dL compared to the DASH dietary pattern. (Moderate)
Sofi, 2013			
To investigate the association between the Mediterranean diet and risk and incidence of CVD Meta-analysis AMSTAR: 9/11	Mediterranean Mortality from and/or incidence of cardio- and cerebrovascular diseases	14 14 PCS	A 2-point increase of adherence to the Mediterranean diet was associated with a reduced risk of mortality and incidence of CVD (RR=0.90; 95% CI: 0.87 to 0.92; P<0.0001).
Martinez-Gonzalez, 2014			
To review the evidence on the association between adherence to a Mediterranean diet and the risk of CVD Meta-analysis AMSTAR: 9/11	Mediterranean Fatal or nonfatal clinical CVD event	13 (12 included in meta-analysis) 13 PCS	Each 2-point increment in a 0-9 Mediterranean diet score was associated with a 10% relative reduction in the risk of CVD (RR=0.90; 95% CI: 0.86 to 0.94).

Rees, 2013			
To determine the effectiveness of dietary advice to follow a Mediterranean-style dietary pattern or the provision of foods relevant to the Mediterranean diet for the primary prevention of CVD Systematic review and meta-analysis AMSTAR: 11/11	Mediterranean Cardiovascular mortality, non-fat endpoints (e.g., MI stroke), change in blood lipids and blood pressure	15 (11 trials) 11 RCT	The limited evidence to date suggests some favorable effects of the Mediterranean diet on cardiovascular risk factors. Clinical events were reported in only one trial where no statistically significant effects of the intervention were seen on fatal and non-fatal endpoints at eight years. Small reductions in total cholesterol (-0.16 mmol/L, 95% CI: -0.26 to -0.06) and LDL-C (-0.07 mmol/L, 95% CI: -0.13 to -0.01) were seen with the intervention. Subgroup analyses revealed statistically significant greater reductions in total cholesterol in those trials describing the intervention as a Mediterranean diet (-0.23 mmol/L, 95% CI: -0.27 to -0.2) compared with control (-0.06 mmol/L, 95% CI: -0.13 to 0.01). Heterogeneity precluded meta-analyses for other outcomes. Reductions in blood pressure were seen in three of five trials reporting this outcome.
Salehi-Abargouei, 2013			
To summarize and if possible quantify the longitudinal effects of a DASH-style diet on the incidence of CVDs Meta-analysis AMSTAR: 9/11	DASH-style Fatal or nonfatal CVDs, including CHD and stroke	7 (6 included in meta-analysis) 5 PCS; 1 RCT	A DASH-like diet can significantly reduce CVDs (RR=0.80; 95% CI: 0.74 to 0.86), CHD (RR=0.79; 95% CI: 0.71 to 0.88), and stroke (RR=0.81; 95% CI: 0.72 to 0.92). A linear and negative association was obtained between DASH-style diet concordance and all CVDs, as well.
Huang, 2012			
To investigate cardiovascular disease mortality among vegetarians and non-vegetarians Meta-analysis AMSTAR: 9/11	Vegetarian (lacto-ovo and vegan) Non-vegetarian Mortality from ischemic heart disease, circulatory diseases and cerebrovascular disease	7 7 PCS	Mortality from ischemic heart disease was significantly lower in vegetarians than in nonvegetarians (RR=0.71; 95% CI: 0.56 to 0.87). Authors observed a 16% lower mortality from circulatory diseases (RR=0.84; 95% CI: 0.54 to 1.14) and a 12% lower mortality from cerebrovascular disease (RR=0.88; 95% CI: 0.70 to 1.06) in vegetarians compared to non-vegetarians.
Yokoyama, 2014			

To conduct a systematic review and meta-analysis of controlled clinical trials and observational studies that have examined the association between vegetarian diets and BP Meta-analysis AMSTAR: 10/11	Vegetarian Systolic and diastolic BP	7 7 RCT	Consumption of vegetarian diets was associated with a reduction in mean systolic blood pressure (-4.8 mm Hg; 95% CI: -6.6 to -3.1; P<0.01) and diastolic blood pressure (-2.2 mm Hg; 95% CI: -3.5 to -1.0) compared with the consumption of omnivorous diets.

* A measurement tool for the ‘assessment of multiple systematic reviews’ (AMSTAR)

** Reference overlap: Of the 142 articles included in total across the reviews, 35 were included in two or more reviews. The greatest crossover was between Sofi and Martinez-Gonzalez, which included 12 of the same articles in meta-analyses (of 14 and 13 studies, respectively).

References Included in Review

1. Nutrition Evidence Library. A series of systematic reviews on the relationship between dietary patterns and health outcomes. Alexandria, VA: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, March 2014. Available from: http://www.nel.gov/vault/2440/web/files/DietaryPatterns/DPRptFullFinal.pdf

2. National Heart, Lung, and Blood Institute. Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group, 2013. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, 2013. Available from: http://www.nhlbi.nih.gov/guidelines/cvd_adult/lifestyle/index.htm
   Associated Lifestyle Guideline:
   Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2014;63(25 Pt B):2960-84. PMID: 24239922. http://www.ncbi.nlm.nih.gov/pubmed/24239922

3. Huang T, Yang B, Zheng J, Li G, Wahlqvist ML, Li D. Cardiovascular disease mortality and cancer incidence in vegetarians: a meta-analysis and systematic review. Ann Nutr Metab. 2012;60(4):233-40. PMID: 22677895. http://www.ncbi.nlm.nih.gov/pubmed/22677895

4. Martinez-Gonzalez MA, Bes-Rastrollo M. Dietary patterns, Mediterranean diet, and cardiovascular disease. Curr Opin Lipidol. 2014 Feb;25(1):20-6. PMID: 24370845. http://www.ncbi.nlm.nih.gov/pubmed/24370845

5. Rees K, Hartley L, Flowers N, Clarke A, Hooper L, Thorogood M, Stranges S. 'Mediterranean' dietary pattern for the primary prevention of cardiovascular disease.

Cochrane Database Syst Rev. 2013 Aug 12;8:CD009825. PMID: 23939686. http://www.ncbi.nlm.nih.gov/pubmed/23939686

6. Salehi-Abargouei A, Maghsoudi Z, Shirani F, Azadbakht L. Effects of Dietary Approaches to Stop Hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases--incidence: a systematic review and meta-analysis on observational prospective studies. Nutrition. 2013 Apr;29(4):611-8. PMID: 23466047. http://www.ncbi.nlm.nih.gov/pubmed/23466047

7. Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr. 2013 Nov 29:1-14. PMID: 24476641. http://www.ncbi.nlm.nih.gov/pubmed/24476641

8. Yokoyama Y, Nishimura K, Barnard ND, Takegami M, Watanabe M, Sekikawa A, Okamura T, Miyamoto Y. Vegetarian Diets and Blood Pressure: A Meta-analysis. JAMA Intern Med. 2014 Apr;174(4):577-87. PMID: 24566947. http://www.ncbi.nlm.nih.gov/pubmed/24566947

Additional References

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11. Folsom AR, Parker ED, Harnack LJ. Degree of concordance with DASH diet guidelines and incidence of hypertension and fatal cardiovascular disease. Am J Hypertens. 2007;20(3):225-32. PMID: 17324731. http://www.ncbi.nlm.nih.gov/pubmed/17324731.

12. Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, Ruiz-Gutiérrez V, Covas MI, et al. Effects of a Mediterranean-style diet on cardiovascular risk factors: a randomized trial. Ann Intern Med. 2006;145(1):1-11. PMID: 16818923. http://www.ncbi.nlm.nih.gov/pubmed/16818923.
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21. Tortosa A, Bes-Rastrollo M, Sanchez-Villegas A, Basterra-Gortari FJ, Nuñez-Cordoba JM, Martinez-Gonzalez MA. Mediterranean diet inversely associated with the incidence of metabolic syndrome: the SUN prospective cohort. Diabetes Care. 2007;30(11):2957-9. PMID: 17712023. http://www.ncbi.nlm.nih.gov/pubmed/17712023.

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23. Fung TT, Chiuve SE, McCullough ML, Rexrode KM, Logroscino G, Hu FB. Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. Arch Intern Med. 2008;168(7):713-20. PMID: 18413553. http://www.ncbi.nlm.nih.gov/pubmed/18413553.

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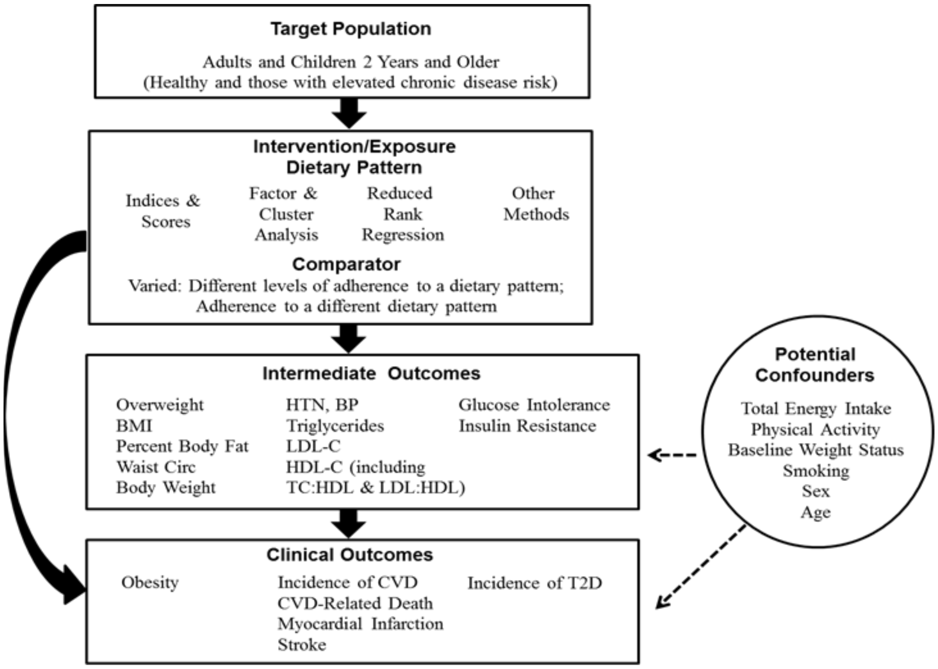
    Associated Guideline
    Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol. 2014;63(25 Pt B):2985-3023. PMID: 24239920. http://www.ncbi.nlm.nih.gov/pubmed/24239920.

Supplementary Information:

*(**Note:** The search and update for the dietary patterns and CVD, body weight, and type 2 diabetes reviews were done simultaneously and are described together below.)*

Analytical Framework



Methodology

The questions examining dietary patterns and risk of CVD, obesity, and type 2 diabetes were answered using existing reports, systematic reviews, and meta-analyses. All three of these questions were addressed in the Nutrition Evidence Library (NEL) Dietary Patterns Systematic Review Project. This project was supported by USDA's Center for Nutrition Policy and Promotion and was informed by a Technical Expert Collaborative of experts in dietary patterns research.[1] Additionally, the DGAC reviewed reports from systematic reviews recently conducted by the National Heart, Lung, and Blood Institute (NHLBI) that included dietary patterns research. For CVD, the DGAC used the NHLBI *Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group* and the associated American Heart Association (AHA)/ American College of Cardiology (ACC) *Guideline on Lifestyle Management to Reduce Cardiovascular Risk*.[2] For body weight, the DGAC used the NHLBI *Managing Overweight and Obesity in Adults: Systematic Evidence Review from the Obesity Expert Panel* and the associated AHA/ACC/ The Obesity Society (TOS) *Guideline for the Management of Overweight and Obesity in Adults*.[24] For all three questions, in an attempt to capture new research published since the searches for these systematic reviews were completed, the Committee considered existing systematic reviews and meta-analyses published in peer-reviewed journals since 2008. The existing systematic reviews and meta-analyses considered

by the DGAC had to meet the general inclusion criteria of the DGAC, and were required to consider dietary patterns and the outcomes of interest.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

(“diet quality” OR dietary pattern* OR diet pattern* OR eating pattern* OR food pattern* OR eating habit* OR dietary habit* OR food habit* OR dietary profile* OR food profile* OR diet profile* OR eating profile* OR dietary guideline* OR dietary recommendation* OR food intake pattern* OR dietary intake pattern* OR diet pattern* OR eating style*) OR

(DASH OR (dietary approaches to stop hypertension) OR "Diet, Mediterranean"[Mesh] OR vegan* OR vegetarian* OR "Diet, Vegetarian"[Mesh] OR “prudent diet” OR “western diet” OR nordiet OR omniheart OR (Optimal Macronutrient Intake Trial to Prevent Heart Disease) OR ((Okinawa* OR "Ethnic Groups"[Mesh] OR “plant based” OR Mediterranean[tiab]OR Nordic) AND (diet[mh] OR diet[tiab] OR food[mh])))
OR
("Guideline Adherence"[Mesh] AND (diet OR food OR eating OR eat OR dietary OR feeding OR nutrition OR nutrient*)) OR (adherence AND (nutrient* OR nutrition OR diet OR dietary OR food OR eat OR eating) AND (guideline* OR guidance OR recommendation*)) OR
(dietary score* OR adequacy index* OR kidmed OR Diet Quality Index* OR Food Score* OR Diet Score* OR MedDietScore OR Dietary Pattern Score* OR “healthy eating index”)OR

((index*[ti] OR score*[ti] OR indexes OR scoring[ti] indices[ti]) AND (dietary[ti] OR nutrient*[ti] OR eating[tiab] OR OR food[ti] OR food[mh] OR diet[ti] OR diet[mh]) AND (pattern* OR habit* OR profile*))

Body weight:
("body size"[tiab] OR body size[mh] OR obesity[tiab] OR obese[tiab] OR obesity[mh] OR overweight [tiab] OR adiposity[tiab] OR adiposity[mh] OR "body weight"[tiab] OR body weight[mh] OR “body-weight related”[tiab] OR "weight gain"[tiab] OR weight gain[mh] OR "weight loss"[tiab] OR Body Weights and Measures[Majr] OR overweight[tiab] OR "Body Composition"[mh] OR "body fat"[tiab] OR adipos*[tiab] OR weight[ti] OR waist[ti] OR "Anthropometry"[Mesh:noexp] OR “body mass index”[tiab] OR BMI[tiab] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab])

CVD:
"Mortality"[Mesh] OR mortality[tiab] OR "blood pressure"[tiab] OR "blood pressure"[mesh] OR "cardiovascular diseases"[mh:noexp] OR cardiovascular disease*[tiab] OR cardiovascular event*[tiab] OR "cholesterol/blood"[mh] OR "Cholesterol, HDL"[Mesh] OR cholesterol[tiab] OR "Cholesterol, Dietary"[Mesh] OR triglyceride* OR stroke[tiab] OR "stroke"[Mesh] OR "Lipids/blood"[Mesh] OR hypertension[tiab] OR "Myocardial Infarction"[Mesh] OR "Myocardial Infarction"[tiab] OR "Heart Failure"[Mesh] OR "Heart Arrest"[Mesh] OR "Myocardial

Ischemia"[Mesh] OR "heart failure"[tiab] OR "heart arrest"[tiab] OR "Myocardial Ischemia"[tiab] OR hypertension[mh]

T2D:
(“insulin resistance”[mh] OR “insulin”[ti] OR inflammation[ti] OR glucose intoleran*[ti] OR "Glucose Intolerance"[Mesh] OR diabetes[ti] OR "Diabetes Mellitus, Type 2"[Mesh] OR "Hemoglobin A, Glycosylated"[Mesh] OR “hemoglobin A1c “[ti] OR (“impaired fasting” AND (glucose OR glycemi*)) OR “onset diabetes” OR “impaired glucose” OR “insulin sensitivity”)

AND limit to: systematic[sb] OR systematic review* OR meta-analys* OR meta analys*

Inclusion Criteria

<u>Date Range:</u>
- Published between January 2008 and April 2014 (in English in a peer-reviewed journal)

<u>Study Design</u>:
- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

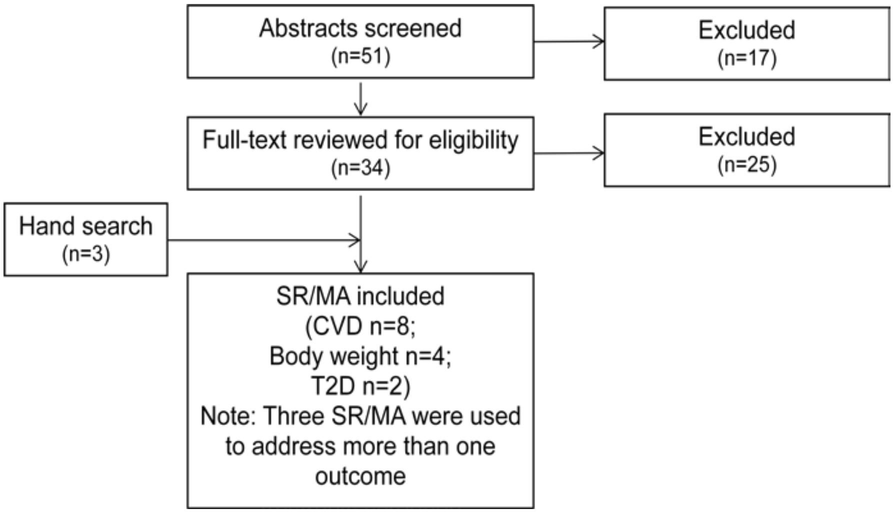
<u>Study Subjects</u>:
- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

<u>Intervention/Exposure</u>:
- Dietary pattern - The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

<u>Outcome:</u>
- CVD: LDL-cholesterol, HDL-cholesterol, triglycerides, blood pressure, incidence of CVD, CVD-related death, myocardial infarction, or stroke
- Body weight: Body mass index, body weight, percent body fat, waist circumference, incidence of overweight or obesity
- Type 2 diabetes: Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

<u>Quality:</u>
- Reviews rated 8-11 on AMSTAR (A measurement tool for the ‘assessment of multiple systematic reviews’)

Search Results



Excluded Articles with Reason for Exclusion

25. Ajala O, English P, Pinkney J. Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes. Am J Clin Nutr. 2013 Mar;97(3):505-16. doi: 10.3945/ajcn.112.042457. Epub 2013 Jan 30. Review. PubMed PMID: 23364002. EXCLUDE: Examined subjects diagnosed with type 2 diabetes (management of type 2 diabetes)

26. Akesson A, Andersen LF, Kristjánsdóttir AG, Roos E, Trolle E, Voutilainen E, Wirfält E. Health effects associated with foods characteristic of the Nordic diet: a systematic literature review. Food Nutr Res. 2013;57. doi: 10.3402/fnr.v57i0.22790. Review. PubMed PMID: 24130513; PubMed Central PMCID: PMC3795297. EXCLUDE: Examined individual components of the diet, not dietary patterns as defined by the Subcommittee

27. Aljadani H., Patterson A., Sibbritt D., Collins C. The association between dietary patterns and weight change in adults over time: A systematic review of studies with follow up. JBI Database of Systematic Reviews and Implementation Reports 2013 11:8 (272-316) EXCLUDE: Did not examine dietary patterns as defined by the Subcommittee

28. Al-Khudairy L, Stranges S, Kumar S, Al-Daghri N, Rees K. Dietary factors and type 2 diabetes in the Middle East: what is the evidence for an association?--a systematic review. Nutrients. 2013 Sep 26;5(10):3871-97. doi: 10.3390/nu5103871. PubMed PMID: 24077241; PubMed Central PMCID: PMC3820049. EXCLUDE: Not all countries in the Middle East are of high or very high development according to the Human Development Index

29. Barbaresko J, Koch M, Schulze MB, Nöthlings U. Dietary pattern analysis and biomarkers of low-grade inflammation: a systematic literature review. Nutr Rev. 2013 Aug;71(8):511-27. doi: 10.1111/nure.12035. Epub 2013 Jun 13. Review. PubMed PMID: 23865797. EXCLUDE: Outcomes were inflammatory markers, which were not included as intermediate outcomes in the Subcommittee’s analytical framework

30. Buckland G, Bach A, Serra-Majem L. Obesity and the Mediterranean diet: a systematic review of observational and intervention studies. Obes Rev. 2008 Nov;9(6):582-93. doi: 10.1111/j.1467-789X.2008.00503.x. Epub 2008 Jun 10. Review. PubMed PMID: 18547378 EXCLUDE: AMSTAR rating was 7 of 11

31. Carter P, Achana F, Troughton J, Gray LJ, Khunti K, Davies MJ. A Mediterranean diet improves HbA1c but not fasting blood glucose compared to alternative dietary strategies: a network meta-analysis. J Hum Nutr Diet. 2013 Jun 22. doi: 10.1111/jhn.12138. [Epub ahead of print] PubMed PMID: 23790149. EXCLUDE: Half of the studies included in the meta-analyses only included participants with T2D or CVD

32. Chan M.Y., Yulianna Y. Effect of mediterranean diet components on selected cardiovascular risk factors, all-cause mortality and cardiovascular mortality: Systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1093) EXCLUDE: Abstract, not a full article

33. Defagó M., Elorriaga N., Irazola V., Rubinstein A.Association between food patterns and biomarkers of endothelial function: A systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1282) EXCLUDE: Outcomes were biomarkers of endothelial function, which were not included as intermediate outcomes in the Subcommittee’s analytical framework

34. Dong JY, Zhang ZL, Wang PY, Qin LQ. Effects of high-protein diets on body weight, glycaemic control, blood lipids and blood pressure in type 2 diabetes: meta-analysis of randomised controlled trials. Br J Nutr. 2013 Sep 14;110(5):781-9. doi: 10.1017/S0007114513002055. Epub 2013 Jul 5. Review. PubMed PMID: 23829939. EXCLUDE: Participants were diagnosed with type 2 diabetes

35. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Mediterranean diet and metabolic syndrome: an updated systematic review. Rev Endocr Metab Disord. 2013 Sep;14(3):255-63. doi: 10.1007/s11154-013-9253-9. PubMed PMID: 23982678. EXCLUDE: Included cross-sectional studies; examined incidence of metabolic syndrome, which is outside the scope of the Subcommittee’s analytical framework

36. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. Metab Syndr Relat Disord. 2010 Dec;8(6):471-6. doi: 10.1089/met.2010.0009. Epub 2010 Oct 19. Review. PubMed PMID: 20958207. EXCLUDE: Of the 10 included studies, 8 were included in the NEL and Alhamzi reviews being considered by the Committee

37. Esposito K, Maiorino MI, Ceriello A, Giugliano D. Prevention and control of type 2 diabetes by Mediterranean diet: a systematic review. Diabetes Res Clin Pract. 2010 Aug;89(2):97-102. doi: 10.1016/j.diabres.2010.04.019. Epub 2010 May 23. Review. PubMed PMID: 20546959. EXCLUDE: Only 3 studies looked at prevention and one was cross-sectional

38. Grosso G, Mistretta A, Frigiola A, Gruttadauria S, Biondi A, Basile F, Vitaglione P, D'Orazio N, Galvano F. Mediterranean diet and cardiovascular risk factors: a systematic review. Crit Rev Food Sci Nutr. 2014;54(5):593-610. doi: 10.1080/10408398.2011.596955. PubMed PMID: 24261534. EXCLUDE: Included cross-sectional studies; included various outcomes

not included in the Subcommittee's analytical framework, including incidence of metabolic syndrome, CRP, IL-6, liver transaminases, etc.

39. Hu T, Mills KT, Yao L, Demanelis K, Eloustaz M, Yancy WS Jr, Kelly TN, He J, Bazzano LA. Effects of low-carbohydrate diets versus low-fat diets on metabolic risk factors: a meta-analysis of randomized controlled clinical trials. Am J Epidemiol. 2012 Oct 1;176 Suppl 7:S44-54. doi: 10.1093/aje/kws264. PubMed PMID: 23035144; PubMed Central PMCID: PMC3530364. EXCLUDE: Did not examine dietary patterns as described by the Subcommittee

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41. Kant AK. Dietary patterns: biomarkers and chronic disease risk. Appl Physiol Nutr Metab. 2010 Apr;35(2):199-206. doi: 10.1139/H10-005. Review. PubMed PMID: 20383233. EXCLUDE: Narrative review

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43. Kastorini CM, Milionis HJ, Goudevenos JA, Panagiotakos DB. Mediterranean diet and coronary heart disease: is obesity a link? - A systematic review. Nutr Metab Cardiovasc Dis. 2010 Sep;20(7):536-51. doi: 10.1016/j.numecd.2010.04.006. Review. PubMed PMID: 20708148. EXCLUDE: Included cross-sectional studies and secondary prevention studies

44. Kastorini CM, Panagiotakos DB. Dietary patterns and prevention of type 2 diabetes: from research to clinical practice; a systematic review. Curr Diabetes Rev. 2009 Nov;5(4):221-7. Review. PubMed PMID: 19531025. EXCLUDE: Included cross-sectional and case-control studies

45. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the Dietary Approaches to Stop Hypertension (DASH) diet: a systematic review. PLoS One. 2013;8(10):e78412. doi: 10.1371/journal.pone.0078412. PubMed PMID: 24205227; PubMed Central PMCID: PMC3813594. EXCLUDE: Examined compliance to the DASH diet

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review was to describe indices being used with children and adolescents – only brief mention of body weight and no conclusions drawn.

48. Martínez-González MÁ, Martín-Calvo N. The major European dietary patterns and metabolic syndrome. Rev Endocr Metab Disord. 2013 Sep;14(3):265-71. doi: 10.1007/s11154-013-9264-6. PubMed PMID: 23979531. EXCLUDE: Narrative review

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51. Nordmann A.J., Suter K., Tuttle K.R., Estruch R., Shai I., Bucher H. Meta-analysis of Mediterranean versus low-fat diets to improve cardiovascular risk factors. European Heart Journal 2010 31 SUPPL. 1 (940) EXCLUDE: Abstract, not a full article

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54. Santos FL, Esteves SS, da Costa Pereira A, Yancy WS Jr, Nunes JP. Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors. Obes Rev. 2012 Nov;13(11):1048-66. doi: 10.1111/j.1467-789X.2012.01021.x. Epub 2012 Aug 21. Review. PubMed PMID: 22905670. EXCLUDE: Did not examine dietary patterns as described by the SC

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10.1016/j.nut.2012.12.021. Epub 2013 Mar 6. Review. PubMed PMID: 23473733. EXCLUDE: Review included articles with less than 30 participants per study arm

57. Smithers LG, Golley RK, Brazionis L, Lynch JW. Characterizing whole diets of young children from developed countries and the association between diet and health: a systematic review. Nutr Rev. 2011 Aug;69(8):449-67. doi: 10.1111/j.1753-4887.2011.00407.x. Review. PubMed PMID: 21790612. EXCLUDE: Included cross-sectional studies; focus of the review was to describe what is currently known about measures of dietary patterns in early life and the general association between dietary patterns and child health and development – only brief mention of body weight

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63. Vadiveloo M, Dixon LB, Parekh N. Associations between dietary variety and measures of body adiposity: a systematic review of epidemiological studies. Br J Nutr. 2013 May;109(9):1557-72. doi: 10.1017/S0007114512006150. Epub 2013 Feb 27. Review. PubMed PMID: 23445540. EXCLUDE: Examined dietary variety, not dietary patterns

64. Wheeler ML, Dunbar SA, Jaacks LM, Karmally W, Mayer-Davis EJ, Wylie-Rosett J, Yancy WS Jr. Macronutrients, food groups, and eating patterns in the management of diabetes: a systematic review of the literature, 2010. Diabetes Care. 2012 Feb;35(2):434-45. doi:

10.2337/dc11-2216. Review. PubMed PMID: 22275443; PubMed Central PMCID: PMC3263899. EXCLUDE: Only included studies with people with type 2 diabetes

65. Yuliana Y., Chan M.Y. Effect of mediterranean diet components on selected cardiovascular risk factors, all-cause mortality and cardiovascular mortality: Systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (981) EXCLUDE: Abstract, not a full article

66. Zhang Z, Wang J, Chen S, Wei Z, Li Z, Zhao S, Lu W. Comparison of Vegetarian Diets and Omnivorous Diets on Plasma Level of HDL-c: A Meta-Analysis. PLoS One. 2014 Mar 26;9(3):e92609. doi: 10.1371/journal.pone.0092609. eCollection 2014.PubMed PMID: 24671216. EXCLUDE: Included cross-sectional studies in meta-analysis

Appendix E2.27: Evidence Portfolio

Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes

What is the relationship between dietary patterns and measures of body weight or obesity?

Conclusion Statement: The DGAC concurs with the 2013 AHA/ACC/TOS *Guideline for the Management of Overweight and Obesity*[1] that strong evidence demonstrates that, preferably as part of a comprehensive lifestyle intervention carried out by multidisciplinary teams of professionals or nutrition professionals, overweight and obese adults can achieve weight loss through a variety of dietary patterns that achieve an energy deficit. Clinically meaningful weight losses that were achieved ranged from 4 to 12 kg at 6-month follow-up. Thereafter, slow weight regain is observed, with total weight loss at 1 year of 4 to 10 kg and at 2 years of 3 to 4 kg. However, some dietary patterns may be more beneficial in the long-term for cardiometabolic health.

DGAC Grade: Strong

The DGAC concurs with the NEL Dietary Patterns Systematic Review Project[2] that moderate evidence indicates dietary patterns that are higher in vegetables, fruits, and whole grains; include seafood and legumes; are moderate in dairy products (particularly low and non-fat dairy) and alcohol; lower in meats (including red and processed meats), and low in sugar-sweetened foods and beverages, and refined grains are associated with favorable outcomes related to healthy body weight (including lower BMI, waist circumference, or percent body fat) or risk of obesity. Components of the dietary patterns associated with these favorable outcomes include higher intakes of unsaturated fats and lower intakes of saturated fats, cholesterol, and sodium.

DGAC Grade: Moderate

Evidence for children is limited, but studies in the NEL Dietary Patterns Systematic Review Project and the systematic review focused on this age group by Ambrosini et al.[3] suggest that dietary patterns in childhood or adolescence that are higher in energy-dense and low-fiber foods, such as sweets, refined grains, and processed meats, as well as sugar-sweetened beverages, whole milk, fried potatoes, certain fats and oils, and fast foods increase the risk of obesity later on in life.

DGAC Grade: Limited

Review of Evidence

The DGAC considered evidence from the 2013 AHA/ACC/TOS *Guideline for the Management of Overweight and Obesity in Adults* and associated NHLBI Obesity Report,[1] which included only randomized trials, the NEL Dietary Patterns Systematic Review Project,[2] which included 38 studies predominately of prospective cohort design and a few randomized trials, and two systematic reviews/meta-analyses published since 2008.[3, 4] In total, 81 articles were considered in these reports. The published reviews provided evidence for the pediatric population (included 7 studies of which 2 overlapped with those in the NEL review) and further evidence for dietary patterns related to the Mediterranean-style diet and its effect on obesity and weight loss (all randomized trials of which 1 out of the 16 studies overlapped with the NEL review).

Dietary Patterns and the Management of Overweight and Obesity

In the NHLBI Obesity Report, the 12 randomized studies described in summary Table 3.1 of the report all confirm that to lose weight, a variety of dietary pattern approaches can be used and a reduction in caloric intake is required. The energy balance equation requires that for weight loss, one must consume less energy than one expends or expend more energy than one consumes. The report states that any one of the following methods can be used to reduce food and calorie intake: prescription of 1,200 to 1,500 kcal/day for women and 1,500 to 1,800 kcal/day for men (kcal levels are usually adjusted for the individual's body weight); prescription of a 500 kcal/day or 750 kcal/day energy deficit; or prescription of an evidence-based diet that restricts certain food types (such as high-carbohydrate foods, low-fiber foods, or high-fat foods) in order to create an energy deficit by reduced food intake.

For the different dietary approaches (provided either as part of a comprehensive lifestyle change intervention carried out by a multi-disciplinary team of trained professionals or within nutrition interventions conducted by nutrition professionals) that the authors of the report evaluated, it is evident that all prescribed diets that achieved an energy deficit were associated with weight loss. There was no apparent superiority of one approach when behavioral components were balanced in the treatment arms. Results indicated that average weight loss is maximal at 6 months with smaller losses maintained for up to 2 years, while treatment and follow-up taper. Weight loss achieved by dietary techniques aimed at reducing daily energy intake ranges from 4 to 12 kg at 6-month follow-up. Thereafter, slow weight regain is observed, with total weight loss at 1 year of 4 to 10 kg and at 2 years of 3 to 4 kg. The following dietary approaches are associated with weight loss if reduction in dietary energy intake is achieved:

- A diet from the European Association for the Study of Diabetes Guidelines, which focuses on targeting food groups, rather than formal prescribed energy restriction while still achieving an energy deficit.
- Higher protein (25 percent of total calories from protein, 30 percent of total calories from fat, 45 percent of total calories from carbohydrate) with provision of foods that realized energy deficit.
- Higher protein Zone™-type diet (5 meals/day, each with 40 percent of total calories from carbohydrate, 30 percent of total calories from protein, 30 percent of total calories from fat) without formal prescribed energy restriction but realized energy deficit.

- Lacto-ovo-vegetarian-style diet with prescribed energy restriction.
- Low-calorie diet with prescribed energy restriction.
- Low-carbohydrate (initially less than 20 g/day carbohydrate) diet without formal prescribed energy restriction but realized energy deficit.
- Low-fat (10 percent to 25 percent of total calories from fat) vegan-style diet without formal prescribed energy restriction but realized energy deficit.
- Low-fat (20 percent of total calories from fat) diet without formal prescribed energy restriction but realized energy deficit.
- Low-glycemic load diet, either with formal prescribed energy restriction or without formal prescribed energy restriction but with realized energy deficit.
- Lower fat (≤30 percent fat), high dairy (4 servings/day) diets with or without increased fiber and/or low-glycemic index/load foods (low-glycemic load) with prescribed energy restriction.
- Macronutrient-targeted diets (15 percent or 25 percent of total calories from protein; 20 percent or 40 percent of total calories from fat; 35 percent, 45 percent, 55 percent, or 65 percent of total calories from carbohydrate) with prescribed energy restriction.
- Mediterranean-style diet with prescribed energy restriction.
- Moderate protein (12 percent of total calories from protein, 58 percent of total calories from carbohydrate, 30 percent of total calories from fat) with provision of foods that realized energy deficit.
- Provision of high-glycemic load or low-glycemic load meals with prescribed energy restriction.
- The AHA-style Step 1 diet (with prescribed energy restriction of 1,500 to 1,800 kcal/day, <30 percent of total calories from fat, <10 percent of total calories from saturated fat).

Although these dietary patterns with an energy deficit will result in weight loss during a 6-months to 2-year period, long-term health implications with certain patterns may be detrimental to cardiometabolic health. These associations have been discussed in the dietary patterns and cardiovascular health section as well as the saturated fat and cardiovascular health section.

Dietary Patterns and their Association with Body Weight

A total of 14 studies met the inclusion criteria for the index/score question of the NEL systematic review and were categorized based on dietary pattern exposure. Two major categories were identified: (1) studies that examined exposure based on a Mediterranean-designated dietary pattern and (2) studies that examined exposure based on expert dietary guidelines recommendations. Taken together, there were six studies on Mediterranean-designated diet scores,[5-10] five studies on dietary guidelines-based indices,[11-15] two studies on Mediterranean-designated scores and dietary guidelines indices,[16, 17] and one study that used a trial-based customized score.[18] Two of the studies were RCTs of positive quality[5, 18] and 12 were prospective cohort studies. The studies were carried out between 2006 and 2012.

The sample sizes for prospective cohort studies ranged from 732 to 373,803 participants, with follow-up times from 1.5 to 20 years. Ten out of 12 of the prospective cohort studies were conducted with generally healthy adults with a mean age of 25 to 63 years. Two studies were conducted with children and adolescents (one with girls).[11, 12] The two RCTs were conducted in adults with elevated chronic disease risk: one study with a Mediterranean-designated diet intervention on older adults at increased CVD risk with more than 90 percent overweight or obese[5] and one study using an a priori diet intervention on men with pre-existing metabolic syndrome.[18] The sample sizes for the RCTs were from 187 to 769 subjects and duration of follow-up ranged from 3 to 12 months.

Mediterranean-style Dietary Pattern

Four out of the six studies evaluating the Mediterranean style dietary pattern were conducted in Spain.[5, 7-9] Of the other two, one study was the European multicenter study that was part of the EPIC-Physical Activity, Nutrition, Alcohol Consumption, Cessation of Smoking, Eating out of Home, and Obesity (EPIC-PANACEA) study,[10] and one was conducted in the United States.[6]

Dietary Patterns and Body Weight and Incidence of Overweight and/or Obesity

The Prevencion con Dieta Mediterranean (PREDIMED) study tested the effects of a Mediterranean diet on the primary prevention of cardiovascular disease in a high-risk group of men and women. Subjects either had type 2 diabetes or three cardiovascular disease risk factors (such as hypertension or current smoking) and 90 percent were overweight or obese defined as BMI ≥25 kg/m^2. The PREDIMED trial randomly assigned participants to three interventions: (1) Mediterranean diet with extra virgin olive oil, (2) Mediterranean diet with mixed nuts, and (3) low-fat diet. At end of 3 months of a 4-year clinical trial, the authors found that the Mediterranean diet score increased in the two Mediterranean diet groups of the trial and remained unchanged in the low-fat group. However, no significant changes in body weight and adiposity occurred within or between groups from baseline to the 3 months. Beunza et al., 2010 reported on a prospective cohort study in Spain, the Seguimiento Universidad de Navarra (SUN) study.[8] Participants with the highest adherence to a Mediterranean dietary pattern, assessed using the Trichopoulou Mediterranean Diet Score (MDS) were found to have lower average yearly weight gain, -0.059 kg/y (95% CI = -0.111 to -0.008 kg/y; p for trend = 0.02), than participants in the lowest adherence group.[19] However, the MDS was not associated with incidence of overweight or obesity in participants who were normal weight at baseline. Mendez et al., 2006 reported on the EPIC-Spain prospective cohort study.[9] Adherence to a Mediterranean diet was assessed using a slight modification of the Trichopoulou MDS, with exposure categorized in tertiles of low (0-3), medium (4-5), and high (6-8) adherence. Participants with highest MDS adherence had reduced incidence of obesity when overweight at baseline; overweight women and men were 27 percent and 29 percent, respectively, less likely to become obese. High MDS adherence was not associated with incidence of overweight in subjects who were normal weight at baseline. The EPIC-PANACEA study examined the association between adherence to the relative Mediterranean dietary pattern (rMDS), prospective weight change, and the incidence of overweight or obesity. Participants with high rMED adherence gained less weight in 5 years than did participants with low rMED adherence (-0.16 kg; 95% CI = -0.24 to -0.07 kg) and had a 10 percent lower odds of becoming overweight or obese (OR = 0.90; 95% CI = 0.82 to 0.96). The contribution of each rMED scoring component also was assessed and it was found that the association between rMED and weight change was no longer significant when meat and meat products were not part of the score. Lastly, a meta-analysis of the odds ratio scores of all 10 European countries showed that a 2-point increase in rMED score was associated with 3 percent (95% CI = 1 to 5%) lower odds of becoming overweight or obese over 5 years.

Dietary Patterns and Waist Circumference

Rumawas et al., 2009 conducted a prospective cohort study using a subset of the Framingham Offspring and Spouse (FOS) study.[6] Dietary exposure was assessed in quintiles of low to high adherence to the Mediterranean style dietary pattern score (MSDPS). Participants with a higher MSDPS had significantly lower waist circumference (p for trend < 0.001). Tortosa et al., 2007 reported on the association of the Mediterranean dietary pattern and metabolic syndrome in the SUN study conducted in Spain.[7] Participants in the highest tertile of adherence to the MDS had lower waist circumference, -0.05 cm over 6 years (p for trend = 0.038), compared to the lowest tertile.

Although some mixed results from prospective studies may be due to differences in the length of follow up, definition of the Mediterranean dietary pattern and population included, the results of randomized studies indicate a significant reduction in body weight when calories are restricted. A high quality meta-analysis (AMSTAR rating of 11) on the association of a Mediterranean-style diet with body weight conducted by Esposito included 16 randomized studies of which one[7] overlapped with the NEL systematic review was included in the DGAC body of evidence for this question. The meta-analysis included studies conducted in the United States, Italy, Spain, France, Israel, Greece, Germany, and the Netherlands that lasted from 4 weeks to 24 months with a total of 3,436 participants. Using a random effects model, participants in the Mediterranean diet group had significant weight loss (mean difference between Mediterranean diet and control diet, -1.75 kg; 95% CI = -2.86 to -0.64) and reduction in BMI (mean difference, -0.57 kg/m^2; 95% CI = 0.93 to 0.21 kg/m^2) compared to those in the control arm. The effect of Mediterranean diet on body weight was greater in association with energy restriction (mean difference, -3.88 kg; 95% CI = -6.54 to -1.21 kg), increased physical activity (-4.01 kg; 95% CI = -5.79 to -2.23 kg), and follow up longer than 6 months (-2.69 kg; 95% CI = -3.99 to -1.38 kg). Across all 16 studies, the Mediterranean style dietary pattern did not cause weight gain.

Dietary Guidelines-Based Indices

Of the seven studies conducted on dietary guidelines-based indices, three studies were conducted in the United States with U.S.-based indices.[11, 13, 15] One study was conducted in

Germany with an index developed in the United States,[12] and two studies were conducted in France (one used a French index,[14] and the other compared six different dietary scores).[16]

Dietary Patterns and Body Weight and Incidence of Overweight and/or Obesity

Gao et al., 2008 reported on a prospective cohort study of White, African American, Hispanic, and Chinese men and women in the Multi-Ethnic Study of Atherosclerosis (MESA) in the US. Two versions of the 2005 HEI were used: the original and a modified version that adjusted the food group components to incorporate levels of caloric need based on sex, age, and activity level.[13] For the overall population, there was an inverse association between quintiles of each HEI score and BMI ($p<0.001$). The risk of obesity in normal weight participants was inversely associated with HEI scores only for Whites ($p<0.05$). A comparison of the HEI-1995 and HEI-2005 scores indicated that beta-coefficients, as predictors of body weight and BMI, were higher for the HEI-2005 scores in Whites. Zamora et al., 2010 analyzed data from the prospective cohort study, Coronary Artery Risk Development in Young Adults (CARDIA), conducted in the United States, to examine the association between diets consistent with the 2005 Dietary Guidelines and subsequent weight gain in Black and White young adults.[15] The Diet Quality Index (DQI) included 10 components of the 2005 Dietary Guidelines relating to the consumption of total fat, saturated fat, cholesterol, added sugars, reduced-fat milk, fruit, vegetables, whole grains, nutrient-dense foods, and limited sodium and alcohol intake. They found, a 10-point increase in DQI score was associated with a 10 percent lower risk of gaining 10 kg in normal-weight Whites. However, the same magnitude increase in score was associated with a 15 percent higher risk in obese Blacks ($p<0.001$). Kesse-Guyot et al., 2009 conducted a prospective cohort study in France to examine the association between adherence to a dietary score based on the French 2001 nutritional guidelines (Programme National Nutrition Sante´ guidelines score (PNNS-GS) and changes in body weight, body fat distribution, and obesity risk.[14] The PNNS-GS includes 12 nutritional components: fruit and vegetables, starchy foods, whole grains, dairy products, meat, seafood, added fat, vegetable fat, sweets, water and soda, alcohol, and salt. The last PNNS-GS component is physical activity. In fully adjusted models, an increase of one PNNS-GS unit was associated with lower weight gain ($P=0.004$), and lower BMI gain ($P=0.002$). An increase of 1 PNNS-GS unit was associated with a lower probability of becoming overweight (including obese) (OR = 0.93; 95% CI = 0.88 to 0.99). Similarly, an increase of 1 PNNS-GS unit was associated with a lower probability of becoming obese (OR = 0.89; 95% CI = 0.80 to 0.99).

Two studies were conducted in children. Cheng et al., 2010 analyzed data from a prospective cohort study conducted in Germany, the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) study, to examine whether the diet quality of healthy children before puberty was associated with body composition at onset of puberty.[12] Adherence to a diet pattern was assessed by the Revised Children's Diet Quality Index (RC-DQI) which was based on the Dietary Guidelines for Americans. In this study, a higher dietary quality was associated with a higher energy intake, and children with a lower diet quality had lower BMI and Fat Mass Index (FMI) Z-scores at baseline ($p<0.01$) but not at onset of puberty. Berz et al., 2011 reported on a prospective cohort study to assess the effects of the DASH eating pattern on BMI in adolescent females over a 10-year period.[11] Only seven out of the 10 original components of the DASH score were used; the three excluded were added sugars, discretionary fats and oils, and alcohol. Overall, girls in the highest vs. lowest quintile of DASH score had an adjusted mean BMI of 24.4 vs. 26.3 kg/m2 ($p<0.05$).

Dietary Patterns and Waist Circumference

Gao et al, found, for the overall population in the MESA study, an inverse association between quintiles of each HEI score and waist circumference (WC) ($p<0.001$).[13] The study by Kesse-Guyot conducted in France showed, in fully adjusted models, an increase of one PNNS-GS unit was associated with lower waist circumference gain ($p=0.01$) and lower waist-to-hip ratio gain ($P=0.02$).[14]

Other Indices

Jacobs et al., 2009 conducted an RCT in Norway, the Oslo Diet and Exercise Study, to examine the effect of changes in diet patterns on body weight and other outcomes among men who met the criteria for the metabolic syndrome (n=187 men).[18] Study participants were randomly assigned to: (1) the diet protocol, (2) the exercise protocol, (3) the diet + exercise protocol, or (4) the control protocol. The trial duration was 12 months. The authors created their own diet score to assess adherence to the intervention. The score was based on summing the participants ranking of intake (across tertiles) of 35 food groups that, based on the literature, had a beneficial neutral or detrimental effect on health. A higher score reflected greater adherence to the diet intervention. Over the course of the intervention, the diet score increased by 2 points (SD ±5.5) in both diet groups, with a decrease of an equivalent amount in the exercise and control groups. A 10-point change in the diet score during the intervention period was associated with a 3.5 kg decrease in weight, a 2.8 cm decrease in waist circumference and 1.3 percent decrease in percent body fat (all significant at $p<0.0001$).

Studies that Compared Various Dietary Indices

In a study by Lassale et al., subjects were participants in the SUpplementation en VItamines et Minereaux AntioXydants (SU.VI.MAX) study and diet quality was assessed using a Mediterranean Score (MDS, rMED, MSDPS), the Diet Quality Index-International (DQI-I), the 2005 Dietary Guidelines for Americans Adherence Index (DGAI), and the French Programme National Nutrition Sante-Guidelines Score (PNNS-GS).[16] Overall, better adherence to a Mediterranean diet (except for the MSDPS) or expert dietary guidelines was associated with lower weight gain in men who were normal weight at baseline (p for trend = <0.05). In addition, among the 1,569 non-obese men at baseline, the odds of becoming obese associated with one standard deviation increase in dietary score ranged from OR = 0.63 (95% CI = 0.51 to 0.78) for the DGAI to OR = 0.72 (95% CI = 0.59 to 0.88) for the MDS, only the MSDPS was non-significant. In women, no association between diet scores and weight gain or incidence of obesity was found. Woo et al., 2008 reported on a prospective cohort study in Hong Kong to examine adherence to a diet pattern using the MDS and the Diet Quality Index International

(DQI-I).[17] They found that increased adherence to either the MDS or DQI-I was not associated with becoming overweight.

Dietary Patterns from Data-Driven Methods

In the NEL review, a total of 11 studies from prospective cohort studies were included that either used factor or cluster analyses to derive dietary patterns. Eight of the eleven studies were conducted in the United States, with additional studies from the United Kingdom, Iran, and Sweden. The sample sizes ranged from 206 to 51,670 participants with follow-up times from 3 to 20 years. The majority of the studies were conducted with generally healthy adult men and women,[20-25] five studies included women only,[26-30] and one was conducted in children to examine weight gain in adolescence over the period of follow-up.[29] Outcomes examined included change in body weight (3 studies), BMI (7 studies), and waist circumference (6 studies); one study examined both percent body fat and incidence of overweight/obesity.

Most of the studies found at least two generic food patterns: a “healthy/prudent” food pattern and an “unhealthy/western” pattern. Generally, healthy patterns were associated with more favorable body weight outcomes, while the opposite was seen for unhealthy patterns. However, not all studies reported significant associations. There was a potential difference in associations found by sex: of the three studies that analyzed men and women separately, men tended to have null results. However, data were insufficient to draw conclusions about population subgroups. Furthermore, because the patterns are data-driven, they represent what was consumed by the study population, and thus it is difficult to compare across the disparate patterns. The one study that analyzed the dietary patterns of pre-pubescent children transitioning into adolescence showed that patterns vary widely at this age and caution should be observed when analyzing these data because the diet of children changes rapidly, as does their weight.

The DGAC considered the systematic review by Ambrosini et al. that included seven articles, two of which overlapped with the NEL review.[3] Results demonstrated a positive association between a dietary pattern high in energy-dense, high fat, and low fiber foods and later obesity (4 of the 7 studies), while three studies demonstrated null associations. The seven longitudinal studies of children from the United Kingdom, United States, Australia, Norway, Finland, and Colombia had follow-up periods ranging from 2 to 21 years and had sample sizes from 427 to 6772 individuals. The studies determined dietary patterns using factor or cluster analysis (5) or reduced rank regression (2).

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between dietary patterns and measures of body weight or obesity

Question/ Purpose AMSTAR Rating*	Dietary Patterns and Outcomes	Included Studies** (Number and Study Design)	Evidence/ Conclusion Statement from Existing Report/ SR/ MA

NEL Dietary Patterns Systematic Review Project, 2014			
Overarching Finding/ Recommendation: More favorable outcomes related to body weight or risk of obesity were observed when there was increased adherence to a diet that emphasized fruits, vegetables, and whole grains. Some studies also reported more favorable body weight status over time with regular intake of fish and legumes, moderate intake of dairy products (particularly low-fat dairy) and alcohol, and low intake of meat (including red and processed meat), sugar-sweetened foods and drinks, refined grains, saturated fat, cholesterol, and sodium.			
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using an index or score, and measures of body weight or obesity?	Dietary pattern assessed using index/score methodology Body weight, BMI, percent body fat, waist circumference, overweight, obesity	14 12 PCS (from 10 cohorts); 2 RCT	There is moderate evidence that, in adults, increased adherence to dietary patterns scoring high in fruits, vegetables, whole grains, legumes, unsaturated oils, and fish; low in total meat, saturated fat, cholesterol, sugar-sweetened foods and drinks and sodium; and moderate in dairy products and alcohol is associated with more favorable outcomes related to body weight or risk of obesity, with some reports of variation based on gender, race or body weight status. (Moderate)
Are prevailing patterns of dietary intake in a population, assessed using cluster or factor analyses, related to the risk of obesity?	Dietary pattern assessed using factor or cluster analysis Body weight, BMI, percent body fat, waist circumference, overweight, obesity	11 11 PCS	Limited and inconsistent evidence from epidemiological studies examining dietary patterns derived using factor or cluster analysis in adults found that consumption of a dietary pattern characterized by vegetables, fruits, whole grains and reduced-fat dairy products tends to be associated with more favorable body weight status over time than consumption of a dietary pattern characterized by red meat, processed meats, sugar-sweetened foods and drinks, and refined grains. (Limited)
What combinations of food intake, assessed using reduced rank regression, explain the most variation in risk of obesity?	Dietary pattern assessed using reduced rank regression Body weight, BMI, percent body fat, waist circumference, overweight, obesity	6 6 PCS	There are a number of methodological differences among the studies examining the relationship between dietary patterns derived using reduced rank regression and body weight status. The disparate nature of these studies made it difficult to compare results, and therefore, no conclusions were drawn. (Grade not Assignable)
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using methods other than index/score, cluster or factor, or reduced rank regression analyses, and body weight status?	Dietary pattern assessed using methodologies other than index, factor, cluster, or reduced rank regression analyses Body weight, BMI, percent body fat, waist circumference, overweight, obesity	7 4 RCT; 3 PCS	There is moderate evidence that adherence to a dietary pattern that emphasizes vegetables, fruits, and whole grains is associated with modest benefits in preventing weight gain or promoting weight loss in adults. (Moderate)

Managing overweight and obesity in adults: Systematic evidence review from the Obesity Expert Panel (National Heart, Lung, and Blood Institute, 2013)

AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults (Jensen, 2013)

Overarching Finding/ Recommendation: Prescribe a diet to achieve reduced calorie intake for obese or overweight individuals who would benefit from weight loss, as part of a comprehensive lifestyle intervention. Any one of the following methods can be used to reduce food and calorie intake:

a. Prescribe 1,200–1,500 kcal/day for women and 1,500–1,800 kcal/day for men (kcal levels are usually adjusted for the individual's body weight);
b. Prescribe a 500 kcal/day or 750 kcal/day energy deficit; or
c. Prescribe one of the evidence-based diets that restricts certain food types (such as high-carbohydrate foods, low-fiber foods or high-fat foods) in order to create an energy deficit by reduced food intake.

Prescribe a calorie restricted diet, for obese and overweight individuals who would benefit from weight loss, based on the patient's preferences and health status and preferably refer to a nutrition professional* for counseling. A variety of dietary approaches can produce weight loss in overweight and obese adults, as presented in CQ3, Evidence Statement 2 (Strong)

In overweight or obese adults, what is the comparative efficacy/ effectiveness of diets of differing forms and structures (macronutrient content, CHO and fat quality, nutrient density, amount of energy deficit, dietary pattern) or other dietary weight loss strategies (e.g., meal timing, portion controlled meal replacements) in achieving or maintaining weight loss? During weight loss or weight maintenance after weight loss, what are the comparative health benefits or harms of the above diets and other dietary weight loss strategies?	• Low calorie • Very low-calorie diet (VLCD) • Low-fat • High-fiber • High-protein • High-carbohydrate • Low-carbohydrate • Scheduling (meals and meal pattern) • Carbohydrate counting • Meal replacement • Low glycemic index • Glycemic load • Dietary Approaches to Stop Hypertension (DASH) • Omni • Atkins • Vegetarian • Therapeutic Lifestyle Changes • Portfolio • Ketogenic • Mediterranean • South Beach® • Zone® • Ornish • Pritikin • Energy density • Portion control • Volumetrics Reduction in body weight as	18 18 articles from 12 RCT	ES 2. A variety of dietary approaches can produce weight loss in overweight and obese adults. All of the following dietary approaches (listed in alphabetical order below) are associated with weight loss if reduction in dietary energy intake is achieved: • A diet from the European Association for the Study of Diabetes Guidelines, which focuses on targeting food groups, rather than formal prescribed energy restriction while still achieving an energy deficit. • Higher protein (25% of total calories from protein, 30% of total calories from fat, 45% of total calories from carbohydrate) with provision of foods that realized energy deficit • Higher protein Zone®-type diet (5 meals/day, each with 40% of total calories from carbohydrate, 30% of total calories from protein, 30% of total calories from fat) without formal prescribed energy restriction but realized energy deficit • Lacto-ovo-vegetarian-style diet with prescribed energy restriction • Low-calorie diet with prescribed energy restriction • Low-carbohydrate (initially <20 g/day carbohydrate) diet without formal prescribed energy restriction but realized energy deficit • Low-fat (10% to 25% of total calories from fat) vegan style diet without formal prescribed energy restriction but realized energy deficit • Low-fat (20% of total calories from fat) diet without formal prescribed energy restriction but realized energy deficit • Low-glycemic load diet, either with formal prescribed energy restriction or without formal prescribed energy restriction but with realized energy deficit • Lower fat (≤30% fat), high dairy (4 servings/day) diets with or without increased fiber and/or low-glycemic index/load foods (low-glycemic load) with prescribed energy restriction • Macronutrient-targeted diets (15% or 25% of total calories from protein; 20% or 40% of total calories from fat; 35%, 45%, 55%, or 65% of total calories from carbohydrate) with prescribed energy restriction • Mediterranean-style diet with prescribed energy restriction • Moderate protein (12% of total calories from protein, 58% of total calories from carbohydrate, 30% of total calories from fat) with provision of foods that realized energy deficit • Provision of high-glycemic load or low-glycemic load meals

	measured by: • Weight (kg, lb., %) • BMI and BMI change • Waist circumference • Waist-hip ratio • % body fat • % reduction of excess weight • Weight loss maintenance		with prescribed energy restriction • The AHA-style Step 1 diet (with prescribed energy restriction of 1,500–1,800 kcal/day, <30% of total calories from fat, <10% of total calories from saturated fat) (High)
Ambrosini, 2013			
To systematically review the current evidence pertaining to overall dietary patterns and childhood and later obesity risk AMSTAR: 8/11	Principal components analysis, factor analysis, and reduced rank regression Obesity	7 7 PCS	Dietary patterns that are high in energy-dense, high-fat, and low-fiber foods predispose young people to later overweight and obesity.
Esposito, 2011			
To evaluate the effect of Mediterranean diets on body weight in randomized controlled trials Meta-analysis AMSTAR: 11/11	Mediterranean dietary pattern (control group varied: low-fat, high carb, prudent, usual diet, ADA diet, high-sat fat, general diet info, less counseling on Med diet) Change in body weight or BMI	16 16 RCT	Mediterranean diet may be a useful tool to reduce body weight, especially when the Mediterranean diet is energy-restricted, associated with physical activity, and more than 6 months in length. Mediterranean diet does not cause weight gain. In a random-effects meta-analysis, the Mediterranean diet group had a significant effect on weight [mean difference between Mediterranean diet and control diet, -1.75 kg; 95% CI: -2.86 to -0.64) and BMI (mean difference, -0.57 kg/m^2, -0.93 to 0.21 kg/m^2). The effect of Mediterranean diet on body weight was greater in association with energy restriction (mean difference, -3.88 kg, 95% CI: -6.54 to -1.21 kg), increased physical activity (-4.01 kg, 95% CI: -5.79 to -2.23 kg), and follow up longer than 6 months (-2.69 kg, 95% CI: -3.99 to -1.38 kg).

*A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

**Reference overlap: Of the 81 articles included in total across the reviews, 3 were included in two or more reviews.

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Associated Guideline:
Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol. 2014;63(25 Pt B):2985-3023. PMID: 24239920. http://www.ncbi.nlm.nih.gov/pubmed/24239920

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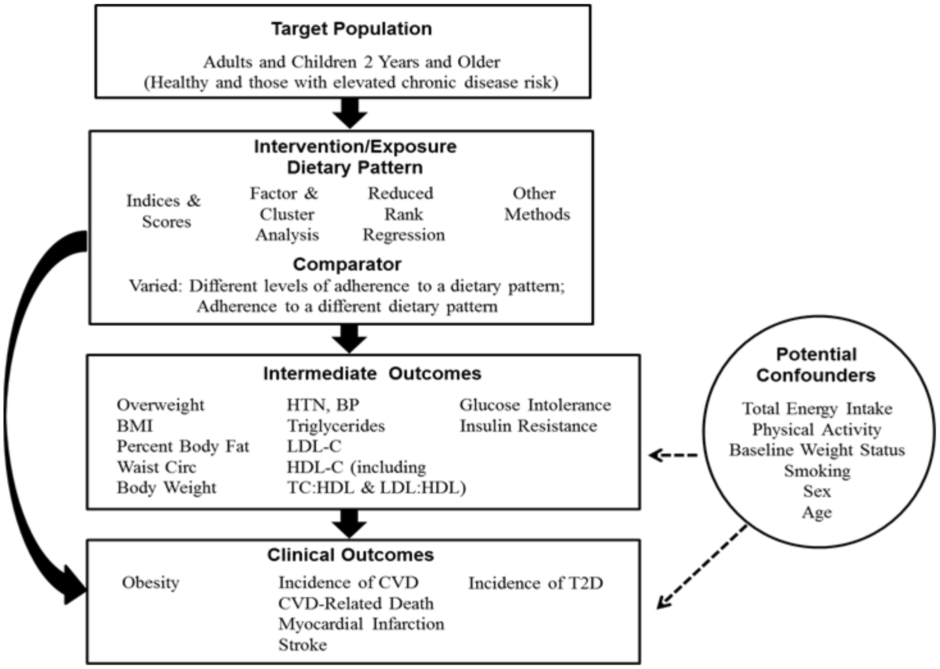
Associated Lifestyle Guideline:

Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2014;63(25 Pt B):2960-84. PMID: 24239922. http://www.ncbi.nlm.nih.gov/pubmed/24239922

Supplementary Information:

*(**Note:** The search and update for the dietary patterns and CVD, body weight, and type 2 diabetes reviews were done simultaneously and are described together below.)*

Analytical Framework



Methodology

The questions examining dietary patterns and risk of CVD, obesity, and type 2 diabetes were answered using existing reports, systematic reviews, and meta-analyses. All three of these questions were addressed in the Nutrition Evidence Library (NEL) Dietary Patterns Systematic Review Project. This project was supported by USDA's Center for Nutrition Policy and Promotion and was informed by a Technical Expert Collaborative of experts in dietary patterns research.[2] Additionally, the DGAC reviewed reports from systematic reviews recently conducted by the National Heart, Lung, and Blood Institute (NHLBI) that included dietary patterns research. For CVD, the DGAC used the NHLBI *Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group* and the associated American Heart Association (AHA)/ American College of Cardiology (ACC) *Guideline on Lifestyle Management to Reduce Cardiovascular Risk*.[31] For body weight, the DGAC used the NHLBI *Managing Overweight and Obesity in Adults: Systematic Evidence Review from the Obesity Expert Panel* and the associated AHA/ACC/ The Obesity Society (TOS) *Guideline for the Management of Overweight and Obesity in Adults*.[1] For all three questions, in an attempt to capture new research published since the searches for these systematic reviews were completed, the Committee considered existing systematic reviews and meta-analyses published in peer-reviewed journals since 2008. The existing systematic reviews and meta-analyses considered

by the DGAC had to meet the general inclusion criteria of the DGAC, and were required to consider dietary patterns and the outcomes of interest.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

(“diet quality” OR dietary pattern* OR diet pattern* OR eating pattern* OR food pattern* OR eating habit* OR dietary habit* OR food habit* OR dietary profile* OR food profile* OR diet profile* OR eating profile* OR dietary guideline* OR dietary recommendation* OR food intake pattern* OR dietary intake pattern* OR diet pattern* OR eating style*) OR

(DASH OR (dietary approaches to stop hypertension) OR "Diet, Mediterranean"[Mesh] OR vegan* OR vegetarian* OR "Diet, Vegetarian"[Mesh] OR “prudent diet” OR “western diet” OR nordiet OR omniheart OR (Optimal Macronutrient Intake Trial to Prevent Heart Disease) OR ((Okinawa* OR "Ethnic Groups"[Mesh] OR “plant based” OR Mediterranean[tiab]OR Nordic) AND (diet[mh] OR diet[tiab] OR food[mh])))
OR
("Guideline Adherence"[Mesh] AND (diet OR food OR eating OR eat OR dietary OR feeding OR nutrition OR nutrient*)) OR (adherence AND (nutrient* OR nutrition OR diet OR dietary OR food OR eat OR eating) AND (guideline* OR guidance OR recommendation*)) OR
(dietary score* OR adequacy index* OR kidmed OR Diet Quality Index* OR Food Score* OR Diet Score* OR MedDietScore OR Dietary Pattern Score* OR “healthy eating index”)OR

((index*[ti] OR score*[ti] OR indexes OR scoring[ti] indices[ti]) AND (dietary[ti] OR nutrient*[ti] OR eating[tiab] OR OR food[ti] OR food[mh] OR diet[ti] OR diet[mh]) AND (pattern* OR habit* OR profile*))

Body weight:
("body size"[tiab] OR body size[mh] OR obesity[tiab] OR obese[tiab] OR obesity[mh] OR overweight [tiab] OR adiposity[tiab] OR adiposity[mh] OR "body weight"[tiab] OR body weight[mh] OR “body-weight related”[tiab] OR "weight gain"[tiab] OR weight gain[mh] OR "weight loss"[tiab] OR Body Weights and Measures[Majr] OR overweight[tiab] OR "Body Composition"[mh] OR "body fat"[tiab] OR adipos*[tiab] OR weight[ti] OR waist[ti] OR "Anthropometry"[Mesh:noexp] OR “body mass index”[tiab] OR BMI[tiab] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab])

CVD:
"Mortality"[Mesh] OR mortality[tiab] OR "blood pressure"[tiab] OR "blood pressure"[mesh] OR "cardiovascular diseases"[mh:noexp] OR cardiovascular disease*[tiab] OR cardiovascular event*[tiab] OR "cholesterol/blood"[mh] OR "Cholesterol, HDL"[Mesh] OR cholesterol[tiab] OR "Cholesterol, Dietary"[Mesh] OR triglyceride* OR stroke[tiab] OR "stroke"[Mesh] OR "Lipids/blood"[Mesh] OR hypertension[tiab] OR "Myocardial Infarction"[Mesh] OR "Myocardial Infarction"[tiab] OR "Heart Failure"[Mesh] OR "Heart Arrest"[Mesh] OR "Myocardial

Ischemia"[Mesh] OR "heart failure"[tiab] OR "heart arrest"[tiab] OR "Myocardial Ischemia"[tiab] OR hypertension[mh]

T2D:
(“insulin resistance”[mh] OR “insulin”[ti] OR inflammation[ti] OR glucose intoleran*[ti] OR "Glucose Intolerance"[Mesh] OR diabetes[ti] OR "Diabetes Mellitus, Type 2"[Mesh] OR "Hemoglobin A, Glycosylated"[Mesh] OR “hemoglobin A1c “[ti] OR (“impaired fasting” AND (glucose OR glycemi*)) OR “onset diabetes” OR “impaired glucose” OR “insulin sensitivity”)

AND limit to: systematic[sb] OR systematic review* OR meta-analys* OR meta analys*

Inclusion Criteria

Date Range:
- Published between January 2008 and April 2014 (in English in a peer-reviewed journal)

Study Design:
- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

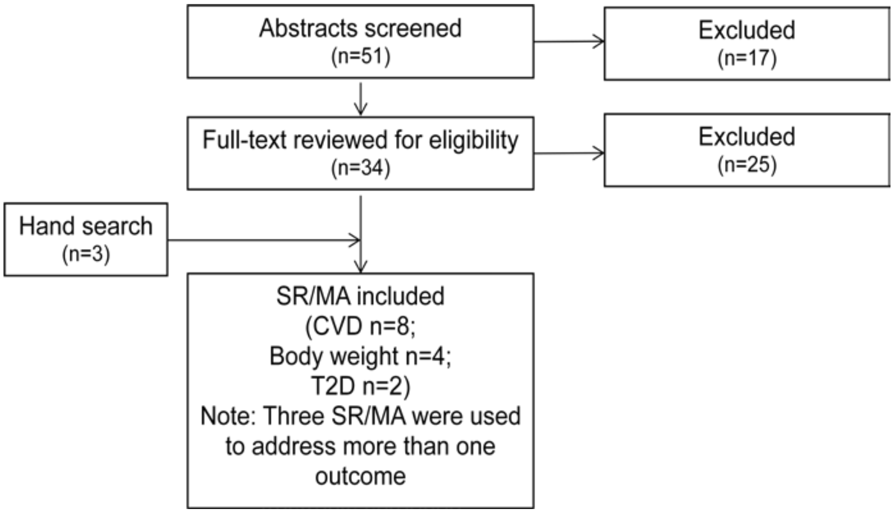
Study Subjects:
- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:
- Dietary pattern - The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

Outcome:
- CVD: LDL-cholesterol, HDL-cholesterol, triglycerides, blood pressure, incidence of CVD, CVD-related death, myocardial infarction, or stroke
- Body weight: Body mass index, body weight, percent body fat, waist circumference, incidence of overweight or obesity
- Type 2 diabetes: Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

Quality:
- Reviews rated 8-11 on AMSTAR (A measurement tool for the ‘assessment of multiple systematic reviews’)

Search Results



Excluded Articles with Reason for Exclusion

32. Ajala O, English P, Pinkney J. Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes. Am J Clin Nutr. 2013 Mar;97(3):505-16. doi: 10.3945/ajcn.112.042457. Epub 2013 Jan 30. Review. PubMed PMID: 23364002. EXCLUDE: Examined subjects diagnosed with type 2 diabetes (management of type 2 diabetes)

33. Akesson A, Andersen LF, Kristjánsdóttir AG, Roos E, Trolle E, Voutilainen E, Wirfält E. Health effects associated with foods characteristic of the Nordic diet: a systematic literature review. Food Nutr Res. 2013;57. doi: 10.3402/fnr.v57i0.22790. Review. PubMed PMID: 24130513; PubMed Central PMCID: PMC3795297. EXCLUDE: Examined individual components of the diet, not dietary patterns as defined by the Subcommittee

34. Aljadani H., Patterson A., Sibbritt D., Collins C. The association between dietary patterns and weight change in adults over time: A systematic review of studies with follow up. JBI Database of Systematic Reviews and Implementation Reports 2013 11:8 (272-316) EXCLUDE: Did not examine dietary patterns as defined by the Subcommittee

35. Al-Khudairy L, Stranges S, Kumar S, Al-Daghri N, Rees K. Dietary factors and type 2 diabetes in the Middle East: what is the evidence for an association?--a systematic review. Nutrients. 2013 Sep 26;5(10):3871-97. doi: 10.3390/nu5103871. PubMed PMID: 24077241; PubMed Central PMCID: PMC3820049. EXCLUDE: Not all countries in the Middle East are of high or very high development according to the Human Development Index

36. Barbaresko J, Koch M, Schulze MB, Nöthlings U. Dietary pattern analysis and biomarkers of low-grade inflammation: a systematic literature review. Nutr Rev. 2013 Aug;71(8):511-27. doi: 10.1111/nure.12035. Epub 2013 Jun 13. Review. PubMed PMID: 23865797. EXCLUDE: Outcomes were inflammatory markers, which were not included as intermediate outcomes in the Subcommittee’s analytical framework

37. Buckland G, Bach A, Serra-Majem L. Obesity and the Mediterranean diet: a systematic review of observational and intervention studies. Obes Rev. 2008 Nov;9(6):582-93. doi: 10.1111/j.1467-789X.2008.00503.x. Epub 2008 Jun 10. Review. PubMed PMID: 18547378 EXCLUDE: AMSTAR rating was 7 of 11

38. Carter P, Achana F, Troughton J, Gray LJ, Khunti K, Davies MJ. A Mediterranean diet improves HbA1c but not fasting blood glucose compared to alternative dietary strategies: a network meta-analysis. J Hum Nutr Diet. 2013 Jun 22. doi: 10.1111/jhn.12138. [Epub ahead of print] PubMed PMID: 23790149. EXCLUDE: Half of the studies included in the meta-analyses only included participants with T2D or CVD

39. Chan M.Y., Yulianna Y. Effect of mediterranean diet components on selected cardiovascular risk factors, all-cause mortality and cardiovascular mortality: Systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1093) EXCLUDE: Abstract, not a full article

40. Defagó M., Elorriaga N., Irazola V., Rubinstein A.Association between food patterns and biomarkers of endothelial function: A systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1282) EXCLUDE: Outcomes were biomarkers of endothelial function, which were not included as intermediate outcomes in the Subcommittee's analytical framework

41. Dong JY, Zhang ZL, Wang PY, Qin LQ. Effects of high-protein diets on body weight, glycaemic control, blood lipids and blood pressure in type 2 diabetes: meta-analysis of randomised controlled trials. Br J Nutr. 2013 Sep 14;110(5):781-9. doi: 10.1017/S0007114513002055. Epub 2013 Jul 5. Review. PubMed PMID: 23829939. EXCLUDE: Participants were diagnosed with type 2 diabetes

42. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Mediterranean diet and metabolic syndrome: an updated systematic review. Rev Endocr Metab Disord. 2013 Sep;14(3):255-63. doi: 10.1007/s11154-013-9253-9. PubMed PMID: 23982678. EXCLUDE: Included cross-sectional studies; examined incidence of metabolic syndrome, which is outside the scope of the Subcommittee's analytical framework

43. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. Metab Syndr Relat Disord. 2010 Dec;8(6):471-6. doi: 10.1089/met.2010.0009. Epub 2010 Oct 19. Review. PubMed PMID: 20958207. EXCLUDE: Of the 10 included studies, 8 were included in the NEL and Alhamzi reviews being considered by the Committee

44. Esposito K, Maiorino MI, Ceriello A, Giugliano D. Prevention and control of type 2 diabetes by Mediterranean diet: a systematic review. Diabetes Res Clin Pract. 2010 Aug;89(2):97-102. doi: 10.1016/j.diabres.2010.04.019. Epub 2010 May 23. Review. PubMed PMID: 20546959. EXCLUDE: Only 3 studies looked at prevention and one was cross-sectional

45. Grosso G, Mistretta A, Frigiola A, Gruttadauria S, Biondi A, Basile F, Vitaglione P, D'Orazio N, Galvano F. Mediterranean diet and cardiovascular risk factors: a systematic review. Crit Rev Food Sci Nutr. 2014;54(5):593-610. doi: 10.1080/10408398.2011.596955. PubMed PMID: 24261534. EXCLUDE: Included cross-sectional studies; included various outcomes

not included in the Subcommittee's analytical framework, including incidence of metabolic syndrome, CRP, IL-6, liver transaminases, etc.

46. Hu T, Mills KT, Yao L, Demanelis K, Eloustaz M, Yancy WS Jr, Kelly TN, He J, Bazzano LA. Effects of low-carbohydrate diets versus low-fat diets on metabolic risk factors: a meta-analysis of randomized controlled clinical trials. Am J Epidemiol. 2012 Oct 1;176 Suppl 7:S44-54. doi: 10.1093/aje/kws264. PubMed PMID: 23035144; PubMed Central PMCID: PMC3530364. EXCLUDE: Did not examine dietary patterns as described by the Subcommittee

47. Joung H, Hong S, Song Y, Ahn BC, Park MJ. Dietary patterns and metabolic syndrome risk factors among adolescents. Korean J Pediatr. 2012 Apr;55(4):128-35. doi: 10.3345/kjp.2012.55.4.128. Epub 2012 Apr 30. PubMed PMID: 22574073; PubMed Central PMCID: PMC3346835. EXCLUDE: Meta-analysis of cross-sectional data

48. Kant AK. Dietary patterns: biomarkers and chronic disease risk. Appl Physiol Nutr Metab. 2010 Apr;35(2):199-206. doi: 10.1139/H10-005. Review. PubMed PMID: 20383233. EXCLUDE: Narrative review

49. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. J Am Coll Cardiol. 2011 Mar 15;57(11):1299-313. doi: 10.1016/j.jacc.2010.09.073. PubMed PMID: 21392646. EXCLUDE: Included cross-sectional studies

50. Kastorini CM, Milionis HJ, Goudevenos JA, Panagiotakos DB. Mediterranean diet and coronary heart disease: is obesity a link? - A systematic review. Nutr Metab Cardiovasc Dis. 2010 Sep;20(7):536-51. doi: 10.1016/j.numecd.2010.04.006. Review. PubMed PMID: 20708148. EXCLUDE: Included cross-sectional studies and secondary prevention studies

51. Kastorini CM, Panagiotakos DB. Dietary patterns and prevention of type 2 diabetes: from research to clinical practice; a systematic review. Curr Diabetes Rev. 2009 Nov;5(4):221-7. Review. PubMed PMID: 19531025. EXCLUDE: Included cross-sectional and case-control studies

52. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the Dietary Approaches to Stop Hypertension (DASH) diet: a systematic review. PLoS One. 2013;8(10):e78412. doi: 10.1371/journal.pone.0078412. PubMed PMID: 24205227; PubMed Central PMCID: PMC3813594. EXCLUDE: Examined compliance to the DASH diet

53. Maghsoudi Z, Azadbakht L. How dietary patterns could have a role in prevention, progression, or management of diabetes mellitus? Review on the current evidence. J Res Med Sci. 2012 Jul;17(7):694-709. PubMed PMID: 23798934; PubMed Central PMCID: PMC3685790. EXCLUDE: Included cross-sectional studies and seminars and symposiums

54. Marshall S, Burrows T, Collins CE. Systematic review of diet quality indices and their associations with health-related outcomes in children and adolescents. J Hum Nutr Diet. 2014 Feb 13. doi: 10.1111/jhn.12208. [Epub ahead of print] PubMed PMID: 24524271. EXCLUDE: Included cross-sectional and case-control studies; included abstracts; focus of

review was to describe indices being used with children and adolescents – only brief mention of body weight and no conclusions drawn.

55. Martínez-González MÁ, Martín-Calvo N. The major European dietary patterns and metabolic syndrome. Rev Endocr Metab Disord. 2013 Sep;14(3):265-71. doi: 10.1007/s11154-013-9264-6. PubMed PMID: 23979531. EXCLUDE: Narrative review

56. McEvoy C., Cardwell C., Woodside J., Young I., Hunter S., McKinley M. A systematic review and meta-analysis examining 'a posteriori' dietary patterns and risk of type 2 diabetes. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (864) EXCLUDE: Abstract, not a full article

57. Mente A, de Koning L, Shannon HS, Anand SS. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch Intern Med. 2009 Apr 13;169(7):659-69. doi:10.1001/archinternmed.2009.38. Review. PubMed PMID: 19364995. EXCLUDE: Some studies included secondary prevention, did not provide list of included articles; describes dietary factors, rather than dietary pattern as defined by the SC

58. Nordmann A.J., Suter K., Tuttle K.R., Estruch R., Shai I., Bucher H. Meta-analysis of Mediterranean versus low-fat diets to improve cardiovascular risk factors. European Heart Journal 2010 31 SUPPL. 1 (940) EXCLUDE: Abstract, not a full article

59. Osei-Assibey G, Boachie C. Dietary interventions for weight loss and cardiovascular risk reduction in people of African ancestry (blacks): a systematic review. Public Health Nutr. 2012 Jan;15(1):110-5. doi: 10.1017/S1368980011001121. Epub 2011 Jun 1. Review. PubMed PMID: 21729478. EXCLUDE: Examined dietary interventions, in general, not dietary patterns specifically

60. Psaltopoulou T, Sergentanis TN, Panagiotakos DB, Sergentanis IN, Kosti R, Scarmeas N. Mediterranean diet, stroke, cognitive impairment, and depression: A meta-analysis. Ann Neurol. 2013 Oct;74(4):580-91. doi: 10.1002/ana.23944. Epub 2013 Sep 16. PubMed PMID: 23720230. EXCLUDE: Included case-control studies

61. Santos FL, Esteves SS, da Costa Pereira A, Yancy WS Jr, Nunes JP. Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors. Obes Rev. 2012 Nov;13(11):1048-66. doi: 10.1111/j.1467-789X.2012.01021.x. Epub 2012 Aug 21. Review. PubMed PMID: 22905670. EXCLUDE: Did not examine dietary patterns as described by the SC

62. Schwingshackl L, Hoffmann G. Long-term effects of low-fat diets either low or high in protein on cardiovascular and metabolic risk factors: a systematic review and meta-analysis. Nutr J. 2013 Apr 15;12:48. doi: 10.1186/1475-2891-12-48. Review. PubMed PMID: 23587198; PubMed Central PMCID: PMC3636027. EXCLUDE: Did not examine dietary patterns as described by the SC

63. Shirani F, Salehi-Abargouei A, Azadbakht L. Effects of Dietary Approaches to Stop Hypertension (DASH) diet on some risk for developing type 2 diabetes: a systematic review and meta-analysis on controlled clinical trials. Nutrition. 2013 Jul-Aug;29(7-8):939-47. doi:

10.1016/j.nut.2012.12.021. Epub 2013 Mar 6. Review. PubMed PMID: 23473733. EXCLUDE: Review included articles with less than 30 participants per study arm

64. Smithers LG, Golley RK, Brazionis L, Lynch JW. Characterizing whole diets of young children from developed countries and the association between diet and health: a systematic review. Nutr Rev. 2011 Aug;69(8):449-67. doi: 10.1111/j.1753-4887.2011.00407.x. Review. PubMed PMID: 21790612. EXCLUDE: Included cross-sectional studies; focus of the review was to describe what is currently known about measures of dietary patterns in early life and the general association between dietary patterns and child health and development – only brief mention of body weight

65. Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr. 2010 Nov;92(5):1189-96. doi: 10.3945/ajcn.2010.29673. Epub 2010 Sep 1. Review. PubMed PMID: 20810976. EXCLUDE: Meta-analysis captured in Sofi 2013

66. Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. BMJ. 2008 Sep 11;337:a1344. doi: 10.1136/bmj.a1344. Review. PubMed PMID: 18786971; PubMed Central PMCID: PMC2533524. EXCLUDE: Meta-analysis captured in Sofi 2013

67. Sofi F. The Mediterranean diet revisited: evidence of its effectiveness grows. Curr Opin Cardiol. 2009 Sep;24(5):442-6. doi: 10.1097/HCO.0b013e32832f056e. Review. PubMed PMID: 19550306. EXCLUDE: Narrative review

68. Summerbell CD, Douthwaite W, Whittaker V, Ells LJ, Hillier F, Smith S, Kelly S, Edmunds LD, Macdonald I. The association between diet and physical activity and subsequent excess weight gain and obesity assessed at 5 years of age or older: a systematic review of the epidemiological evidence. Int J Obes (Lond). 2009 Jul;33 Suppl 3:S1-92. doi: 10.1038/ijo.2009.80. Review. Erratum in: Int J Obes (Lond). 2010 Apr;34(4):789. abstract no. 5.3 only. Int J Obes (Lond). 2010 Apr;34(4):788. abstract no. 5.2 only. PubMed PMID: 19597430. EXCLUDE: Considered various aspects of eating, including fast food intake, frequency of eating, night eating, individual food groups, as well as physical activity, etc.; included relevant section with 6 studies, 1 considered glycemic index/load, and 4 included in NEL review

69. Tyrovolas S, Panagiotakos DB. The role of Mediterranean type of diet on the development of cancer and cardiovascular disease, in the elderly: a systematic review. Maturitas. 2010 Feb;65(2):122-30. doi: 10.1016/j.maturitas.2009.07.003. Epub 2009 Aug 4. Review. PubMed PMID: 19656644. EXCLUDE: Narrative review; considers cross-sectional and case-control studies

70. Vadiveloo M, Dixon LB, Parekh N. Associations between dietary variety and measures of body adiposity: a systematic review of epidemiological studies. Br J Nutr. 2013 May;109(9):1557-72. doi: 10.1017/S0007114512006150. Epub 2013 Feb 27. Review. PubMed PMID: 23445540. EXCLUDE: Examined dietary variety, not dietary patterns

71. Wheeler ML, Dunbar SA, Jaacks LM, Karmally W, Mayer-Davis EJ, Wylie-Rosett J, Yancy WS Jr. Macronutrients, food groups, and eating patterns in the management of diabetes: a systematic review of the literature, 2010. Diabetes Care. 2012 Feb;35(2):434-45. doi:

10.2337/dc11-2216. Review. PubMed PMID: 22275443; PubMed Central PMCID: PMC3263899. EXCLUDE: Only included studies with people with type 2 diabetes

72. Yuliana Y., Chan M.Y. Effect of mediterranean diet components on selected cardiovascular risk factors, all-cause mortality and cardiovascular mortality: Systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (981) EXCLUDE: Abstract, not a full article

73. Zhang Z, Wang J, Chen S, Wei Z, Li Z, Zhao S, Lu W. Comparison of Vegetarian Diets and Omnivorous Diets on Plasma Level of HDL-c: A Meta-Analysis. PLoS One. 2014 Mar 26;9(3):e92609. doi: 10.1371/journal.pone.0092609. eCollection 2014.PubMed PMID: 24671216. EXCLUDE: Included cross-sectional studies in meta-analysis

Appendix E2.28: Evidence Portfolio

Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes

What is the relationship between dietary patterns and risk of type 2 diabetes?

Conclusion Statement: Moderate evidence indicates that healthy dietary patterns higher in vegetables, fruits, and whole grains and lower in red and processed meats, high-fat dairy products, refined grains, and sweets/sugar-sweetened beverages reduce the risk of developing type 2 diabetes.

DGAC Grade: Moderate

Evidence is lacking for the pediatric population.

Review of Evidence

The Committee considered two sources of evidence. The primary source was the NEL Dietary Patterns Systematic Review Project which included 37 studies predominantly of prospective cohorts design and some randomized trials (n=8).[1] This primary source was supplemented by a published meta-analysis that included 15 cohort studies of which 13 overlapped with the NEL review.[2] The meta-analysis provided an estimate of the effect size of incident type 2 diabetes associated with a healthy and unhealthy dietary pattern.

Although the NEL rated the overall body of evidence for type 2 diabetes as limited, this was primarily a result of examining the different methods for defining dietary patterns (e.g. indices, data driven, and reduce rank regression) separately. As such, the NEL noted these methodological inconsistencies across studies but stated general support for the consumption of a dietary pattern rich in vegetables and fruits and low in high-fat dairy and meats. The DGAC concurred with this conclusion. However, the DGAC has elevated the grade of the entire body of evidence to moderate given that the NEL findings were corroborated by the results of a high quality meta-analysis (AMSTAR rating of 11) and the magnitude of the associations that showed when the results of 15 cohort studies are pooled, evidence indicated a 21 percent reduction in the risk of developing type 2 diabetes associated with dietary patterns characterized by high consumption of whole grains, vegetables, and fruit. Conversely, a 44 percent increased risk of developing type 2 diabetes was seen with an unhealthy dietary pattern characterized by higher consumption of red or processed meats, high-fat dairy, refined grains, and sweets.

Dietary Patterns and Incident Type 2 Diabetes

Dietary Approaches to Stop Hypertension (DASH)

One study used the DASH score in a cohort of 820 U.S. adults ages 40 to 69 years and with equal sex distribution and racial diversity.[3] Liese et al. found adherence to the DASH score was associated with markedly reduced odds of type 2 diabetes in Whites but not in the total population, or in the Blacks and Hispanics, which comprised the majority of this cohort.

Mediterranean-style Dietary Patterns

Three studies assessed Mediterranean-style dietary pattern adherence (Mediterranean Diet Score [MDS]) with sample sizes ranging from 5,000 to more than 20,000 in both Mediterranean and U.S. populations. One study conducted in Spain with the SUN cohort (n=13,380) found a favorable association between the MDS (the original MDS of Trichopoulou) and risk of type 2 diabetes. Overall, a 2-point increase in MDS was associated with a 35 percent reduction in risk of type 2 diabetes.[4] Another study, conducted in Greece with the EPIC-Greece cohort (n=22,295), also assessed the relationship between the MDS and type 2 diabetes. In this second Mediterranean population, adherence to the MDS also was favorably associated with decreased risk of diabetes.[5] Conversely, a study conducted in the United States, using the authors' MedDiet Score with the Multi-Ethnic Study of Atherosclerosis (MESA) cohort (n=5,390) found no association between their MedDiet Score and type 2 diabetes incidence in the total population, in men or women, or in specific racial/ethnic groups.[6]

Dietary Indices based on the Dietary Guidelines

Four studies used dietary-guidelines based indices such as the AHEI and the Diet Quality Index (DQI). The sample sizes of the studies ranged from 1,821 to 80,029. A study that assessed adherence to the AHEI in the United States found a favorable association between AHEI score and risk of incident type 2 diabetes in women in the Nurses' Health Study (n=80,029).[7] In the CARDIA study (n=4,381), also from the United States, the authors found no association between DQI-2005 score and type 2 diabetes incidence in the total population or in Blacks or Whites.[8] Studies from outside the United States included one conducted in Australia using a Total Diet score in the Blue Mountains Eye Study (BMES, n=1,821) and one from Germany using a German Food Pyramid Index with the EPIC-Potsdam cohort (n=23,531). Neither found an association between these scores and incident type 2 diabetes.[9,10] Thus, evidence for an association only exists with the AHEI, which does contain slightly different components from the other indices, such as nuts and legumes, trans fat, EPA + DHA (n–3 FAs), PUFAs, alcohol, red and processed meat.

Data-Driven Approaches

Eleven studies used factor analysis and one study used cluster analysis. These analyses were all conducted using data from prospective cohort studies published between 2004 and 2012 and had sample sizes ranging from 690 to more than 75,000 individuals. Five studies were conducted in the United States and the rest from developed countries around the world. Each study identified one to four dietary patterns, with the most common comparison between "western"/"unhealthy" and "prudent"/"healthier" patterns; a total of 35 diverse dietary patterns were identified within the body of evidence. Many studies had null findings, particularly studies with duration of less than 7 years of follow up.[11-14] Patterns associated with lower risk of type 2 diabetes were characterized by higher intakes of vegetables, fruits, low-fat dairy products, and whole grains, and those associated with increased risk were characterized by higher intakes of red meat, sugar-sweetened foods and drinks, French fries, refined grains, and high-fat dairy products. However, the food groups identified varied substantially, even among patterns with the same name.

Three prospective cohort studies used reduced rank regression to examine the relationship between dietary patterns and type 2 diabetes.[15-17] Two of the studies were conducted in the United States and one in the United Kingdom. The sample sizes were 880 for Liese (2009), 2,879 for Imamura (2009), and 6,699 for McNaughton (2008). The independent variables in these studies were dietary pattern scores, and biomarkers were used as response variables in two of the studies. Dietary patterns that included meat intake and incident type 2 diabetes were positively associated in the two studies that used biomarkers as response variables, though the definitions of meat differed.[15, 16] However, because so few studies were available and the methodology used and different populations considered varied so much, the information was insufficient to assess consistency or draw conclusions.

Other Dietary Patterns

The body of evidence examined included seven studies conducted between 2004 and 2013, consisting of six RCTs[18-24] and one prospective cohort study (PCS).[25] Two studies were conducted in the United States; one in the United States and Canada; one in Spain (2 PREDIMED articles); and one each in Greece, Italy, and Sweden. The sample sizes of the RCTs ranged from 82 to 1,224 participants and the PCS had a sample size of 41,387 participants. All eight studies were conducted in adults. RCT duration ranged from 6 weeks to a median of 4 years and the PCS duration was 2 years. The RCTs were primary prevention studies of at-risk participants. Baseline health status in the study participants included those with mild hypercholesterolemia, overweight or obesity, metabolic syndrome, abdominal obesity, and three or more CVD risk factors, including metabolic syndrome. The PCS participants were individuals in the Adventist Health Study who did not have type 2 diabetes.[25] Three studies looked at a Mediterranean-style diet,[20, 22-24] one study examined the Nordic diet (defined by the authors of the study as a diet rich in high-fiber plant foods, fruits, berries, vegetables, whole grains, rapeseed oil, nuts, fish and low-fat milk products, but low in salt, added sugars, and saturated fats),[18] and three studies looked at either the DASH diet or a variation of the DASH diet,[19, 21] or a vegetarian diet.[25]

Two of the seven studies examined the association between adherence to a dietary pattern and incidence of type 2 diabetes.[24, 25] Although the results of both studies showed a favorable association between either a Mediterranean-style or a vegetarian dietary pattern and incidence of type 2 diabetes the studies differed in design and dietary pattern used to assess diet exposure. The other studies examined the intermediate outcomes of impaired glucose tolerance and/or insulin resistance and are discussed in the next section.

Dietary Patterns and Intermediate Outcomes

Five studies examined adherence to a dietary pattern and intermediate outcomes related to glucose tolerance and/or insulin resistance: two RCTs[26, 27] and three prospective cohort studies.[8, 9, 28] It was difficult to assess food components across these studies, as numerous different scores were used and no compelling number of studies used any one score or index. Even so, favorable associations between dietary patterns and intermediate outcomes were found.

The two RCTs were conducted in populations in Europe that were at risk of diabetes. An early report from the PREDIMED trial showed that a Mediterranean diet decreased fasting blood glucose, fasting insulin, and HOMA-IR scores in a Spanish population at risk of CVD.[26] In the Oslo Diet and Exercise Study (ODES), increased adherence to the authors' a priori diet score resulted in decreased fasting insulin and insulin after a glucose challenge, but not fasting glucose, in Norwegian men with metabolic syndrome.[27] Results from prospective cohort studies were consistent in showing a favorable association between diet score and fasting glucose, fasting insulin or HOMA-IR,[8, 28] with the exception of one study that found the association with fasting glucose only in men.[9]

Data-Driven Approaches

Variations in populations studies, definition of outcomes, dietary assessment methodologies, and methods used to derive patterns resulted in a highly variable set of dietary patterns, thus making it difficult to draw conclusions from studies using data-driven approaches. For example, one study measured fasting blood glucose with a cutoff of 6.1 and greater mmol/L;[29] another study measured plasma glucose with a cutoff of 5.1 and greater mmol/L,[30] while a third study measured plasma glucose after an overnight fast and after a standard 75 g oral glucose tolerance test.[31] Three prospective cohort studies assessed the association between dietary patterns and plasma glucose levels. Two U.S. studies derived patterns using cluster analysis[29, 30] and one study conducted in Denmark used factor analysis.[31] Duffey et al. identified two diet clusters: "Prudent Diet" and "Western Diet";[29] Kimokoti et al. identified five clusters: "Heart Healthier," "Lighter Eating," "Wine and Moderate Eating," "Higher Fat," and "Empty Calories";[30] and Lau et al. derived two factors: "Modern" and "Traditional."[31]

Table 1: Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between dietary patterns and risk of type 2 diabetes

Question/ Purpose **AMSTAR Rating***	**Dietary Patterns and Outcomes**	**Included Studies** (Number and Study Design)**	**Evidence/ Conclusion Statement from Existing Report/ SR/ MA**
NEL Dietary Patterns Systematic Review Project, 2014			
Overarching Finding/ Recommendation: The bodies of evidence examining the relationship between dietary patterns and risk of type 2 diabetes were limited or insufficient, but they generally supported consumption of a dietary pattern rich in fruits and vegetables and low in high-fat dairy and meats.			
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using an index or score, and risk of type 2 diabetes?	Dietary pattern assessed using index/score methodology Glucose intolerance, insulin resistance, incidence of T2D	11 9 PCS; 2 RCT	There is limited evidence that adherence to a dietary pattern rich in fruits, vegetables, legumes, cereals/whole grains, nuts, fish, and unsaturated oils, and low in meat, and high fat dairy, assessed using an index or score, is associated with decreased risk of type 2 diabetes. (Limited)
Are prevailing patterns of dietary intake in a population, derived using cluster or factor analysis, related to the risk of type 2 diabetes?	Dietary pattern assessed using factor or cluster analysis Glucose intolerance, insulin resistance, incidence of T2D	15 15 PCS	Limited and inconsistent evidence from epidemiological studies indicates that in adults, dietary patterns derived using factor or cluster analysis, characterized by vegetables, fruits, and low-fat dairy products tend to have an association with decreased risk of type 2 diabetes and those patterns characterized by red meat, sugar-sweetened foods and drinks, French fries, refined grains and high-fat dairy products tended to show an increased association for risk of type 2 diabetes. Among studies there was substantial variation in food group components and not all studies with similar patterns showed significant association. (Limited)
What combinations of food intake, assessed using reduced rank regression, explain the most variation in risk of type 2 diabetes?	Dietary pattern assessed using reduced rank regression Glucose intolerance, insulin resistance, incidence of T2D	3 3 PCS	There is insufficient evidence, due to a small number of studies, to examine the relationship between dietary patterns derived using reduced rank regression and risk of type 2 diabetes. The differences in the methods used and populations studied made it difficult to compare results, and therefore no conclusions were drawn. (Grade not Assignable)
What is the relationship between adherence to dietary guidelines/ recommendations or specific dietary patterns, assessed using methods other than index/score, cluster or factor, or reduced rank regression analyses, and risk of type 2 diabetes?	Dietary pattern assessed using methodologies other than index, factor, cluster, or reduced rank regression analyses Glucose intolerance, insulin resistance, incidence of T2D	8 7 RCT (from 6 trials); 1 PCS	There is insufficient evidence on a relationship between adherence to a Mediterranean-style or vegetarian diet pattern and incidence of type 2 diabetes. There is limited, inconsistent evidence that adherence to a Mediterranean-style, DASH or modified DASH, or Nordic dietary pattern results in improved glucose tolerance and insulin resistance. (Limited – Intermediate outcomes; Grade not Assignable – T2D incidence)

Alhazmi, 2013			
Association between dietary patterns and risk of type 2 diabetes Meta-analysis AMSTAR: 11/11	"Healthy" and "unhealthy" dietary patterns; for studies that reported more than one dietary pattern, only the patterns that shared similar characteristics with the healthy/unhealthy pattern were included in the meta-analysis Incidence of T2D	15 15 PCS	The results of this systematic review and meta-analysis indicate that dietary patterns may be associated with the risk of type 2 diabetes. There was evidence of a reduction in the risk of type 2 diabetes in the highest adherence compared to the lowest adherence to healthy dietary patterns [RR = 0.79, 95% confidence interval (CI): 0.74 to 0.86, P < 0.005]. An increase in the risk of type 2 diabetes was evident for the highest adherence compared to the lowest adherence to unhealthy dietary patterns (RR = 1.44, 95% CI: 1.33 to 1.57, P < 0.005). The results indicated that dietary patterns consisting of healthy foods and/or nutrient choices and had higher energy contributions from whole grain products, fruit and vegetables may decrease the risk of type 2 diabetes. By contrast, dietary patterns represented by unhealthy food choices and higher energy contributions from foods such as red or processed meats, high-fat dairy, refined grains and sweets may increase the risk of developing type 2 diabetes.

*A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

** Reference overlap: Of the 39 articles included in total across the reviews, 13 were included in both reviews.

References Included in Review

1. Nutrition Evidence Library. A series of systematic reviews on the relationship between dietary patterns and health outcomes. Alexandria, VA: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, March 2014. Available from: http://www.nel.gov/vault/2440/web/files/DietaryPatterns/DPRptFullFinal.pdf.

2. Alhazmi A, Stojanovski E, McEvoy M, Garg ML. The association between dietary patterns and type 2 diabetes: a systematic review and meta-analysis of cohort studies. J Hum Nutr Diet. 2014 Jun;27(3):251-60. PMID: 24102939. http://www.ncbi.nlm.nih.gov/pubmed/24102939.

Additional References

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    Associated Lifestyle Guideline:
    Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2014;63(25 Pt B):2960-84. PMID: 24239922. http://www.ncbi.nlm.nih.gov/pubmed/24239922

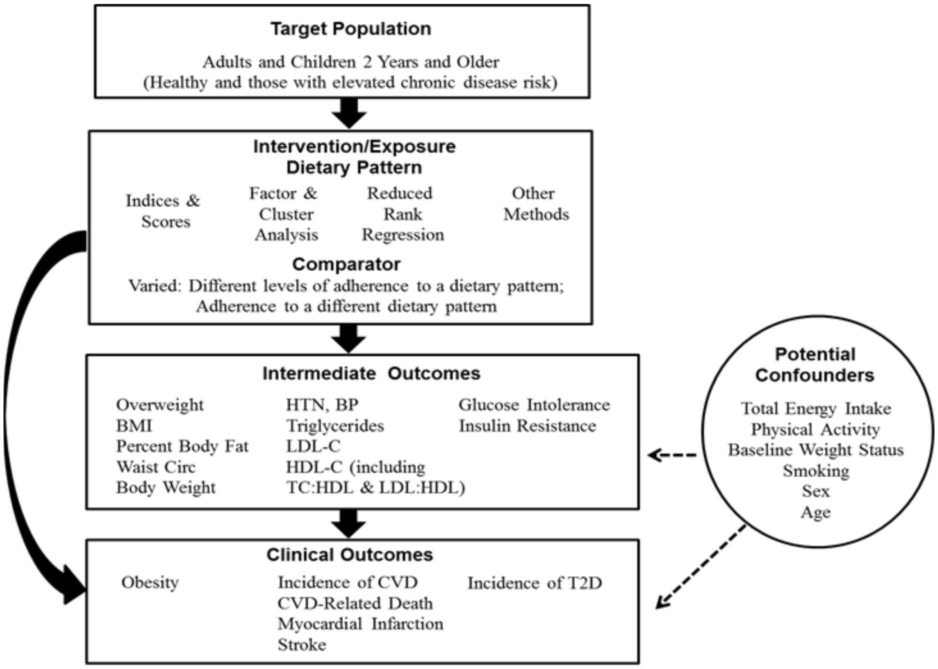
33. National Heart Lung and Blood Institute. Managing overweight and obesity in adults: Systematic evidence review from the Obesity Expert Panel, 2013. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health; 2013. Available from: http://www.nhlbi.nih.gov/guidelines/obesity/ser/index.htm.

    Associated Guideline
    Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol. 2014;63(25 Pt B):2985-3023. PMID: 24239920. http://www.ncbi.nlm.nih.gov/pubmed/24239920.

Supplementary Information:

*(**Note:** The search and update for the dietary patterns and CVD, body weight, and type 2 diabetes reviews were done simultaneously and are described together below.)*

Analytical Framework



Methodology

The questions examining dietary patterns and risk of CVD, obesity, and type 2 diabetes were answered using existing reports, systematic reviews, and meta-analyses. All three of these questions were addressed in the Nutrition Evidence Library (NEL) Dietary Patterns Systematic Review Project. This project was supported by USDA's Center for Nutrition Policy and Promotion and was informed by a Technical Expert Collaborative of experts in dietary patterns research.[1] Additionally, the DGAC reviewed reports from systematic reviews recently conducted by the National Heart, Lung, and Blood Institute (NHLBI) that included dietary patterns research. For CVD, the DGAC used the NHLBI *Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group* and the associated American Heart Association (AHA)/ American College of Cardiology (ACC) *Guideline on Lifestyle Management to Reduce Cardiovascular Risk*.[32] For body weight, the DGAC used the NHLBI *Managing Overweight and Obesity in Adults: Systematic Evidence Review from the Obesity Expert Panel* and the associated AHA/ACC/ The Obesity Society (TOS) *Guideline for the Management of Overweight and Obesity in Adults*.[33] For all three questions, in an attempt to capture new research published since the searches for these systematic reviews were completed, the Committee considered existing systematic reviews and meta-analyses published in peer-reviewed journals since 2008. The existing systematic reviews and meta-analyses considered

by the DGAC had to meet the general inclusion criteria of the DGAC, and were required to consider dietary patterns and the outcomes of interest.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

(“diet quality” OR dietary pattern* OR diet pattern* OR eating pattern* OR food pattern* OR eating habit* OR dietary habit* OR food habit* OR dietary profile* OR food profile* OR diet profile* OR eating profile* OR dietary guideline* OR dietary recommendation* OR food intake pattern* OR dietary intake pattern* OR diet pattern* OR eating style*) OR

(DASH OR (dietary approaches to stop hypertension) OR "Diet, Mediterranean"[Mesh] OR vegan* OR vegetarian* OR "Diet, Vegetarian"[Mesh] OR “prudent diet” OR “western diet” OR nordiet OR omniheart OR (Optimal Macronutrient Intake Trial to Prevent Heart Disease) OR ((Okinawa* OR "Ethnic Groups"[Mesh] OR “plant based” OR Mediterranean[tiab]OR Nordic) AND (diet[mh] OR diet[tiab] OR food[mh])))
OR
("Guideline Adherence"[Mesh] AND (diet OR food OR eating OR eat OR dietary OR feeding OR nutrition OR nutrient*)) OR (adherence AND (nutrient* OR nutrition OR diet OR dietary OR food OR eat OR eating) AND (guideline* OR guidance OR recommendation*)) OR
(dietary score* OR adequacy index* OR kidmed OR Diet Quality Index* OR Food Score* OR Diet Score* OR MedDietScore OR Dietary Pattern Score* OR “healthy eating index”)OR

((index*[ti] OR score*[ti] OR indexes OR scoring[ti] indices[ti]) AND (dietary[ti] OR nutrient*[ti] OR eating[tiab] OR OR food[ti] OR food[mh] OR diet[ti] OR diet[mh]) AND (pattern* OR habit* OR profile*))

Body weight:
("body size"[tiab] OR body size[mh] OR obesity[tiab] OR obese[tiab] OR obesity[mh] OR overweight [tiab] OR adiposity[tiab] OR adiposity[mh] OR "body weight"[tiab] OR body weight[mh] OR “body-weight related”[tiab] OR "weight gain"[tiab] OR weight gain[mh] OR "weight loss"[tiab] OR Body Weights and Measures[Majr] OR overweight[tiab] OR "Body Composition"[mh] OR "body fat"[tiab] OR adipos*[tiab] OR weight[ti] OR waist[ti] OR "Anthropometry"[Mesh:noexp] OR “body mass index”[tiab] OR BMI[tiab] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab])

CVD:
"Mortality"[Mesh] OR mortality[tiab] OR "blood pressure"[tiab] OR "blood pressure"[mesh] OR "cardiovascular diseases"[mh:noexp] OR cardiovascular disease*[tiab] OR cardiovascular event*[tiab] OR "cholesterol/blood"[mh] OR "Cholesterol, HDL"[Mesh] OR cholesterol[tiab] OR "Cholesterol, Dietary"[Mesh] OR triglyceride* OR stroke[tiab] OR "stroke"[Mesh] OR "Lipids/blood"[Mesh] OR hypertension[tiab] OR "Myocardial Infarction"[Mesh] OR "Myocardial Infarction"[tiab] OR "Heart Failure"[Mesh] OR "Heart Arrest"[Mesh] OR "Myocardial

Ischemia"[Mesh] OR "heart failure"[tiab] OR "heart arrest"[tiab] OR "Myocardial Ischemia"[tiab] OR hypertension[mh]

T2D:
(“insulin resistance”[mh] OR “insulin”[ti] OR inflammation[ti] OR glucose intoleran*[ti] OR "Glucose Intolerance"[Mesh] OR diabetes[ti] OR "Diabetes Mellitus, Type 2"[Mesh] OR "Hemoglobin A, Glycosylated"[Mesh] OR “hemoglobin A1c “[ti] OR (“impaired fasting” AND (glucose OR glycemi*)) OR “onset diabetes” OR “impaired glucose” OR “insulin sensitivity”)

AND limit to: systematic[sb] OR systematic review* OR meta-analys* OR meta analys*

Inclusion Criteria

Date Range:
- Published between January 2008 and April 2014 (in English in a peer-reviewed journal)

Study Design:
- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

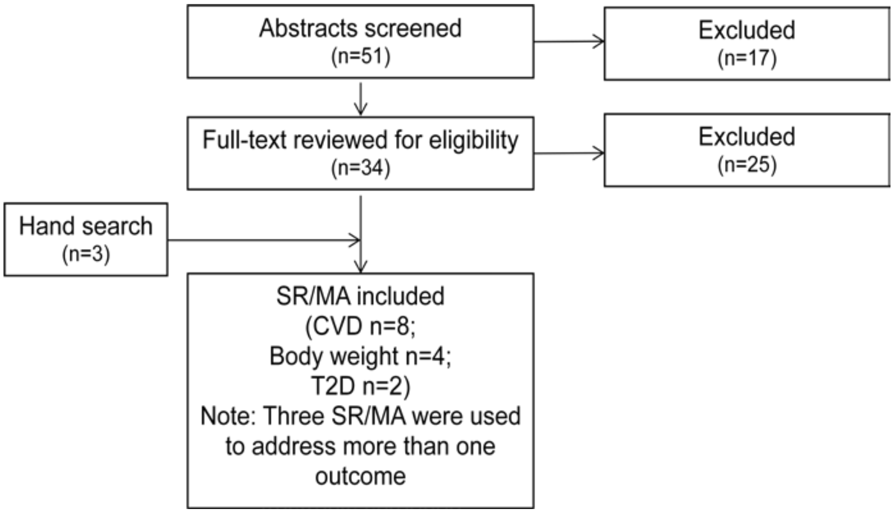
Study Subjects:
- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:
- Dietary pattern - The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

Outcome:
- CVD: LDL-cholesterol, HDL-cholesterol, triglycerides, blood pressure, incidence of CVD, CVD-related death, myocardial infarction, or stroke
- Body weight: Body mass index, body weight, percent body fat, waist circumference, incidence of overweight or obesity
- Type 2 diabetes: Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

Quality:
- Reviews rated 8-11 on AMSTAR (A measurement tool for the ‘assessment of multiple systematic reviews’)

Search Results



Excluded Articles with Reason for Exclusion

34. Ajala O, English P, Pinkney J. Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes. Am J Clin Nutr. 2013 Mar;97(3):505-16. doi: 10.3945/ajcn.112.042457. Epub 2013 Jan 30. Review. PubMed PMID: 23364002. EXCLUDE: Examined subjects diagnosed with type 2 diabetes (management of type 2 diabetes)

35. Akesson A, Andersen LF, Kristjánsdóttir AG, Roos E, Trolle E, Voutilainen E, Wirfält E. Health effects associated with foods characteristic of the Nordic diet: a systematic literature review. Food Nutr Res. 2013;57. doi: 10.3402/fnr.v57i0.22790. Review. PubMed PMID: 24130513; PubMed Central PMCID: PMC3795297. EXCLUDE: Examined individual components of the diet, not dietary patterns as defined by the Subcommittee

36. Aljadani H., Patterson A., Sibbritt D., Collins C. The association between dietary patterns and weight change in adults over time: A systematic review of studies with follow up. JBI Database of Systematic Reviews and Implementation Reports 2013 11:8 (272-316) EXCLUDE: Did not examine dietary patterns as defined by the Subcommittee

37. Al-Khudairy L, Stranges S, Kumar S, Al-Daghri N, Rees K. Dietary factors and type 2 diabetes in the Middle East: what is the evidence for an association?--a systematic review. Nutrients. 2013 Sep 26;5(10):3871-97. doi: 10.3390/nu5103871. PubMed PMID: 24077241; PubMed Central PMCID: PMC3820049. EXCLUDE: Not all countries in the Middle East are of high or very high development according to the Human Development Index

38. Barbaresko J, Koch M, Schulze MB, Nöthlings U. Dietary pattern analysis and biomarkers of low-grade inflammation: a systematic literature review. Nutr Rev. 2013 Aug;71(8):511-27. doi: 10.1111/nure.12035. Epub 2013 Jun 13. Review. PubMed PMID: 23865797. EXCLUDE: Outcomes were inflammatory markers, which were not included as intermediate outcomes in the Subcommittee’s analytical framework

39. Buckland G, Bach A, Serra-Majem L. Obesity and the Mediterranean diet: a systematic review of observational and intervention studies. Obes Rev. 2008 Nov;9(6):582-93. doi: 10.1111/j.1467-789X.2008.00503.x. Epub 2008 Jun 10. Review. PubMed PMID: 18547378 EXCLUDE: AMSTAR rating was 7 of 11

40. Carter P, Achana F, Troughton J, Gray LJ, Khunti K, Davies MJ. A Mediterranean diet improves HbA1c but not fasting blood glucose compared to alternative dietary strategies: a network meta-analysis. J Hum Nutr Diet. 2013 Jun 22. doi: 10.1111/jhn.12138. [Epub ahead of print] PubMed PMID: 23790149. EXCLUDE: Half of the studies included in the meta-analyses only included participants with T2D or CVD

41. Chan M.Y., Yulianna Y. Effect of mediterranean diet components on selected cardiovascular risk factors, all-cause mortality and cardiovascular mortality: Systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1093) EXCLUDE: Abstract, not a full article

42. Defagó M., Elorriaga N., Irazola V., Rubinstein A.Association between food patterns and biomarkers of endothelial function: A systematic review. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (1282) EXCLUDE: Outcomes were biomarkers of endothelial function, which were not included as intermediate outcomes in the Subcommittee’s analytical framework

43. Dong JY, Zhang ZL, Wang PY, Qin LQ. Effects of high-protein diets on body weight, glycaemic control, blood lipids and blood pressure in type 2 diabetes: meta-analysis of randomised controlled trials. Br J Nutr. 2013 Sep 14;110(5):781-9. doi: 10.1017/S0007114513002055. Epub 2013 Jul 5. Review. PubMed PMID: 23829939. EXCLUDE: Participants were diagnosed with type 2 diabetes

44. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Mediterranean diet and metabolic syndrome: an updated systematic review. Rev Endocr Metab Disord. 2013 Sep;14(3):255-63. doi: 10.1007/s11154-013-9253-9. PubMed PMID: 23982678. EXCLUDE: Included cross-sectional studies; examined incidence of metabolic syndrome, which is outside the scope of the Subcommittee’s analytical framework

45. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. Metab Syndr Relat Disord. 2010 Dec;8(6):471-6. doi: 10.1089/met.2010.0009. Epub 2010 Oct 19. Review. PubMed PMID: 20958207. EXCLUDE: Of the 10 included studies, 8 were included in the NEL and Alhamzi reviews being considered by the Committee

46. Esposito K, Maiorino MI, Ceriello A, Giugliano D. Prevention and control of type 2 diabetes by Mediterranean diet: a systematic review. Diabetes Res Clin Pract. 2010 Aug;89(2):97-102. doi: 10.1016/j.diabres.2010.04.019. Epub 2010 May 23. Review. PubMed PMID: 20546959. EXCLUDE: Only 3 studies looked at prevention and one was cross-sectional

47. Grosso G, Mistretta A, Frigiola A, Gruttadauria S, Biondi A, Basile F, Vitaglione P, D'Orazio N, Galvano F. Mediterranean diet and cardiovascular risk factors: a systematic review. Crit Rev Food Sci Nutr. 2014;54(5):593-610. doi: 10.1080/10408398.2011.596955. PubMed PMID: 24261534. EXCLUDE: Included cross-sectional studies; included various outcomes

not included in the Subcommittee's analytical framework, including incidence of metabolic syndrome, CRP, IL-6, liver transaminases, etc.

48. Hu T, Mills KT, Yao L, Demanelis K, Eloustaz M, Yancy WS Jr, Kelly TN, He J, Bazzano LA. Effects of low-carbohydrate diets versus low-fat diets on metabolic risk factors: a meta-analysis of randomized controlled clinical trials. Am J Epidemiol. 2012 Oct 1;176 Suppl 7:S44-54. doi: 10.1093/aje/kws264. PubMed PMID: 23035144; PubMed Central PMCID: PMC3530364. EXCLUDE: Did not examine dietary patterns as described by the Subcommittee

49. Joung H, Hong S, Song Y, Ahn BC, Park MJ. Dietary patterns and metabolic syndrome risk factors among adolescents. Korean J Pediatr. 2012 Apr;55(4):128-35. doi: 10.3345/kjp.2012.55.4.128. Epub 2012 Apr 30. PubMed PMID: 22574073; PubMed Central PMCID: PMC3346835. EXCLUDE: Meta-analysis of cross-sectional data

50. Kant AK. Dietary patterns: biomarkers and chronic disease risk. Appl Physiol Nutr Metab. 2010 Apr;35(2):199-206. doi: 10.1139/H10-005. Review. PubMed PMID: 20383233. EXCLUDE: Narrative review

51. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. J Am Coll Cardiol. 2011 Mar 15;57(11):1299-313. doi: 10.1016/j.jacc.2010.09.073. PubMed PMID: 21392646. EXCLUDE: Included cross-sectional studies

52. Kastorini CM, Milionis HJ, Goudevenos JA, Panagiotakos DB. Mediterranean diet and coronary heart disease: is obesity a link? - A systematic review. Nutr Metab Cardiovasc Dis. 2010 Sep;20(7):536-51. doi: 10.1016/j.numecd.2010.04.006. Review. PubMed PMID: 20708148. EXCLUDE: Included cross-sectional studies and secondary prevention studies

53. Kastorini CM, Panagiotakos DB. Dietary patterns and prevention of type 2 diabetes: from research to clinical practice; a systematic review. Curr Diabetes Rev. 2009 Nov;5(4):221-7. Review. PubMed PMID: 19531025. EXCLUDE: Included cross-sectional and case-control studies

54. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the Dietary Approaches to Stop Hypertension (DASH) diet: a systematic review. PLoS One. 2013;8(10):e78412. doi: 10.1371/journal.pone.0078412. PubMed PMID: 24205227; PubMed Central PMCID: PMC3813594. EXCLUDE: Examined compliance to the DASH diet

55. Maghsoudi Z, Azadbakht L. How dietary patterns could have a role in prevention, progression, or management of diabetes mellitus? Review on the current evidence. J Res Med Sci. 2012 Jul;17(7):694-709. PubMed PMID: 23798934; PubMed Central PMCID: PMC3685790. EXCLUDE: Included cross-sectional studies and seminars and symposiums

56. Marshall S, Burrows T, Collins CE. Systematic review of diet quality indices and their associations with health-related outcomes in children and adolescents. J Hum Nutr Diet. 2014 Feb 13. doi: 10.1111/jhn.12208. [Epub ahead of print] PubMed PMID: 24524271. EXCLUDE: Included cross-sectional and case-control studies; included abstracts; focus of

review was to describe indices being used with children and adolescents – only brief mention of body weight and no conclusions drawn.

57. Martínez-González MÁ, Martín-Calvo N. The major European dietary patterns and metabolic syndrome. Rev Endocr Metab Disord. 2013 Sep;14(3):265-71. doi: 10.1007/s11154-013-9264-6. PubMed PMID: 23979531. EXCLUDE: Narrative review

58. McEvoy C., Cardwell C., Woodside J., Young I., Hunter S., McKinley M. A systematic review and meta-analysis examining 'a posteriori' dietary patterns and risk of type 2 diabetes. Annals of Nutrition and Metabolism 2013 63 SUPPL. 1 (864) EXCLUDE: Abstract, not a full article

59. Mente A, de Koning L, Shannon HS, Anand SS. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch Intern Med. 2009 Apr 13;169(7):659-69. doi:10.1001/archinternmed.2009.38. Review. PubMed PMID: 19364995. EXCLUDE: Some studies included secondary prevention, did not provide list of included articles; describes dietary factors, rather than dietary pattern as defined by the SC

60. Nordmann A.J., Suter K., Tuttle K.R., Estruch R., Shai I., Bucher H. Meta-analysis of Mediterranean versus low-fat diets to improve cardiovascular risk factors. European Heart Journal 2010 31 SUPPL. 1 (940) EXCLUDE: Abstract, not a full article

61. Osei-Assibey G, Boachie C. Dietary interventions for weight loss and cardiovascular risk reduction in people of African ancestry (blacks): a systematic review. Public Health Nutr. 2012 Jan;15(1):110-5. doi: 10.1017/S1368980011001121. Epub 2011 Jun 1. Review. PubMed PMID: 21729478. EXCLUDE: Examined dietary interventions, in general, not dietary patterns specifically

62. Psaltopoulou T, Sergentanis TN, Panagiotakos DB, Sergentanis IN, Kosti R, Scarmeas N. Mediterranean diet, stroke, cognitive impairment, and depression: A meta-analysis. Ann Neurol. 2013 Oct;74(4):580-91. doi: 10.1002/ana.23944. Epub 2013 Sep 16. PubMed PMID: 23720230. EXCLUDE: Included case-control studies

63. Santos FL, Esteves SS, da Costa Pereira A, Yancy WS Jr, Nunes JP. Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors. Obes Rev. 2012 Nov;13(11):1048-66. doi: 10.1111/j.1467-789X.2012.01021.x. Epub 2012 Aug 21. Review. PubMed PMID: 22905670. EXCLUDE: Did not examine dietary patterns as described by the SC

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Appendix E-2.29a: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of school-based approaches on the dietary intake, quality, behaviors and/or preferences of school-aged children?

Conclusion Statement: Moderate evidence indicates that multi-component school-based approaches can increase daily vegetable and fruit consumption in children in grades kindergarten through 8th. Sufficient school-based studies have not been conducted with youth in grades 9 to 12. Vegetable and fruit consumption individually, as well as in combination, can be targeted with specific school-based approaches.

DGAC Grade: Moderate

Key Findings

- This evidence portfolio includes three systematic reviews (Evans, 2012; Jensen, 2011; Langellotto and Gupta, 2012); two of which included meta-analyses (Evans, 2012; Langellotto and Gupta, 2012), which collectively evaluated 75 studies published between 1985 and 2011. Forty-nine studies were conducted in the United States and the remaining studies were completed in other highly developed countries. The systematic reviews examined the impact of school-based approaches targeting the dietary intake, quality, behaviors and/or preferences of school-aged children.
- The studies used a variety of intervention strategies targeting behaviors related to dietary intake. Some approaches were multi-component, with a combination of interventions targeting children, their parents, and/or the school environment. The primary dietary outcome of interest was fruit and vegetable intake.
- In the body of evidence available, the school-based approaches were diverse, making comparison across studies challenging. Despite this variability, multi-component interventions, and in particular those that engage both children and their families were more effective than single-component interventions for eliciting significant dietary improvements. Broadly, school-based intervention programs moderately increase total daily fruit and vegetable intakes and fruit (with and without fruit juice) intake alone. Furthermore, school-based economic incentive programs can effectively increase fruit and vegetable consumption and reduce consumption of low-nutrient-dense foods while children are at school. Nutrition education programs that include gardening effectively increase the consumption of vegetables in school-aged children, along with small, but significant increases in fruit intake.
- The evidence base includes three reviews evaluating several studies by independent investigators with sufficient sample sizes. Some inconsistency is evident across studies and may be explained by differences in the populations sampled, outcome measures, duration or exposure of intervention and follow-up periods. Although findings indicate that school-based approaches effectively increase the combined intake of fruit and vegetables, the magnitude of the effect as well as the public health significance is difficult to assess because of different measures and methodology.

Description of the Evidence

This evidence portfolio includes 3 systematic reviews/meta-analyses published between 2011 and 2012 (Evans, 2012; Jensen, 2011; Langellotto and Gupta, 2012). Collectively, the reviews included a total of 75 studies published between the years 1985 to 2011, with no overlap of studies between reviews. Study designs included randomized controlled trials

(RCTs), non-randomized controlled trials, cross-sectional studies, modeling studies, and simulation studies. Evans *et al* reviewed 27 controlled trials; 21 were included in the meta-analysis. Jensen *et al* reviewed 28 studies, from 30 publications, consisting of the following: 4 RCTs, 10 quasi-experimental studies, 4 price simulation experiments, 4 cafeteria sales incentives, and 6 cross-sectional studies. Langellotto and Gupta reviewed 20 studies, consisting of the following: 2 RCTs, 12 quasi-experimental studies with a control group, and 6 quasi-experimental studies without a control group.

The systematic reviews/meta-analyses had relatively low risk of bias, as evidenced by AMSTAR scores, ranging from 8 points out of a possible 11 to 11 out of 11. Evans *et al* evaluated the quality of the studies included in their meta-analysis based on the following 3 criteria: reporting of sequence generation criteria, allocation concealment, and blinding of participants, personnel, or outcome assessors. Trials were considered to be at high risk of bias if none of the criteria were met (n=11), at medium risk of bias if one or two of the criteria were met (n=10), or at low risk of bias if all three of the criteria were met (n=1). The other two reviews did not assess the risk of bias of the included studies.

The sample sizes reported for individual studies ranged from 6 to 3,382 children. The Evans *et al* meta-analysis presented pooled results for 26,361 subjects with a mean of 909 children per study and a median of 486 children per study.

Population

The studies examined generally healthy children in kindergarten through 12th grade, with the majority of findings pertaining to children aged 5 to 12 years. Of the 75 studies included in the three reviews, 49 were conducted in the United States, while 26 were conducted in other highly developed countries. The reviews did not review or present results by gender or race/ethnicity (refer to the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of school-based approaches for targeting the dietary intake of children and their behaviors related to nutrition, including educational programs, social marketing, changes to the environment, and economic incentives. The majority of the programs were multi-component, with many of the interventions targeting daily fruit and/or vegetable intake. The studies included in the Jensen *et al* review evaluated economic incentives focused on physical, social, and political environmental factors to promote healthier eating. Some incentives directly targeted students' selection of specific foods by reducing or eliminating the cost of fruits and vegetables available during the school day. The Langellotto and Gupta review examined the impact of programs that included hands-on gardening experiences versus nutrition education programs without a gardening component.

Outcomes

The Jensen *et al* review reported various outcome data regarding food and beverage intake of school-aged children, including food choice observations from controlled experiments (representing intake), self-reported intake with changed economic incentives, observed sales data (a measurement of intake in schools), and intake data measured directly by researchers. The Evans *et al* review reported the difference in portions (total weight in grams per 80 grams) of fruit and vegetables, separately and combined, consumed daily, excluding potatoes, between intervention and control groups. Trials that included fruit juice together with fruit and vegetables were analyzed separately. Langellotto and Gupta evaluated children's nutrition knowledge, preference for fruit and vegetables, and/or consumption of fruit and vegetables.

Evidence Synthesis

Findings from the Evans *et al* review and meta-analysis of (primarily multi-component) school-based programs designed to increase daily fruit and/or vegetable intake in children consistently demonstrated moderate effectiveness for increased total fruit and vegetable intake. Improvements in dietary intake, specifically fruit and vegetable consumption, were primarily attributable to fruit intake which increased 1/4 to 1/3 of a portion (equivalent to a 20–30-g daily increase). Although most programs aimed to improve intake of both fruit and vegetables, most schemes failed to increase vegetable intake by a meaningful amount. Studies that included fruit juice when assessing fruit and vegetable consumption tended to have higher intakes at baseline and greater increases as a result of the intervention. The exclusion of fruit juice, which is not strongly associated with health outcomes, attenuated the impact of programs on daily fruit and vegetable intake. Multi-component school-based programs designed to improve child and family eating behaviors tended to be more effective than single-component programs. However, due to a paucity of data strong conclusions could not be made regarding single-component interventions, which primarily involved distributing free or subsidized fruits and vegetables to children in the school setting.

Jensen *et al* reviewed studies that aimed to improve the diets of children using economic incentives. Consistent with Evans *et al*, school-based approaches effectively increased consumption of fruit and vegetables. Specifically, programs to reduce or eliminate the cost of fruit and vegetables effectively increased consumption, especially when the program focused on the cost and availability directly to the student. Additionally, findings indicate that economic incentives can be used to simultaneously increase fruit and vegetable intakes while reducing the intakes of foods low in nutrient density (e.g., soda/candy/chips). Limited information suggested that economic incentives focused on physical, social, and political environmental factors also may promote healthier eating behaviors of students, but effectiveness was not clearly documented. The multitude of approaches assessed in this systematic review made it difficult to draw strong conclusions; and the lack of a meta-analysis precluded quantifying the magnitude of dietary behavior responses. In summary, Jensen *et al* concluded that manipulating the cost of foods can impact dietary intake and behaviors (i.e., food purchases) among school-aged children.

The review and quantitative analysis assessing the impact of garden-based nutrition education programs on children's nutrition knowledge, preference for fruit and vegetables, and/or consumption of fruit and vegetables by Langellotto and Gupta was limited by the small number of studies that reported the full suite of descriptive statistics needed to conduct a meta-analysis. Nonetheless, gardening was associated with increased consumption of fruit and vegetables; while nutrition education programs significantly increased nutrition knowledge. Neither gardening nor nutrition education programs significantly improved preferences for fruit and/or vegetables.

Despite the variability in school-based approaches (i.e., programs and interventions) targeting dietary intake and eating behaviors among school-aged children, multi-component approaches effectively increase daily fruit and vegetable consumption in children grades kindergarten through 8th; yet data are lacking among youth in grades 9th through 12th. Fruit and vegetable consumption individually, as well as in combination, can be targeted through a variety of school-based approaches, including educational programs, changes to the environment, economic incentives, and gardening programs.

Overview Table

Summary of systematic review examining the impact of school-based approaches on the dietary intake, quality, behaviors and/or preferences of school-aged children

Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
Evans, 2012 Systematic review/meta-analysis AMSTAR Score: 11/11	To quantify the impact of school-based interventions on fruit and vegetable (FV) intake in children aged 5-12 y Total N = 26,361 (mean of	**Independent variables:** intervention elements included: school lessons, communications with parents, students, teachers, food provision such as the availability of	School-based interventions of all types were estimated to improve daily FV consumption by an average of one-quarter to one-third of a portion (equivalent to a 20–30-g daily increase).

27 randomized controlled trials or controlled trials 21 studies used in meta-analysis	909 children/study) **Location:** 12 studies in the US 5 studies in the UK 4 studies in the Netherlands 3 studies in Norway 1 each in Canada, Denmark, New Zealand	FV at lunchtime, free FV distribution, food marketing, point-of-purchase incentives, food preparation or tasting during school, home-based projects or homework, improvements in school environment, and community, supermarket, or industry involvement **Outcomes:** difference in portions (total weight in g/80 g) of FV, separately and combined, consumed daily, excluding potatoes	**Daily difference in FV consumption, excluding fruit juice** = 0.25 portions (95% CI: 0.06, 0.43; P <0.01) **Daily difference in FV consumption, including fruit juice** = 0.32 portions (95%CI: 0.14, 0.50; P < 0.01) **Daily difference in fruit consumption, excluding fruit juice** = 0.24 portions (95% CI: 0.05, 0.43; P <0.01); Egger's test for asymmetry was significant (P = 0.02) **Daily difference in fruit consumption, including fruit juice** = 0.28 portions (95% CI: 0.12, 0.44; P <0.01) **Daily difference in vegetable consumption** = 0.07 portions (95% CI: 20.03, 0.16; NS)
Jensen, 2011 Systematic review AMSTAR Score: 8/11 28 studies (30 publications): • 4 randomized controlled trials • 10 quasi-experimental • 4 price simulation experiments • 4 cafeteria sales incentives • 6 cross-sectional	Focused on interventions that aimed to improve the diets of children aged 10-12 y using various types of economic incentives. Non-obese children **Location:** 17 studies the US 3 studies in Norway 1 each in Ireland, UK, Australia 5 not identified	**Independent variables:** economic incentives designed to influence dietary behavior – measured as intake of relevant foods, beverages, and snacks – or the availability of healthy foods and beverages in schools **Outcomes:** food choice observations (representing intake), self-reported intake with changed economic incentives, observed sales, and intake data measured directly by researchers	In general, the review supports the hypothesis that the choice of foods, snacks, and beverages by schoolchildren can be influenced by economic incentives. Overall, studies of price incentives in schools suggested that incentives are effective for increasing FV consumption in schools in the short term and, to some extent, in the long term. Two crucial determinants for the effectiveness of price instruments were identified: 1) foods or beverages are offered (for sale) at the schools, and 2) 10–12-year-old children bring money to school to buy some of these items.
Langellotto, 2012 Systematic review/meta-analysis AMSTAR Score: 8/11 20 studies reported 66 observations: • 2 randomized controlled trials • 12 quasi-experimental with control 6 quasi-experimental without control	Meta-analysis examined the efficacy of garden-based nutrition education programs for increasing children's nutrition knowledge, preference for fruit and vegetables, and/or consumption of fruit and vegetables. Children from kindergarten through 8th grade. (search was for K-12th grade) **Location:** US	**Independent variables:** three categories of interventions: nutrition education with garden component, nutrition education without garden component, or control with no formal nutrition education program **Outcomes:** nutrition knowledge, fruit and vegetable preference, and/or fruit and vegetable	**Change in FV preferences** • Gardening treatment Fruit: E^{++} = –0.02; CI: –0.20, 0.01, df = 3; NS Vegetables: E^{++}= 0.10; CI: 0.01, 0.19, df = 1; Significant • Nutrition education treatment: insufficient observations to quantify changes in FV preferences • Control Fruit: E^{++} = –0.01; CI: –0.01, 0.00, df = 1; NS Vegetables: E^{++} = –0.01; CI: –0.05, 0.11; df = 2; NS **Change in fruit intake** • Garden-based program: E^{++} = 0.08; CI:

		consumption	0.02, 0.12; df = 1; Significant • Nutrition education treatment: E^{++} = –0.02; CI: –0.14, –0.002; df = 2; Negative effect • Control: E^{++} = –0.04; CI: –0.24, 0.003; df = 3; NS **Change in vegetable intake** • Garden treatment: E^{++} = 0.42; CI: 0.07, 2.07; df = 3; fail-safe number = 50.5; Significant • Nutrition education treatment: E^{++} = –0.002; CI: –0.0073, 0.04; df = 2; fail-safe number = 0; NS • Control: E^{++} = –0.03; CI: –0.14, –0.01; df = 5; fail-safe number = 0; NS **Qualitative analysis of the vote counting:** Pre- vs. posttest comparisons revealed that the majority of the outcomes (26 out of 39) were non-significant in the control and nutrition education groups, but positive and significant for the gardening group.
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 75 independent studies with 43 controlled studies evaluated in three rigorous systematic reviews, two of which include a quantitative meta-analysis. The reviews/meta-analyses are of high-quality with AMSTAR scores of 8 to 11 out of 11 possible points.

Consistency: Across individual studies and reviews, school-based approaches consistently increased fruit and vegetable intake. In particular, the utility of economic incentives to promote fruit and vegetable intake consumption was evident across reviews (Evans, 2012; Jensen, 2011). Additionally, findings from Langellotto and Gupta support the effectiveness of school-based programs that include hands-on gardening experiences to increase the consumption of vegetables. All three reviews indicate that multi-component programs are more effective than single-component programs.

Impact: Daily total fruit and vegetable intakes increased by 1/4 to 1/3 of a portion, but the potential health impact of this change was not evaluated in these reports. For reference, the *Dietary Guidelines for Americans* recommend between 1 to 1½ cups of fruit and 1½ to 2 cups of vegetables per day for most school-aged children.

Generalizability: Collectively, the studies included in the reviews were geographically diverse (both nationally and internationally), but information on the characteristics of the participating children was very limited. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the included reviews were of high quality, the authors of the individual reviews commented that the quality of the studies included in their assessments varied, with some studies having a high risk for bias. Evans *et al* included controlled studies with and without randomization and reporting of results was not consistent across studies. Additionally, the authors noted that successful programs may not have been included in the analysis because of a lack of suitable published data on improvements in fruit and vegetable intake over the whole day. Jensen *et al* noted the problem of separating the effects of economic incentives from those of other intervention strategies for the studies they reviewed as well as a paucity of relevant studies. Furthermore, many of the significant improvements in fruit and vegetable consumption reported by Langellotto and Gupta with regard to school-garden programs were small in magnitude.

Implications*

Existing evidence indicates that school-based programs designed to improve the food environment and support healthy behaviors may effectively promote improved dietary intake and weight status of school-aged children. Programs that emphasize multicomponent, multidimensional approaches (including increased physical activity) are important to changing behavior and need to be reinforced within the home environment, as well as the community, including neighborhood food retail outlets that surround schools. Policies should strive to support effective programs that increase availability, accessibility, and consumption of healthy foods and beverages, while reducing less healthy competitive foods and beverages. The combination of economic incentives along with specific policies can increase the likelihood that specific approaches will be effective.

The recently updated USDA nutrition standards for school meals and snacks and beverages sold in schools will ensure that students throughout the U.S. will have healthier school meals and snack and beverage options, but schools need support and active engagement from students, parents, teachers, administrators, community members, and their districts and states to successfully implement and sustain them.

Research Recommendations*

1. New research is needed to document the types and quantities of foods and beverages students consume both at school and daily before, during and after school-based healthy eating approaches and policies are implemented.

   Rationale: Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the 2015 DGAC to address this issue did not comprehensively measure or report dietary information. While the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

2. Improvements are needed in the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized control trials.

   Rationale: While the methodological quality of the systematic reviews and meta-analyses used by the 2015 DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized control trial experimental designs, with randomization at the individual, classroom, school, or school district level. Feasibility studies may also be helpful to more quickly identify promising novel approaches to improve dietary intake and weight control outcomes.

3. Post-program follow-up assessments lasting >1 year are needed to determine the longer-term retention of changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, more research is needed in adolescents (grades 9-12).

   Rationale: Literature supports that eating and physical activity behaviors and body weight status of children are predictive of changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

4. A wider variety of innovative school-based approaches and policies are needed to increase vegetable intakes.

   Rationale: Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase fruit and vegetable intakes are generally more effective at increasing fruit intake – the documented exceptions being school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruits and vegetables as a single food group, which props the need for new research using prospective, repeated measures, randomized control trial experimental designs specifically targeting increased consumption of healthy vegetables.

*Because the schools questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement for the four questions along with collective research recommendations.

References

1. Evans CE, Christian MS, et al. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. Am J Clin Nutr 2013;96(4):889-901. PMID:22952187 http://www.ncbi.nlm.nih.gov/pubmed/22952187
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3. Langellotto GA and Gupta A. Gardening increases vegetable consumption in school-aged children: a meta-analytical synthesis. Horttechnology 2012;22(4):430-445. http://horttech.ashspublications.org/content/22/4/430.abstract

Appendix E-2.29b: Search Plan and Results—Schools

Part D. Chapter 4: Food Environment and Settings

1. What is the impact of school-based approaches on the dietary intake, quality, behaviors, and/or preference of school-aged children? (see **Appendix E-2.29a: Evidence Portfolio**)

2. What is the impact of school-based policies on the dietary intake, quality, behaviors, and/or preferences of school-aged children? (see **Appendix E-2.30: Evidence Portfolio**)

3. What is the impact of school-based approaches on the weight status of school-aged children? (see **Appendix E-2.31: Evidence Portfolio**)

4. What is the impact of school-based policies on the weight status of school-aged children? (see **Appendix E-2.32: Evidence Portfolio**)

Table of Contents

Search Strategy

Dates Searched: 1/30/14, 1/31/14, 3/19/14

Databases: MEDLINE, Cochrane, Embase, ERIC, Sociological Abstracts, Web of Science

Year Range: January, 2010 to March, 2014

Search Terms and Date(s):

MEDLINE:
Date(s) Searched: 1/30/14, 1/31/14
Search Terms:

((Schools[mh] OR school*[tiab] OR schools[tiab] OR “school-based”[tiab] OR “school based”[tiab] OR school health services[mh])) AND (child nutritional physiological phenomena[mh:noexp] OR nutrition[tiab] OR diet[mh] OR diet[ti] OR dietary[ti] OR food preferences[mh] OR feeding behavior[mh:noexp] OR nutrition surveys[mh] OR food*[tiab] OR "Food and Beverages"[mh] OR food supply[majr] OR Eating[mh] OR eating behavior*[tiab] OR eating behaviour*[tiab] OR meals[ti] OR meal[ti] OR breakfast[tiab] OR lunch[tiab] OR dinner[tiab] OR snacks[tiab] OR snack[tiab]OR "caloric density"[tiab] OR “caloric intake”[tiab] OR caloric dens*[tiab] OR high calori*[tiab] OR energy dens*[tiab] OR fruit*[tiab] OR vegetable*[tiab] OR food analysis[mh] OR dietary intake*[tiab] OR food intake*[tiab] OR energy intake*[tiab] OR food habits[mh] OR dietary habit*[tiab] OR diet habit*[tiab] OR eating habit*[tiab] OR nutrient intake*[tiab] OR food choice*[tiab] OR portion size*[tiab] OR "diet quality"[tiab] OR dietary choice*[tiab] OR dietary change*[tiab] OR diet records[mh] OR nutritional status[mh] OR nutritional sciences[mh] OR dietary pattern*[tiab] OR diet pattern*[tiab] OR eating pattern*[tiab] OR food pattern*[tiab] OR eating habit*[tiab] OR dietary habit*[tiab] OR food habit*[tiab] OR dietary profile*[tiab] OR food profile*[tiab] OR diet profile*[tiab] OR eating profile*[tiab] OR dietary guideline*[tiab] OR dietary recommendation*[tiab] OR food intake pattern*[tiab] OR dietary intake pattern*[tiab] OR eating style*[tiab] OR obesity/pc[mh] OR overweight/pc[mh]))

OR

((Schools[mh] OR school*[tiab] OR schools[tiab] OR “school-based”[tiab] OR “school based”[tiab] OR school health services[mh])) AND (Garden*[tiab]OR vending machine*[tiab] OR food dispensers, automatic[mh] OR nutritional sciences/education[mh] OR counseling[mh] OR “farm to school”[tiab] OR "farm-to-school"[tiab]OR child nutrition sciences/education[mh] OR health promotion/methods[mh] OR health education[mh] OR organizational policy[mh] OR policy[mh] OR "Nutrition Policy"[Mesh] OR "Public Policy"[Mesh] OR intervention[ti] OR interventions[ti] OR program[ti] OR programs[ti] OR program development[mh] OR food services[mh] OR "Dietary Services"[Mesh] OR cafeteria*[tiab] OR salad bar*[tiab] OR kitchen*[tiab] OR cooking[mh] OR cooking[ti] OR chef[tiab])

OR

((Schools[mh] OR school*[tiab] OR schools[tiab] OR “school-based”[tiab] OR “school based”[tiab] OR school health services[mh])) AND (body weight[mh] OR child development[mh] OR adolescent development[mh] OR weight[tiab] OR growth[tiab] OR growth[mh:noexp] OR “body size”[tiab] OR “body height”[tiab] OR "Body Height"[Mesh] OR “body weight”[ti] OR “body-weight related”[tiab] OR "weight gain"[ti] OR weight gain[mh] OR "weight loss"[tiab] OR Body Weights and Measures[Majr] OR obesity[tiab] OR obese[tiab] OR obesity[mh] OR overweight [tiab] OR overnutrition[tiab] OR adiposity[tiab] OR adiposity[mh] OR overweight[tiab] OR "Body Composition"[mh] OR "body fat"[tiab] OR adipos*[tiab] OR weight[ti] OR waist[ti] OR "Anthropometry"[Mesh:noexp] OR “body mass index”[tiab] OR BMI[tiab] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab] OR ideal body weight[mh])

AND (reviews[ptyp] OR systematic[sb])

Cochrane:
Date(s) Searched: 3/19/2014
Search Terms:

'garden* OR garden-based in Title, Abstract, Keywords and nutrition* OR diet* and school* - limited to Cochrane Database of Systematic Reviews

Embase:
Date(s) Searched: 3/19/2014
Search Terms:

'school'/exp OR school*:ab,ti AND ('gardening'/exp OR garden*:ab,ti OR 'garden-based':ab,ti)

AND

'review'/exp OR 'review' OR 'meta analysis (topic)'/exp OR 'meta analysis (topic)' OR 'meta analysis'/exp OR 'meta analysis' OR 'systematic review'/exp OR 'systematic review' OR 'systematic review (topic)'/exp OR 'systematic review (topic)' OR [meta analysis]/lim OR [systematic review]/lim OR [cochrane review]/lim AND [2010-2014]/py

ERIC:
Date(s) Searched: 3/19/2014
Search Terms:

(garden* OR garden-based) AND school* AND (nutrition* OR eating OR food OR diet*) AND review

Sociologic Abstracts:
Date(s) Searched: 3/19/2014
Search Terms:

(garden OR gardening OR garden-based OR gardens) AND (schools OR school) AND review

Web of Scienc:
Date(s) Searched: 3/19/2014
Search Terms:

TITLE: (garden* OR garden-based) *AND* TITLE: (school OR schools) *AND* TOPIC: (systematic OR review)
Indexes=SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=2010-2014

Inclusion/ Exclusion Criteria

Inclusion criteria for the school-based systematic reviews included the following:

- Human subjects
- Subject populations from countries with high or very high human development, according to the 2012 Human Development Index
- School-aged children (kindergarten through 12th grade students)
- Subjects who were healthy or at elevated chronic disease risk
- Systematic reviews and meta-analyses
- The intervention or exposure in the reviewed articles was a school program, policy or practice targeting dietary behaviors and/or weight status
- The comparator in the reviewed articles was different levels of intervention, different types of intervention, or no intervention/policy (a control group)
- The outcome(s) was(were) dietary intake, dietary quality, dietary behaviors, dietary preferences, or weight-related measures

In addition, articles were included if they were published in English in a peer-reviewed journal between January 2010 and March 2014. If an author was included on more than one primary research article contained within a review that is similar in content, the paper with the most pertinent data/endpoints was included. If data/endpoints from both papers were appropriate, it was made clear that results were from the same intervention. If a primary research article was included in more than one review, the study overlap was noted.

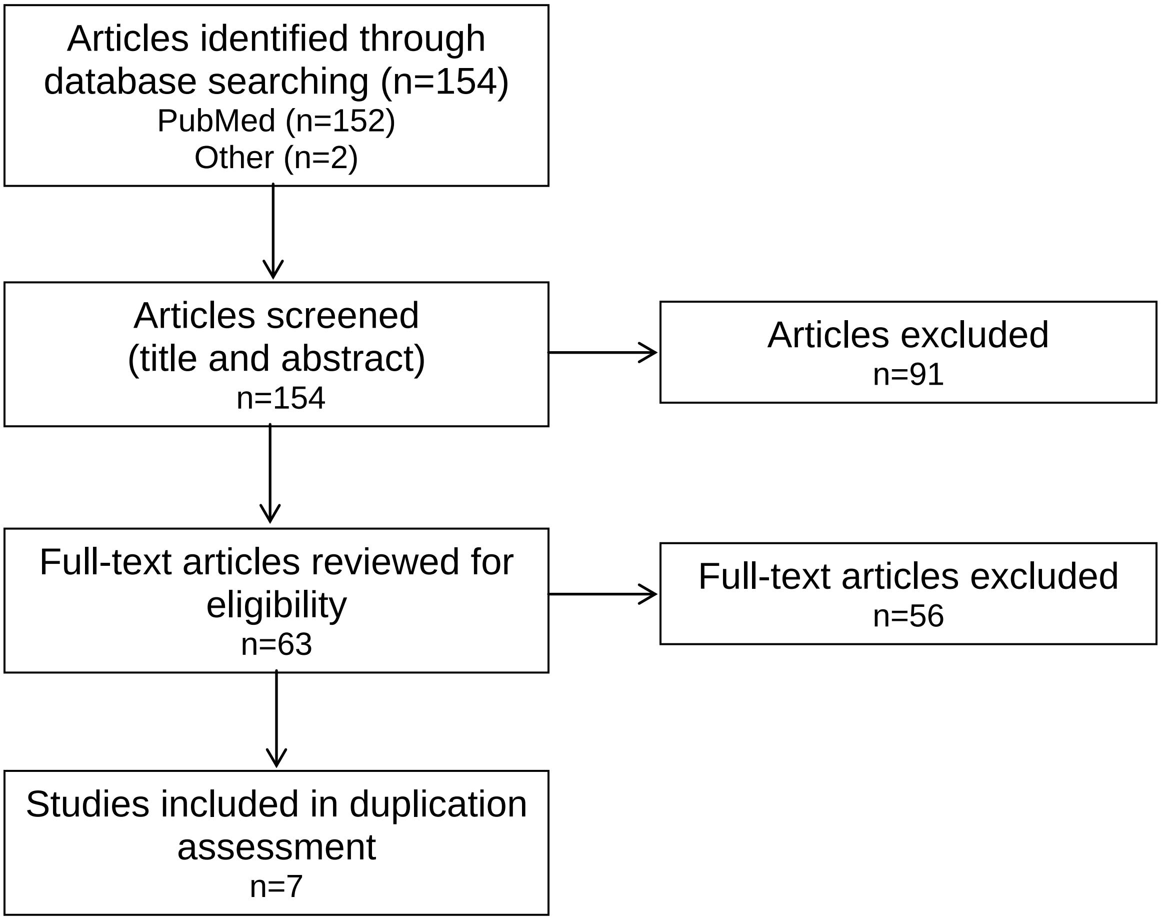
Exclusion criteria for the dietary patterns systematic reviews included:

- Animals and in vitro models
- Subject populations from countries with medium or low human development, according to the Human Development Index
- Adults
- Subjects who were hospitalized, diagnosed with disease, and/or receiving medical treatment
- Literature reviews, editorials, and commentaries

Articles were excluded if they were not published in English, or were published before January 2010. Articles, abstracts, and presentations not published in peer-reviewed journals (e.g., websites, magazine articles, Federal reports) were also excluded. Finally, if an author was included on more than one review article or primary research article that was similar in content, the paper with the most pertinent data/endpoints was included, and others were excluded. If a primary research article was included in more than one review, the study overlap was noted.

Search Results

Date Updated: 12/05/14



Included Articles

The following articles have been determined to be relevant for inclusion in the body of evidence used for the systematic review questions:

Approaches & Diet

1. Evans CE, Christian MS, et al. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. Am J Clin Nutr 2013;96(4):889-901. PMID:22952187 http://www.ncbi.nlm.nih.gov/pubmed/22952187
2. Jensen JD, Hartmann H, et al. Economic incentives and nutritional behavior of children in the school setting: a systematic review. Nutr Rev 2011;69(11):660-74. PMID:22029832. http://www.ncbi.nlm.nih.gov/pubmed/22029832
3. Langellotto GA and Gupta A. Gardening increases vegetable consumption in school-aged children: a meta-analytical synthesis. Horttechnology 2012;22(4):430-445. http://horttech.ashspublications.org/content/22/4/430.abstract

Policies & Diet

1. Chriqui JF, Pickel M, Story M. Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA Pediatrics 2014;168(3):279-86. PMID:24473632. http://www.ncbi.nlm.nih.gov/pubmed/24473632
2. Jensen JD, Hartmann H, et al. Economic incentives and nutritional behavior of children in the school setting: a systematic review. Nutr Rev 2011;69(11):660-74. PMID:22029832. http://www.ncbi.nlm.nih.gov/pubmed/22029832

Approaches & Weight

1. Wang Y, Wu Y, Wilson RF, Bleich S, Cheskin L, Weston C, Showell N, Fawole O, Lau B, Segal J. Childhood obesity prevention programs: comparative effectiveness review and meta-analysis. Comparative effectiveness review No. 115. AHRQ Publication No. 13-EHC081-EF. Rockville, MD: Agency for Healthcare Research and Quality; June 2013. http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0057623/pdf/TOC.pdf
2. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews. 2011; (12). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001871.pub3/abstract

Policies & Weight

1. Chriqui JF, Pickel M, Story M. Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA Pediatr 2014;168(3):279-86. PMID:24473632. http://www.ncbi.nlm.nih.gov/pubmed/24473632
2. Williams AJ, Henley WE, et al. Systematic review and meta-analysis of the association between childhood overweight and obesity and primary school diet and physical activity policies. Int J Behav Nutr Phys Act 2013;10:101. PMID:23965018. http://www.ncbi.nlm.nih.gov/pubmed/23965018

Appendix E-2.30: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of school-based policies on the dietary intake, quality, behaviors, and/or preferences of school-aged children?

Conclusion Statement: Strong evidence demonstrates that implementing school policies for nutrition standards to improve the availability, accessibility, and consumption of healthy foods and beverages sold outside the school meal programs (competitive foods and beverages) and (or) reducing or eliminating unhealthy foods and beverages are associated with improved purchasing behavior and result in higher quality dietary intake by children while at school.

DGAC Grade: Strong

Key Findings

- This evidence portfolio includes two systematic reviews (Jensen, 2011; Chriqui, 2014), which collectively evaluated 52 studies published between 1990 and 2013. Forty-one studies were conducted in the United States and the remaining studies were conducted in other highly-developed countries. The systematic reviews examined the impact of school policies, at the state and district levels, on dietary intake and behaviors.
- The studies included a variety of policies, including economic incentives and both state and school-district policies, targeting behaviors related to dietary intake. The primary outcomes of interest were fruit and vegetable intakes and availability, purchasing, and consumption of competitive foods and beverages (CF&B).
- In the body of evidence available, school policies were diverse, making comparison across studies challenging. Despite this variability, school-based policies targeting the availability of foods and beverages can positively impact the behaviors related to nutrition among children while they are at school. School-based economic incentive programs can effectively increase fruit and vegetable consumption and reduce consumption of low-nutrient-dense foods while children are at school. The implementation of school policies to change the availability and accessibility of healthier foods and beverages versus unhealthy CF&B is associated with the expected changes in consumption within the school setting. In addition, strong and consistent enforcement of more comprehensive policies to change the availability of healthier foods and beverages versus unhealthy CF&B at schools is associated with desired changes in consumption and purchasing within the school setting. Also, policies restricting the use of food as a reward for academic performance or as part of a fundraiser were associated with a reduction in using foods and beverages for these purposes.
- The evidence base includes two reviews evaluating several studies by independent investigators with sufficient sample sizes. Although findings indicate that school policies can effectively increase the combined intake of fruits and vegetables and/or decrease the availability, purchasing, and consumption of unhealthy CF&B, the magnitude of the effect as well as the public health significance is difficult to ascertain.

Description of the Evidence

This evidence portfolio includes two systematic reviews published in 2011 and 2014 (Jensen, 2011; Chriqui, 2014). Collectively, the reviews included a total of 52 studies published between the years 1990 and 2013, with no overlap of studies between the reviews. Study designs included randomized controlled trials (RCTs), non-randomized controlled trials, cross-sectional studies, pre/post studies, and price simulation analyses. The systematic reviews had relatively low risk of bias, as evidenced by AMSTAR scores, ranging from 8 points out of a possible 11 to 9 out of 11 points.

Population

The studies examined generally healthy children in kindergarten through 12th grade, with Jensen *et al* focusing on children aged 5 to 12 years. Of the 52 included studies, 41 were conducted in the United States, while 11 were conducted in other highly-developed countries. The sample sizes ranged from three high schools to 130,353 children, as well as a varying number of districts. The reviews did not review or present results by gender or race/ethnicity. (See the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of school-based policies. The studies included in the Jensen *et al* review evaluated economic incentives designed to influence dietary behavior. Some incentives directly targeted students' selection of specific foods by reducing or eliminating the cost of fruits and vegetables available during the school day. Chriqui *et al* assessed state laws and school district policies related to CF&B.

Outcomes

The Jensen *et al* review reported various outcome data regarding food and beverage intake of school-aged children, including food choice observations from controlled experiments (representing intake), self-reported intake with changed economic incentives, observed sales data (a measurement of intake in schools), and intake data measured directly by researchers. The outcomes assessed by Chriqui *et al* included CF&B availability and consumption and weight-related outcomes (e.g., change in weight or BMI, probability of overweight or obesity).

Evidence Synthesis

Chriqui *et al* reviewed 24 studies examining the relationship between state laws and/or school district policies (in practice, not just "on the book" policies) and student weight-related outcomes and availability, purchasing, and consumption of CF&B. In general, the findings demonstrate the effectiveness of school-based policies to reduce CF&B availability and consumption within schools. Fifteen of 24 studies reviewed found that state laws and/or district policies had significant positive impact on consumption, BMI, or other weight outcomes; while nine of 24 studies reported mixed or non-significant results. Strong and consistent enforcement of more comprehensive policies to reduce or eliminate the availability of CF&B at schools was associated with greater changes in purchasing and consumption within the school setting. Also, policies restricting the use of food as a reward for academic performance or as part of a fundraiser were associated with a reduction in using foods and beverages for these purposes. The report did not quantify the impact of the policies on the outcomes of interest. The authors stated that caution should be exercised when interpreting the results since the studies were primarily of cross-sectional design. Additionally, the studies were "natural experiments" which raises concerns regarding the internal and external validity of the findings.

Jensen *et al* reviewed 28 studies that aimed to improve the diets of children using economic incentives. School-based programs to reduce or eliminate the cost of fruits and vegetables effectively increased consumption, especially when the program focused on the cost and availability directly to the student. Additionally, findings indicate that economic incentives can be used to simultaneously increase fruit and vegetable intakes while reducing the intake of foods low in nutrient density (e.g., soda, candy, and chips). Limited information suggested that economic incentives focused on physical, social, and political environmental factors also may promote healthier eating behaviors among students, but effectiveness was not clearly documented. The multitude of programs and policies assessed in this systematic review made it difficult to draw strong conclusions; and the lack of a meta-analysis precluded quantifying the magnitude of dietary behavior responses. In summary, Jensen *et al* concluded that manipulating the cost of foods can impact dietary intake and behaviors (i.e., food purchases) among school-aged children.

Collectively, the research indicates that school-based policies targeting the availability of foods and beverages can positively impact behaviors related to nutrition, such as the purchasing and consumption of certain foods, among children while they are at school.

Overview Table

Summary of systematic review examining school-based approaches and dietary intake, quality and behavior

Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
Chriqui, 2014 Systematic review AMSTAR Score: 9/11 24 studies: • 3 longitudinal • 20 cross-sectional • 1 combined 16 examined pre-/post-policy changes 8 examined post-policy changes	To examine the potential influence of federal rule on the relationship between state laws and/or school district policies and student body mass index (BMI) and weight outcomes, consumption and availability of competitive foods and beverages (CF&B) Laws and policies impacting schools; grades kindergarten through 12th grade. **Location:** US	**Independent variables:** state laws or school district policies related to CF&B • State laws: 14 studies • District policies: 8 studies • Combined laws and policies: 2 studies **Outcomes:** • Change in BMI or weight; probability of overweight or obesity: 4 studies • CF&B consumption: 10 studies • CF&B availability: 13 studies Examined more than 1 outcome: 3 studies	15 of 24 studies reviewed found that state laws and/or district policies had significant positive impact on consumption, BMI or weight outcomes, while 9 of 24 studies reported mixed or non-significant results. Selected Results: • 3 bivariate studies reported that milk policy changes reduced calories and saturated fats • 3 bivariate studies, all examining early policy changes in Texas (2 state law studies and 1 district policy study), reported a mix of expected, unexpected, and non-significant policy influences
Jensen, 2011 Systematic review AMSTAR Score: 8/11 28 studies (30 publications): • 4 randomized controlled trials • 10 quasi-experimental • 4 price simulation experiments • 4 cafeteria sales incentives 6 cross-sectional	Focused on interventions that aimed to improve the diets of children using various types of economic incentives. Non-obese children aged 10–12 y **Location:** 17 studies the US 3 studies in Norway 1 each in Ireland, UK, Australia 5 not identified	**Independent variables:** economic incentives designed to influence dietary behavior – measured as intake of relevant foods, beverages, and snacks – or the availability of healthy foods and beverages in schools **Outcomes:** food choice observations (representing intake), self-reported intake with changed economic incentives, observed sales, and intake data measured directly by researchers	In general, the review supports the hypothesis that the choice of foods, snacks, and beverages by schoolchildren can be influenced by economic incentives. Overall, studies of price incentives in schools suggested that incentives are effective for increasing fruit and vegetable consumption in schools in the short term and, to some extent, in the long term. Two crucial determinants for the effectiveness of price instruments were identified: 1) foods or beverages are offered (for sale) at the schools, and 2) 10–12-year-old children bring money to school to buy some of these items.
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 52 independent studies evaluated in two systematic reviews. The reviews are of high quality with AMSTAR scores of 8 and 9 out of 11 possible points. The evidence base consists mostly of cross-sectional studies (n=26), quasi-experimental studies (n=10), and incentive/price simulation studies (n=8). Three longitudinal studies, four RCTs, and one study of combined design (i.e., longitudinal with cross-sectional analyses) also are included.

Consistency: Overall, the majority of research findings were consistent and positive. No explicit contradictory findings were evident, although some studies included in the reviews had null or mixed results.

Impact: The impact of policies to change the availability and consumption of certain foods, such as fruits, vegetables, and CF&B, in schools is generally strong. However, the public health significance of the results is unknown given that detailed findings regarding daily food and beverage consumption are limited.

Generalizability: Collectively, the studies included in the reviews were geographically diverse (primarily domestically), but information on the characteristics of the participating children was very limited. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the included reviews were of high quality, the authors of the individual reviews commented that the quality of the studies included in their assessments varied, with some studies having a high risk for bias. The number of relevant empirical studies was limited. Many of the studies focused on “natural experiments;” thus, traditional randomized controlled study designs were not possible and the studies are subject to numerous threats to both internal and external validity. For example, separating the effects of economic incentives from those of other intervention strategies is difficult.

Implications*

Existing evidence indicates that school-based programs designed to improve the food environment and support healthy behaviors may effectively promote improved dietary intake and weight status of school-aged children. Programs that emphasize multicomponent, multidimensional approaches (including increased physical activity) are important to changing behavior and need to be reinforced within the home environment, as well as the community, including neighborhood food retail outlets that surround schools. Policies should strive to support effective programs that increase availability, accessibility, and consumption of healthy foods and beverages, while reducing less healthy competitive foods and beverages. The combination of economic incentives along with specific policies can increase the likelihood that specific approaches will be effective.

The recently updated USDA nutrition standards for school meals and snacks and beverages sold in schools will ensure that students throughout the U.S. will have healthier school meals and snack and beverage options, but schools need support and active engagement from students, parents, teachers, administrators, community members, and their districts and states to successfully implement and sustain them.

Research Recommendations*

1. New research is needed to document the types and quantities of foods and beverages students consume both at school and daily before, during and after school-based healthy eating approaches and policies are implemented.

Rationale: Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the 2015 DGAC to address this issue did not comprehensively measure or report dietary information. While the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

2. Improvements are needed in the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized control trials.

   Rationale: While the methodological quality of the systematic reviews and meta-analyses used by the 2015 DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized control trial experimental designs, with randomization at the individual, classroom, school, or school district level. Feasibility studies may also be helpful to more quickly identify promising novel approaches to improve dietary intake and weight control outcomes.

3. Post-program follow-up assessments lasting >1 year are needed to determine the longer-term retention of changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, more research is needed in adolescents (grades 9-12).

   Rationale: Literature supports that eating and physical activity behaviors and body weight status of children are predictive of changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

4. A wider variety of innovative school-based approaches and policies are needed to increase vegetable intakes.

   Rationale: Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase fruit and vegetable intakes are generally more effective at increasing fruit intake – the documented exceptions being school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruits and vegetables as a single food group, which prompts the need for new research using prospective, repeated measures, randomized control trial experimental designs specifically targeting increased consumption of healthy vegetables.

*Because the schools questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement for the four questions along with collective research recommendations.

References

1. Chriqui JF, Pickel M, Story M. Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA Pediatrics 2014;168(3):279-86. PMID:24473632. http://www.ncbi.nlm.nih.gov/pubmed/24473632
2. Jensen JD, Hartmann H, et al. Economic incentives and nutritional behavior of children in the school setting: a systematic review. Nutr Rev 2011;69(11):660-74. PMID:22029832. http://www.ncbi.nlm.nih.gov/pubmed/22029832

Appendix E-2.31: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of school-based approaches on the weight status of school-aged children?

Conclusion Statement: Moderate and generally consistent evidence indicates that multi-component school-based approaches have beneficial effects on weight status (BMI or BMI-z reduced on average by 0.15 kg/m2), especially for children ages 6 to 12 years.

DGAC Grade: Moderate

Conclusion Statement: The body of evidence regarding the impact of school-based approaches on weight status among adolescents is limited due to an insufficient number of studies.

DGAC Grade: Not Assignable

Key Findings

- This evidence portfolio includes two systematic reviews (Water, 2011; Wang, 2013); one of which included a meta-analysis (Waters, 2011). Collectively, 108 studies targeting children in school published prior to August 2012 were evaluated. Forty-nine studies were conducted in the United States and the remaining studies were completed in other highly developed countries. The systematic reviews examined the impact of school-based approaches targeting obesity prevention among school-aged children.
- The studies used a variety of intervention strategies targeting behaviors related to dietary intake and/or physical activity. Some approaches were multi-component, with a combination of interventions targeting children, their parents, and/or the school environment. The primary outcomes of interest were BMI, changes in BMI, rate of weight gain, body fat percentage, waist circumference, skin fold thickness, and prevalence of overweight and obesity.
- In the body of evidence available, the school-based approaches were diverse, making comparison across studies challenging. Despite this variability, school-based interventions significantly improved weight-related outcomes. Multi-component interventions, and in particular those implemented longer term (>6 months), were more effective than single-component and short-term (3-6 months) interventions. Evidence supporting the effectiveness of school-based interventions among children aged 6-12 years was robust; while findings among children aged 13-18 years were weaker, but trend toward effectiveness.
- The evidence base includes two reviews evaluating several studies by independent investigators with sufficient sample sizes. Although findings indicate that school-based approaches effectively improve weight-related outcomes, in particular among children between the ages of 6 and 12, a high degree of heterogeneity means these findings should be interpreted cautiously. While the magnitude of the effect is clinically meaningful, the public health significance is difficult to ascertain.

Description of the Evidence

This evidence portfolio includes 2 systematic reviews (Waters, 2011; Wang, 2013), of which one includes a meta-analysis (Waters, 2011). The Waters *et al* review included 55 studies; 47 were conducted among children aged 6 to 18 years; 37 studies were included in the meta-analysis. The Wang *et al* review included 124 studies; 104 studies evaluated school-based interventions, 61 of which were conducted at schools. Thirteen studies were included in both reviews. Study designs included randomized controlled trials (RCTs) and non-randomized controlled trials. The systematic reviews had low risk of bias, as evidenced by AMSTAR scores of 11 points out of 11 possible points.

Population

The studies examined generally healthy children, with the majority of findings pertaining to children aged 6 to 12 years. Forty-nine studies were conducted in the United States, while 67 were conducted in other highly developed countries. The Waters *et al* review used the PROGRESS (Place, Race, Occupation, Gender, Religion, Education, Socio-economic status, Social status) checklist to collect data relevant for equity. Twenty-six of the studies targeting children aged 6 to 18 years (n=47) analyzed outcomes by at least one PROGRESS item; 25 studies did so by gender. Some studies also analyzed outcomes by race (n=5), socio-economic status (n=3), and education (n=2). The review by Wang *et al* included diverse populations based on race/ethnicity; however, the findings were not reported by these subgroups. (See the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of school-based approaches assessing the effectiveness of childhood obesity prevention interventions. Waters *et al* updated a previous Cochrane review of childhood obesity prevention research and determined the effectiveness of interventions intended to prevent obesity in children. The approaches included educational, health promotion and/or psychological, family, behavioral therapy, counseling, or management interventions that focused on diet, physical activity, or lifestyle support, or a combination. A secondary aim of this review was to identify program characteristics and strategies that work for specific populations, the reasons for their success, and the cost associated with them. The studies included in the Wang *et al* review assessed the effectiveness of childhood obesity prevention interventions that aimed to improve diet, physical activity, or both and were conducted in schools, homes, primary care clinics, childcare settings, the community, or combinations of these settings in the US and other very high-income countries. Only the data from school-based studies were included in this evidence base.

Outcomes

Weight outcomes reported in the Waters *et al* review include changes in BMI, rate of weight gain, and prevalence of obesity. The weight-related outcomes addressed by Wang *et al* were BMI, body fat percentage, waist circumference, skin fold thickness, and prevalence of overweight and obesity. Obesity-related clinical outcomes, such as blood pressure and blood lipids, and behavioral outcomes related to energy balance, such as dietary intake, physical activity, and sedentary behavior, also were addressed by Wang *et al*.

Evidence Synthesis

Findings from the Waters *et al* review and meta-analysis of school-based programs designed to prevent obesity in children demonstrated effectiveness as assessed by change in BMI or BMIz. The effect estimate was a BMI/BMIz reduction of 0.15 kg/m^2 (95% CI: -0.21, -0.09) which corresponds to a small but clinically important shift in population BMI/BMIz if sustained long term. The intervention effects by age subgroups were: -0.26 kg/m^2 (95% CI: -0.53, 0.00) for ages 0 to 5; -0.15 kg/m^2 (95% CI: -0.23, -0.08) for ages 6 to 12; and -0.09 kg/m^2 (95% CI: -0.20, 0.03) for ages 13 to 18.

Heterogeneity was apparent in all three age groups and could not be explained by randomization status or the type, duration, or setting of the intervention.

Over half of the school-based interventions included in Wang *et al* reported statistically significant beneficial effects of the intervention compared with a control group in at least some of the body weight–related measures, such as BMI, BMI z-score, prevalence of overweight and obesity, waist circumference, skinfold thickness, and body fat percentage. In general, intervention groups experienced a smaller increase over time relative to the control group. Additionally, almost all of the studies that reported results regarding intermediate outcomes detected some statistically significant desirable effects, such as increased fruit and vegetable consumption or increased physical activity. Approximately half of the studies that evaluated clinical outcomes reported some statistically significant desirable effects, predominantly regarding blood pressure reduction.

Evidence indicates that multi-component school-based interventions, combining strategies targeting diet and physical activity at school, at home, and/or within a community are most effective for preventing childhood obesity. In addition, longer term interventions (>6 months) are more likely to have lasting effects than short-term interventions (3-6 months). A wide range of strategies was implemented in these studies. While it is not possible to distinguish which of these components contributed most to the beneficial effects observed, the synthesis indicates the following to be promising policies and strategies:

- School curricula that includes healthy eating, physical activity, and body image;
- Increased opportunities for physical activity throughout the school week;
- Improvements in the nutritional quality of foods available in schools;
- Environments that support healthier eating behaviors and physical activity throughout the day;
- Support for teachers and other school staff to implement health promotion strategies and activities (e.g., professional development and capacity building activities); and
- Parental support and home activities that encourage children to be more active, eat more nutritious foods, and spend less time being sedentary.

Overview Table

Summary of systematic review examining school-based approaches and dietary intake, quality and behavior

Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
Waters, 2011 Systematic review/meta-analysis AMSTAR Score: 11/11 55 studies (81 papers): all randomized controlled trials or controlled trials Meta-analysis included 37 studies	Updated Cochrane review of childhood obesity prevention research to determine the effectiveness of interventions intended to prevent obesity in children, assessed by change in Body Mass Index (BMI). Meta-analysis: included 27,946 children; majority of studies targeted children aged 6-12 y: Aged 0-5 y - 8 studies Aged 6-12 y - 39 studies Aged 13-18 y - 8 studies **Location:** 26 studies in the US 6 studies in the UK 4 each in Australia/New Zealand, France 2 each in Canada, Germany, the Netherlands 1 each in Belgium, Italy, Spain, Sweden	**Independent variables:** educational, health promotion and/or psychological, family, behavioral therapy, counseling or management interventions that focused on diet, PA or lifestyle support, or both **Outcomes:** **c**hanges in BMI,	The best estimate of effect on BMI was of a 0.15kg/m2 reduction (95% confidence interval (CI): -0.21 to -0.09), which would correspond to a small but clinically important shift in population BMI if sustained over several years. **Intervention effects by age subgroups** 0-5 y: -0.26kg/m2 (95% CI:-0.53, 0.00) 6-12 y: -0.15kg/m2 (95% CI -0.23, -0.08) 13-18 y: -0.09kg/m2 (95% CI -0.20, 0.03)

	4 in upper middle-income countries (2 in Brazil; 1 each in Chile, Mexico) 1 in lower middle-income country (Thailand)	prevalence of obesity and rate of weight gain	
Wang, 2013 Systematic review AMSTAR Score: 11/11 61 studies: randomized controlled trials, controlled trials and natural experiments	Assess effectiveness of childhood obesity prevention interventions that aimed to improve diet, PA or both, that were conducted in schools, homes, primary care clinics, childcare settings, the community or combinations of these settings in the US and other very high-income countries. For school-based questions, children aged 5-18 y **Location:** 23 studies in the US 4 each in Australia, Germany, Greece 3 each in Canada, Spain, Sweden, UK 2 each in France, Italy, New Zealand 1 each in Austria, Belgium, Chile, Iceland, Norway, Poland, Portugal, Switzerland	**Independent variables:** school-based obesity prevention interventions; **Outcomes:** BMI, waist circumference, % body fat, skinfold thickness, prevalence of obesity and overweight 37 studies assessed the effect of a combined diet and physical activity intervention on weight-related outcomes	Two RCTs, described in three articles, evaluated the effects of diet interventions on weight-related outcomes and showed a decrease in BMI or BMI z-score measures over a period of at least 1 year. These studies were specifically designed to prevent weight gain, and focused on promoting a healthy diet and reducing the consumption of carbonated drinks. Intervention studies with significant impact had a duration of 52 to 156 weeks. Children who followed long-term intervention programs showed significant positive changes in physical performance, whereas children in shorter studies had non-significant results. Similarly, the long studies had a significant effect on energy intake, reduced consumption of sweetened beverages, and increased FV intake. Combination interventions show a low strength of evidence that they are effective at reducing BMI, BMI z-score, prevalence of obesity and overweight, percent body fat, waist circumference, and skinfold thickness. Studies reporting on these outcomes were designed to affect weight gain and included intensive classroom physical activity lessons led by trained teachers, moderate to vigorous physical activity sessions, nutrition education materials, and promoting and providing a healthy diet.
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 108 independent, controlled trials among school-aged children, evaluated in two rigorous systematic reviews, one of which includes a quantitative meta-analysis. The reviews/meta-analysis are of high-quality with AMSTAR scores of 11 out of 11 possible points.

Consistency: Across individual studies and reviews, school-based approaches consistently improved weight-related outcomes among children aged 6-12 years. Data were limited among adolescents. Both reviews indicate that multi-component approaches are more effective than single-component programs. A high degree of heterogeneity of results and variable (mostly moderate) risk of bias among the included studies warrant interpreting the findings with caution.

Impact: The studies included in the reviews specifically evaluated the impact of the interventions on weight-related outcomes. The magnitude of effect was deemed to be clinically significant; yet the public health significance is difficult to assess because of different approaches and methodology.

Generalizability: Collectively, the studies included in the reviews were geographically diverse (both nationally and internationally) and applicable to school-aged children throughout the U.S. Some studies specifically targeted groups of children who were disadvantaged and/or racially or ethnically diverse. Despite some studies analyzing the outcomes by gender, race, and/or socio-economic status, strong conclusions could not be drawn for any subgroups.

Limitations: While the included reviews were of high quality, the authors of the individual reviews noted the high heterogeneity of results among studies.

Implications*

Existing evidence indicates that school-based programs designed to improve the food environment and support healthy behaviors may effectively promote improved dietary intake and weight status of school-aged children. Programs that emphasize multicomponent, multidimensional approaches (including increased physical activity) are important to changing behavior and need to be reinforced within the home environment, as well as the community, including neighborhood food retail outlets that surround schools. Policies should strive to support effective programs that increase availability, accessibility, and consumption of healthy foods and beverages, while reducing less healthy competitive foods and beverages. The combination of economic incentives along with specific policies can increase the likelihood that specific approaches will be effective.

The recently updated USDA nutrition standards for school meals and snacks and beverages sold in schools will ensure that students throughout the U.S. will have healthier school meals and snack and beverage options, but schools need support and active engagement from students, parents, teachers, administrators, community members, and their districts and states to successfully implement and sustain them.

Research Recommendations*

1. New research is needed to document the types and quantities of foods and beverages students consume both at school and daily before, during and after school-based healthy eating approaches and policies are implemented.

   Rationale: Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the 2015 DGAC to address this issue did not comprehensively measure or report dietary information. While the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

2. Improvements are needed in the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized control trials.

   Rationale: While the methodological quality of the systematic reviews and meta-analyses used by the 2015 DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized control trial experimental designs, with randomization at the individual, classroom, school, or school district level. Feasibility studies may also be helpful to more quickly identify promising novel approaches to improve dietary intake and weight control outcomes.

3. Post-program follow-up assessments lasting >1 year are needed to determine the longer-term retention of changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, more research is needed in adolescents (grades 9-12).

   Rationale: Literature supports that eating and physical activity behaviors and body weight status of children are predictive of changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

4. A wider variety of innovative school-based approaches and policies are needed to increase vegetable intakes.

   Rationale: Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase fruit and vegetable intakes are generally more effective at increasing fruit intake – the documented exceptions being school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruits and vegetables as a single food group, which prompts the need for new research using prospective, repeated measures, randomized control trial experimental designs specifically targeting increased consumption of healthy vegetables.

*Because the schools questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement for the four questions along with collective research recommendations.

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1. Wang Y, Wu Y, Wilson RF, Bleich S, Cheskin L, Weston C, Showell N, Fawole O, Lau B, Segal J. Childhood obesity prevention programs: comparative effectiveness review and meta-analysis. Comparative effectiveness review No. 115. AHRQ Publication No. 13-EHC081-EF. Rockville, MD: Agency for Healthcare Research and Quality; June 2013. http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0057623/pdf/TOC.pdf
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Appendix E-2.32: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of school-based policies on the weight status of school-aged children?

Conclusion Statement: Although moderate evidence indicates that school policies improve dietary intake, limited evidence suggests that school policies targeting nutrition, alone and in combination with physical activity, may beneficially affect weight-related outcomes.

DGAC Grade: Limited

Key Findings

- This evidence portfolio includes two systematic reviews (Williams, 2013; Chriqui, 2014), which collectively evaluated 45 studies published between 2003 and 2013. Forty studies were conducted in the United States and the remaining studies were conducted in other highly-developed countries. The systematic reviews examined the impact of school policies, at the state and district levels, on weight-related outcomes.
- The studies included a variety of policies at the school, school-district, or state level, targeting behaviors related to dietary intake, alone and in combination with physical activity. The primary outcome of interest was BMI.
- Limited research exists to systematically review and quantitatively evaluate the effect of school-based nutrition policies on the weight status of children. In addition, high heterogeneity among studies warrants caution when drawing conclusions from the pulled results. In the body of evidence available, the findings related to the impact of school policies targeting nutrition and physical activity on weight outcomes were mixed. Yet, dietary policies related to the School Breakfast Program were associated with a lower body mass index among students who participated in the program in comparison to students who did not participate. Overall, school-based, multi-component interventions including policy elements and policies and laws regarding the availability and accessibility of competitive foods and beverages in schools warrant further research as ways to target childhood obesity.
- The evidence base includes two reviews evaluating several studies by independent investigators with sufficient sample sizes. However, most studies are of weaker design (i.e., cross-sectional) and findings were inconsistent.

Description of the Evidence

This evidence portfolio includes two systematic reviews (Williams, 2013; Chriqui, 2014), of which one includes a meta-analysis (Williams, 2013). Collectively, the reviews included a total of 45 studies published between the years 2003 to 2013, with no overlap of studies between reviews. Study designs included randomized controlled trials (RCTs), non-randomized controlled trials, cross-sectional studies, and pre/post-policy studies. The systematic reviews had relatively low risk of bias, as evidenced by AMSTAR scores, ranging from 9 points out of a possible 11 to 11 out of 11 points.

Population

The studies examined generally healthy children aged 4 to 18 years, with Williams *et al* focusing on children aged 4 to 11 years. Of the 45 included studies, 40 were conducted in the United States, while five were conducted in other highly-developed countries. The sample sizes ranged from three high schools to 130,353 children, as well as a varying number of districts. The reviews did not review or present results by gender or race/ethnicity. (See the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of school-based policies. The studies included in the Williams *et al* review evaluated policies related to diet and physical activity in schools, alone or as part of an intervention program targeting the weight status of children. Chriqui *et al* assessed state laws and school district policies related to competitive foods and beverages (CF&B).

Outcomes

Weight outcomes reported in the Williams *et al* review include BMI, BMI z-score, body fat percentage, waist circumference, waist-to-hip ratio, waist-to-height ratio, and skin fold thickness. The weight status outcomes addressed in the Chriqui *et al* review were change in weight and change in BMI.

Evidence Synthesis

Chriqui *et al* reviewed 24 studies examining the relationship between state laws and/or school district policies (in practice, not just “on the book” policies) and weight-related outcomes among students in addition to the availability, purchasing, and consumption of CF&B. In general, the findings demonstrate the effectiveness of school-based policies to reduce CF&B availability and consumption within schools but results regarding the weight status of school-aged children were mixed. Four multivariate studies examined the policy influences on BMI and weight outcomes. Two studies reviewed by Chriqui *et al* (Coffield, 2011; Tabler, 2012) reported a decreased odds of being overweight or obese. Tabler et al examined 6300 students in 40 states noting a reduced risk of remaining overweight (-4.8; 95% CI: -9.4, -0.1) as students progressed from 5th grade to 8th grade in states with strong laws related to CF&B in comparison to states without laws. The remaining studies did not find a relationship between laws related to CF&B and the weight status of students.

Williams *et al* reviewed 21 studies evaluating the impact of policies related to diet and physical activity in schools, alone or as a part of an intervention program targeting the weight status of children. Dietary policies related to the School Breakfast Program (SBP), but not the National School Lunch Program (NSLP), were associated with a lower body mass index – standard deviation score (BMI-SDS) (-0.80; 95% CI: -0.143, -0.017) among students who participated in the program in comparison to students who did not participate. The pooled effects of other diet-related policies and physical activity policies on BMI-SDS were non-significant. Multi-component interventions tended to include policy elements related to both diet and physical activity (combined cluster), and although these interventions were too varied to pool their results, significant reductions in weight-related outcomes were demonstrated. The evidence from this review suggests that, when implemented alone, school policies related to diet and physical activity are insufficient to prevent or treat overweight or obesity in children; however, they appear to be impactful when combined with more intense interventions.

In summary, limited research exists to systematically review and quantitatively evaluate the effect of school-based nutrition policies on the weight status of school-aged children.

Overview Table

Summary of systematic review examining school-based approaches and dietary intake, quality and behavior

Author, Year AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
Chriqui, 2014	To examine the potential	**Independent Variables:**	Of the 24 included studies, 4 multivariate

Systematic review AMSTAR Score: 9/11 24 studies: • 3 longitudinal • 20 cross-sectional • 1 combined 16 studies examined pre- and post-policy changes 8 studies examined post-policy changes	influence of federal rule on the relationship between state laws and/or school district policies and student body mass index (BMI) and weight outcomes, consumption, and availability of competitive foods and beverages (CF&B) Laws and policies impacting schools; grades kindergarten through 12th grade **Location:** US	State laws or school district policies related to CF&B • State laws: 14 studies • District policies: 8 studies • Combined laws and policies: 2 studies **Outcomes:** • Change in BMI or weight; probability of overweight or obesity: 4 studies • CF&B consumption: 10 studies • CF&B availability: 13 studies Examined more than 1 outcome: 3 studies	studies examined the policy influences on BMI and weight outcomes, reporting mixed results overall.
Williams, 2013 Systematic review and meta-analysis AMSTAR Score: 9/11 21 studies: • 2 randomized controlled trials • 3 controlled before/after • 11 cohort studies • 5 cross-sectional studies Policies: • Diet-related: 10 studies • Physical activity (PA)-related: 5 studies Combined diet and PA: 6 studies	To evaluate the effects of policies related to diet and physical activity in schools, either alone, or as part of an intervention program on the weight status of children Children aged 4-11 y participating in full time education **Location:** 16 studies in the US 1 each in Australia, Canada, Italy, Mexico, UK	**Independent Variables:** Diet or physical activity-related school policies either alone or as part of intervention programs **Outcomes:** Body mass, body mass index z-score or standard deviation score, percentage of body fat, waist circumference, waist-to -hip ratio, waist-to-height ratio, skin pinch/skin fold thickness	Multi-faceted interventions tended to include diet and physical activity policy elements. These interventions demonstrated significant reductions in weight-related outcomes; however they were too varied to pool results. **Change in BMI-SDS (standard deviation score)** Pooled effects of the physical activity and other diet related policies on BMI-SDS were non-significant: BMI-SDS = −0.021 (95% CI −0.066, 0.023; NS) Participation in National School Lunch Program (NSLP): BMI-SDS = 0.038 (95% CI: -0.193, 0.269; NS) Participation in School Breakfast Program (SBP): BMI-SDS = −0.080 (95% CI: −0.143, −0.017; Significant)
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 45 independent studies evaluated in two systematic reviews. The reviews are of high quality with AMSTAR scores of 9 and 11 out of 11 possible points. The evidence base consists mostly of cross-sectional studies (n=25). Two RCTs, three controlled pre/post studies, eleven cohort studies, three longitudinal studies, and one study of combined design (i.e., longitudinal with cross-sectional analyses) also are included.

Consistency: Overall, the research findings were mixed. Also, there was high heterogeneity among studies which reduced confidence in drawing conclusions from the pooled results of the meta-analysis.

Impact: The impact of nutrition policies on weight-related outcomes is unknown at this time.

Generalizability: Collectively, the studies included in the reviews were geographically diverse (primarily domestically), but information on the characteristics of the participating children was very limited. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the included reviews were of high quality, the quality of the studies included in their analyses varied, with some studies having a high risk for bias. The number of relevant empirical studies was limited. Therefore, meta-analyses could not be completed for some topics due to insufficient data. Many of the studies focused on “natural experiments;” thus, traditional randomized controlled study designs were not possible and the studies are subject to numerous threats to both internal and external validity.

Implications*

Existing evidence indicates that school-based programs designed to improve the food environment and support healthy behaviors may effectively promote improved dietary intake and weight status of school-aged children. Programs that emphasize multicomponent, multidimensional approaches (including increased physical activity) are important to changing behavior and need to be reinforced within the home environment, as well as the community, including neighborhood food retail outlets that surround schools. Policies should strive to support effective programs that increase availability, accessibility, and consumption of healthy foods and beverages, while reducing less healthy competitive foods and beverages. The combination of economic incentives along with specific policies can increase the likelihood that specific approaches will be effective.

The recently updated USDA nutrition standards for school meals and snacks and beverages sold in schools will ensure that students throughout the U.S. will have healthier school meals and snack and beverage options, but schools need support and active engagement from students, parents, teachers, administrators, community members, and their districts and states to successfully implement and sustain them.

Research Recommendations*

1. New research is needed to document the types and quantities of foods and beverages students consume both at school and daily before, during and after school-based healthy eating approaches and policies are implemented.

   Rationale: Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the 2015 DGAC to address this issue did not comprehensively measure or report dietary information. While the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

2. Improvements are needed in the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized control trials.

   Rationale: While the methodological quality of the systematic reviews and meta-analyses used by the 2015 DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized control trial experimental designs, with randomization at the individual, classroom, school, or school district level. Feasibility studies may also be helpful to more quickly identify promising novel approaches to improve dietary intake and weight control outcomes.

3. Post-program follow-up assessments lasting >1 year are needed to determine the longer-term retention of changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, more research is needed in adolescents (grades 9-12).

   Rationale: Literature supports that eating and physical activity behaviors and body weight status of children are predictive of changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

4. A wider variety of innovative school-based approaches and policies are needed to increase vegetable intakes.

   Rationale: Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase fruit and vegetable intakes are generally more effective at increasing fruit intake – the documented exceptions being school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruits and vegetables as a single food group, which prompts the need for new research using prospective, repeated measures, randomized control trial experimental designs specifically targeting increased consumption of healthy vegetables.

*Because the schools questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement for the four questions along with collective research recommendations.

References

1. Chriqui JF, Pickel M, Story M. Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review. JAMA Pediatr 2014;168(3):279-86. PMID:24473632. http://www.ncbi.nlm.nih.gov/pubmed/24473632
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Appendix E-2.33a: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of worksite-based approaches on the dietary intake, quality, behaviors and/or preferences of employees?

Conclusion Statement: Moderate evidence indicates that multi-component worksite approaches can increase vegetable and fruit consumption of employees.

DGAC Grade: Moderate

Key Findings

- This evidence portfolio includes two systematic reviews (Geaney, 2013 and Aneni, 2014), which collectively evaluated 35 studies by independent investigators with sufficient sample sizes published before November 2012. The systematic reviews examined the impact of worksite-based approaches targeting the dietary intake, quality, behaviors, and/or preferences of employees.
- The studies used a variety of intervention approaches targeting behaviors related to dietary intake; some were delivered in-person and others were delivered via the internet. Some inconsistencies are evident across studies and may be explained by differences in the populations sampled and methodologies used, including the types and durations of intervention and follow-up periods. Some approaches were multi-component, with a combination of interventions targeting employees and/or the food environment at the worksite. The primary dietary outcome of interest was fruit and vegetable intake.
- Among the body of evidence available, multi-component interventions, and in particular those that incorporated face-to-face contact and nutrition education, were more effective than single-component interventions for eliciting significant dietary improvements. Overall, worksite-based intervention programs moderately increase fruit and vegetable intakes, although the magnitude of the effect is difficult to assess. Nutrition education and internet-based programs appear to be promising approaches for eliciting desired dietary modifications when incorporated into multi-component interventions.

Description of the Evidence

This evidence portfolio includes 2 systematic reviews published in 2013 and 2014 (Geaney, 2013; Aneni, 2014). Collectively, the reviews included a total of 35 studies published prior to November 2012, with no overlap of studies between reviews. Study designs included randomized controlled trials (RCTs), non-randomized controlled trials, and pre/post studies. Geaney *et al* reviewed 6 non-randomized and randomized controlled trials. Aneni *et al* reviewed 29 studies consisting of 18 RCTs and 11 pre/post studies.

The systematic reviews had relatively low risk of bias, as evidenced by AMSTAR scores ranging from 8 to 9 points out of a possible 11. Aneni *et al* evaluated the quality of the studies included in their review based on two criteria: suitability of study design and methodological quality criteria. Each study was assessed for both components. High quality studies were those that received a grade A or B for study design and had at least 4 of 6 methodological criteria (representativeness, randomization, comparability, credibility of data collection instruments, attrition rate, and effects were attributable to intervention). No studies were excluded due to poor quality. Eighteen studies were rated high quality, one was intermediate, and ten were low quality.

Population

The studies examined generally healthy employees defined as: 1) adults over the age of 18 in paid employment in public, voluntary, or private organizations (Geaney, 2013) and 2) employee/working populations taking part in interventions requiring access to the internet (Aneni, 2014). The sample sizes reported for individual studies ranged from 65 to 4,254 participants. Of the six studies included in Geaney *et al*, three were conducted in the United States and three were conducted in other highly developed countries. The Aneni *et al* review did not report the location for individual studies. The reviews did not assess or present results by gender or race/ethnicity (refer to the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of worksite approaches for targeting the dietary intake of employees and their behaviors related to nutrition. The studies included in the Geaney *et al* review evaluated interventions with at least one dietary modification (e.g., menu modifications, increased availability of fruits and vegetables, and point-of-purchase labeling) in the workplace, workplace canteens, and other food service establishments “on-site” at the workplace. Five of the six studies incorporated nutrition education programs at the worksite in addition to dietary modification. The Aneni *et al* review examined the impact of internet-based programs aimed at improving cardiovascular health.

Outcomes

The primary outcome of the Geaney *et al* review was change in diet. Secondary outcomes included health status, self-efficacy, perceived health, nutrition knowledge, co-worker support, job satisfaction, economic cost outcomes, and food purchasing patterns. The studies included in the Aneni *et al* review assessed diet, weight, blood pressure, blood glucose, HbA1c, lipids, physical activity, and smoking.

Evidence Synthesis

Geaney *et al* reviewed studies evaluating the effectiveness of workplace dietary modification interventions alone or in combination with nutrition education on employees' dietary behavior, health status, self-efficacy, perceived health, determinants of food choice, nutrition knowledge, co-worker support, job satisfaction, economic cost, and food-purchasing patterns. Four out of six studies demonstrated significant increases in fruit and vegetable consumption (≤ ½ serving per day); three of these studies included nutrition education interventions. Findings related to other outcomes were inconsistent. Due to the heterogeneity of interventions and outcomes and limited quantity of the studies, drawing conclusions is difficult. Yet, limited evidence suggests that workplace dietary modification interventions, alone and in combination with nutrition education, increase intakes of fruits and vegetables.

The Aneni *et al* review aimed to synthesize evidence from internet-based cardiovascular wellness programs in order to guide the implementation and future development of such programs. Consistent with Geaney *et al*, fruit and vegetable consumption was the dietary outcome with the most significant and consistent improvements. Four out of nine high-quality studies and all 3 studies deemed lower-quality demonstrated significant increases in fruit and vegetable intakes. Programs that included physical (face-to-face) contact in addition to strategies delivered via the internet appeared to be more effective than those that did not.

Collectively, despite the variability in worksite-based approaches (i.e., programs and interventions) targeting dietary intake and eating behaviors among employees, multi-component approaches effectively increase fruit and vegetable intake.

Overview Table

Summary of systematic review examining the impact of worksite-based approaches on the dietary intake, quality, behaviors and/or preferences of employees

Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
Aneni, 2014 Systematic review AMSTAR Score: 9/11 29 studies • 18 high-quality randomized controlled trials • 11 pre/post studies (1 intermediate quality, 10 low quality)	Synthesize evidence from internet-based cardiovascular wellness programs in order to guide the implementation and future development of such programs Employees/working population **Location:** not reported	**Independent variables:** internet-based programs aimed at improving cardiovascular health **Outcomes:** weight, diet, blood pressure, blood glucose, HbA1c, lipids, physical activity, smoking	Of the 9 high-quality randomized controlled trials evaluated, 4 studies demonstrated significant improvements. Outcomes varied and included higher dietary self-efficacy, greater intake of FV in intervention (I) vs. control (C), lower sodium intake in I vs. C. All 3 low-quality, follow-up studies demonstrated increases in FV intake.
Geaney, 2013 Systematic review AMSTAR Score: 8/11 • 6 randomized controlled trials	Evaluate the effectiveness of workplace dietary modification interventions alone or in combination with nutrition education on employees' dietary behavior, health status, self-efficacy, perceived health, determinants of food choice, nutrition knowledge, co-worker support, job satisfaction, economic cost and food-purchasing patterns Adults (>18 y) in paid employment working for public, private, and voluntary organizations **Location:** 3 studies in the US 1 each in Brazil, Netherlands, Belgium	**Independent variables:** interventions included ≥1 dietary modifications in the workplace, workplace canteens, and other "on-site" workplace food service establishments; some studies also included an education intervention **Outcomes:** • Primary outcome: change in diet Secondary outcomes: health status, self-efficacy, perceived health, nutrition knowledge, co-worker support, job satisfaction, economic cost outcomes, food purchasing patterns	Four studies reported significant increases in FV consumption; effect size ≤ ½ serving per day. Out of 3 studies, fat intake decreased significantly in one. Other improvements (I vs. C) • Increase in self-efficacy to consume fruit (n=1) • Increase in nutrition knowledge (n=1) • Greater co-worker support (n=1) Out of 2 studies, purchasing of FV and low-fat foods did not change.

*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 35 independent studies with 24 controlled studies evaluated in two rigorous systematic reviews. The reviews are of high-quality with AMSTAR scores of 8 and 9 out of 11 possible points.

Consistency: Across individual studies and reviews, worksite-based approaches fairly consistently increased fruit and vegetable intakes. Multi-component programs, in particular those incorporating face-to-face contact in addition to internet-based approaches or nutrition education programs in addition to dietary modification, were more effective than single-component programs.

Impact: Fruit and vegetable intakes increased significantly in most studies evaluating this outcome; however the potential health impact of this change was not evaluated in these reports. In Geaney *et al*, the change in consumption was demonstrated to be less than or equal to ½ serving per day. For reference, the *Dietary Guidelines for Americans, 2010* recommend between 1½ to 2 cups of fruit and 2 to 3 cups of vegetables per day for adults.

Generalizability: The studies included in the Geaney *et al* review were geographically diverse (both nationally and internationally), but information on the characteristics of the participants was very limited. Also, the Aneni *et al* review did not provide details regarding race, ethnicity, or geographic location for the included studies. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the included reviews were of high quality, the authors of the individual reviews commented that the quality of the studies included in their assessments varied, with 24 controlled studies deemed to be of higher quality (out of 35 total studies).

Implications*

Existing evidence indicates that worksite approaches focused on dietary intake can increase fruit and vegetable intakes of employees. Multi-component programs targeting nutrition education in combination with dietary modification interventions are found to be effective. Additionally, environmental modifications in conjunction with a variety of worksite policies targeting dietary modification, including point-of-purchase information, catering policies, and menu labeling are effective. Thus, these evidence-based strategies should be implemented in worksites through a variety of means, such as corporate wellness programs, food service policies, and health benefits programs. Programs should emphasize multi-component approaches targeting diet and physical activity while policies should support behavior changes associated with improving health outcomes such as increasing the availability of healthy foods within the workplace and encouraging more physical activity throughout the workday. Given that approximately 64 percent of adults are employed and spend an average of 34 hours per week at work, the workplace remains an important setting for environmental and behavioral interventions for health promotion and disease prevention.

Research Recommendation*

Assessments of the effectiveness of worksite interventions that emphasize obesity prevention and weight control among workers across racially/ethnically diverse populations, blue and white collar employees, and at risk populations are needed. Scientifically rigorous studies (especially RCTs) addressing long-term health impact of worksite-based approaches and policies that improve employee diet, physical activity, and body weight control would have public health relevance.

Rationale: In light of the high rates of obesity and overweight, worksite interventions targeting obesity prevention and weight control, via enhanced dietary behaviors and increased physical activity among workers is important. The majority of the studies to date have been conducted for a relatively short period of time, and the long-term impact of these approaches and policies may prove beneficial.

*Because the four worksite questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement and research recommendation for all of the questions.

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Appendix E-2.33b: Search Plan and Results—Worksites

Part D. Chapter 4: Food Environment and Settings

1. What is the impact of worksite-based approaches on the dietary intake, quality, behaviors, and/or preference of employees? (see **Appendix E-2.33a: Evidence Portfolio** [link])

2. What is the impact of worksite policies on the dietary intake, quality, behaviors, and/or preferences of employees? (see **Appendix E-2.34: Evidence Portfolio** [link])

3. What is the impact of worksite-based approaches on the weight status of employees? (see **Appendix E-2.35: Evidence Portfolio** [link])

4. What is the impact of worksite policies on the weight status of employees? (see **Appendix E-2.36: Evidence Portfolio** [link])

Table of Contents

Search Strategy

Dates Searched: 3/20/14

Databases: MEDLINE, Embase, Cochrane

Year Range: January, 2010 to March, 2014

Search Terms and Date(s):

MEDLINE:
Date(s) Searched: 3/20/14
Search Terms:

workplace[mh] OR workplace[tiab] OR employee[ti] OR employees[ti] OR worker[ti] OR workers[ti] OR worksite[tiab] OR worksites[tiab] OR "employee health"[tiab] OR employers[ti] OR employer[ti] OR “employer-based”[ti] OR “employer-based”[ti] OR employment[ti] OR occupational health services[mh] OR occupational health[mh] OR “occupational health”[tiab] OR “office-based”[tiab] OR “office based”[tiab]

AND

("body size"[tiab] OR body size[mh] OR obesity[tiab] OR obese[tiab] OR obesity[mh] OR overweight [tiab] OR overnutrition[tiab] OR adiposity[tiab] OR adiposity[mh] OR "body weight"[tiab] OR body weight[mh] OR “body-weight related”[tiab] OR "weight gain"[tiab] OR weight gain[mh] OR "weight loss"[tiab] OR Body Weights and Measures[Majr] OR overweight[tiab] OR "Body Composition"[mh] OR "body fat"[tiab] OR adipos*[tiab] OR weight[ti] OR waist[ti] OR "Anthropometry"[Mesh:noexp] OR “body mass index”[ti] OR BMI[ti] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab] OR ideal body weight[mh])

OR

nutrition[tiab] OR diet[mh] OR diet[tiab] OR dietary[tiab] OR food preferences[mh] OR feeding behavior[mh] OR nutrition surveys[mh] OR food*[tiab] OR "Food and Beverages"[mh] OR "Eating"[mh] OR "caloric density"[tiab] OR “caloric intake”[tiab] OR caloric dens*[tiab] OR high calori*[tiab] OR energy dens*[tiab] OR fruit*[tiab] OR vegetable*[tiab] OR food analysis[mh] OR dietary intake*[tiab] OR food intake*[tiab] OR energy intake*[tiab] OR food habits[mh] OR dietary habit*[tiab] OR diet habit*[tiab] OR eating habit*[tiab] OR nutrient intake*[tiab] OR food choice*[tiab] OR portion size*[tiab] OR "diet quality"[tiab] OR dietary choice*[tiab] OR dietary change*[tiab] OR diet records[mh] OR nutritional status[mh] OR nutritional sciences[mh OR dietary pattern*[tiab] OR diet pattern*[tiab] OR eating pattern*[tiab] OR food pattern*[tiab] OR eating habit*[tiab] OR dietary habit*[tiab] OR food habit*[tiab] OR dietary profile*[tiab] OR food profile*[tiab] OR diet profile*[tiab] OR eating profile*[tiab] OR dietary guideline*[tiab] OR dietary recommendation*[tiab] OR food intake pattern*[tiab] OR dietary intake pattern*[tiab] OR eating style*[tiab] OR ((Macronutrient*[tiab] AND (Proportion*[tiab] OR composition[tiab] OR distribution*[tiab] OR percent*[tiab] OR diet composit*[tiab])) OR dietary score*[tiab] OR adequacy index*[tiab] OR kidmed[tiab] OR Food Score*[tiab] OR Diet Score*[tiab] OR MedDietScore[tiab] OR Dietary Pattern Score*[tiab] OR “healthy eating index”[tiab] OR ((index*[ti] OR score*[ti] OR indexes[ti] OR scoring[ti] OR indices[ti]) AND (dietary[ti] OR nutrient*[ti] OR eating[tiab] OR food[ti] OR food[mh] OR diet[ti] OR diet[mh]) AND (pattern* OR habit* OR profile*))

AND review[ptyp] OR systematic[sb]

Embase:
Date(s) Searched: 3/20/14
Search Terms:

workplace:ti,ab OR employee*:ti,ab OR worker*:ti,ab OR worksite*:ti,ab OR "employee health":ti,ab OR employer*:ti,ab OR “employer-based”:ti,ab OR employment:ti,ab OR “occupational health”:ti,ab OR “office-based”:ti,ab OR “office based”:ti,ab OR 'work environment'/exp OR 'workplace'/exp OR 'employment'/exp OR 'occupation'/exp OR 'occupational health'/exp OR 'occupational health service'/exp OR 'employee'/exp

AND

'nutrition'/de OR nutrition:ab,ti OR 'diet'/exp OR 'diet':ab,ti OR 'dietary intake'/exp OR 'caloric intake':ab,ti OR 'caloric density':ab,ti OR 'dietary intake':ab,ti OR 'feeding behavior'/exp OR 'eating habit'/de OR 'food preference'/de OR 'child nutrition'/de OR 'food intake'/exp OR 'nutritional assessment'/de OR 'nutritional status'/de OR 'nutrition surveys':ab,ti OR 'fruit'/exp OR 'vegetable'/exp OR 'food'/exp OR 'energy density':ab,ti OR 'dietary quality':ab,ti OR 'eating pattern':ab,ti OR 'food pattern':ab,ti OR 'dietary habit':ab,ti OR 'food habit':ab,ti OR 'food intake':ab,ti OR 'portion size'/de OR 'food choice':ab,ti OR 'diet quality':ab,ti OR 'dietary profile':ab,ti OR 'food profile':ab,ti OR 'diet profile':ab,ti OR 'eating profile':ab,ti OR 'food intake pattern':ab,ti OR 'dietary intake pattern':ab,ti OR 'eating style':ab,ti OR 'macronutrient':ab,ti OR 'macronutrient'/de OR 'dietary score':ab,ti OR kidmed:ab,ti OR 'food score':ab,ti OR 'diet score':ab,ti OR 'meddietscore':ab,ti OR 'dietary pattern score':ab,ti OR 'healthy eating index':ab,ti OR (index:ab,ti OR score:ab,ti OR scoring:ab,ti OR indices:ab,ti AND (dietary:ab,ti OR nutrient:ab,ti OR eating:ab,ti OR food:ab,ti OR diet:ab,ti) AND (pattern:ab,ti OR habit:ab,ti OR profile:ab,ti))

OR

('body size'/de OR 'obesity'/exp OR overweight:ab,ti OR adiposity:ab,ti OR 'body weight'/exp OR 'weight gain'/de OR 'weight reduction':ab,ti OR 'body composition'/exp OR 'body fat':ab,ti OR 'anthropometry'/de

OR 'body mass'/de OR bmi:ab,ti OR weight:ab,ti OR 'waist circumference'/de OR 'waist circumference':ab,ti OR 'waist hip ratio'/de OR 'body fat'/de OR 'adipose tissue'/exp) NOT [medline]/lim

AND

[cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim

Cochrane:
Date(s) Searched: 3/20/14
Search Terms:

(workplace OR worksite OR employee OR employer OR "employee health" OR "employee health service" OR "occupational health" OR office:ti) AND (diet* OR nutr* OR overweight OR health OR wellness OR healthy OR obes* OR bmi OR "body mass index" OR food* OR weight OR eating OR eat:ti,ab,kw)

Inclusion/ Exclusion Criteria

Inclusion criteria for the worksite-based systematic reviews included the following:

- Human subjects
- Subject populations from countries with high or very high human development, according to the 2012 Human Development Index
- Anyone who works (adolescents, adults, older adults)
- Subjects who were healthy or at elevated chronic disease risk
- Systematic reviews and meta-analyses
- The intervention or exposure in the reviewed articles was a worksite program, policy or practice targeting dietary behaviors and/or weight status
- The comparator in the reviewed articles was different levels of intervention, different types of intervention, or no intervention/policy (a control group)
- The outcome(s) was(were) dietary intake, dietary quality, dietary behaviors, dietary preferences, or weight-related measures

In addition, articles were included if they were published in English in a peer-reviewed journal between January 2010 and March 2014. If an author was included on more than one primary research article contained within a review that is similar in content, the paper with the most pertinent data/endpoints was included. If data/endpoints from both papers were appropriate, it was made clear that results were from the same intervention. If a primary research article was included in more than one review, the study overlap was noted.

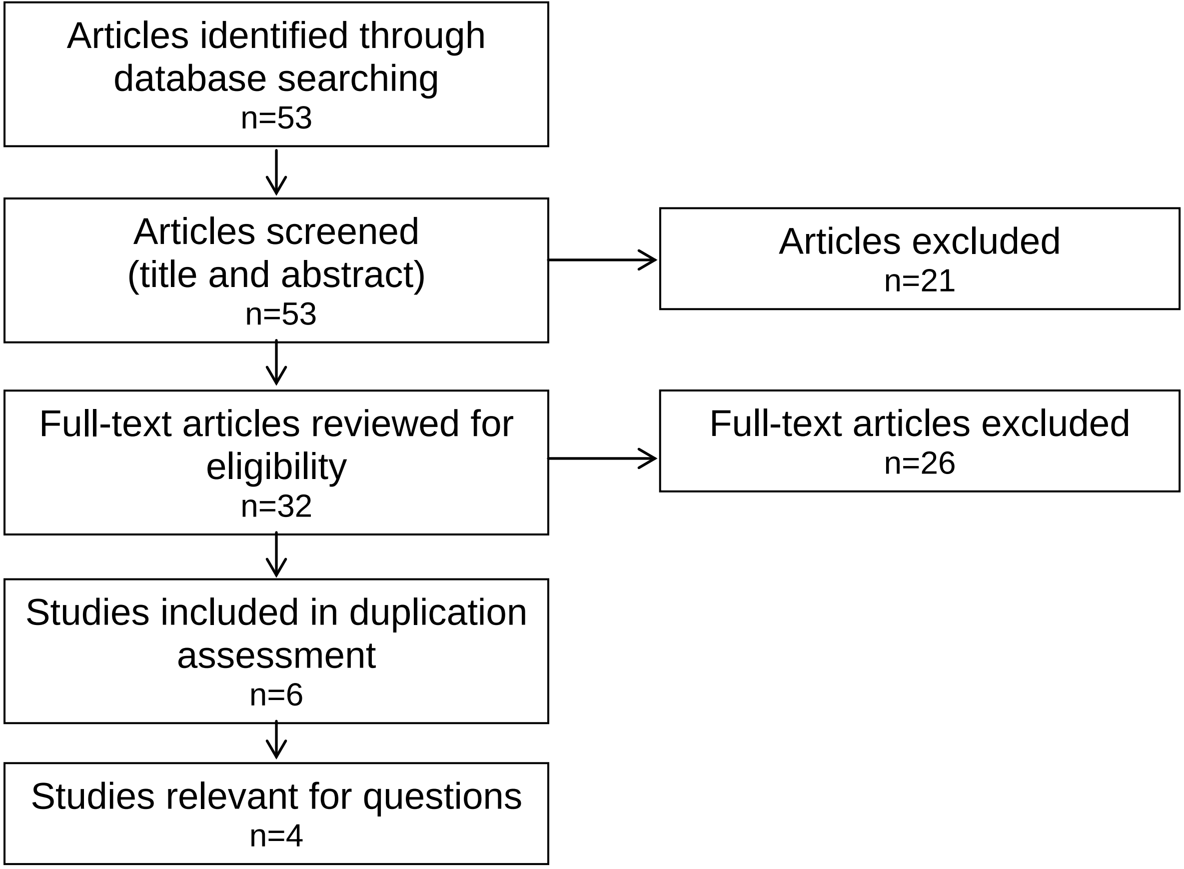
Exclusion criteria for the dietary patterns systematic reviews included:

- Animals and in vitro models
- Subject populations from countries with medium or low human development, according to the Human Development Index
- Children
- Subjects who were hospitalized, diagnosed with disease, and/or receiving medical treatment
- Literature reviews, editorials, and commentaries

Articles were excluded if they were not published in English, or were published before January 2010. Articles, abstracts, and presentations not published in peer-reviewed journals (e.g., websites, magazine articles, Federal reports) were also excluded. Finally, if an author was included on more than one review article or primary research article that was similar in content, the paper with the most pertinent data/endpoints was included, and others were excluded. If a primary research article was included in more than one review, the study overlap was noted.

Search Results

Date Updated: 12/10/14



Included Articles

The following articles have been determined to be relevant for inclusion in the body of evidence used for the systematic review questions:

Approaches & Diet

1. Aneni EC, Robertson LL, et al. A systematic review of internet-based worksite wellness approaches for cardiovascular disease risk management: outcomes, challenges & opportunities. PLos One 2014; 9(1):e83594. PMID: 24421894 http://www.ncbi.nlm.nih.gov/pubmed/24421894
2. Geaney F, Kelly C, et al. The effectiveness of workplace dietary modification interventions: a systematic review. Prev Med 2013; 57(5):438-447. PMID: 23850518 http://www.ncbi.nlm.nih.gov/pubmed/23850518

Policies & Diet

1. Kahn-Marshall JL, Gallant MP. Making healthy behaviors the easy choice for employees: a review of the literature on environmental and policy changes in worksite health promotion. Health Educ Behav 2012;39(6):752-776. PMID: 22872583 http://www.ncbi.nlm.nih.gov/pubmed/22872583

Approaches & Weight

1. Aneni EC, Robertson LL, et al. A systematic review of internet-based worksite wellness approaches for cardiovascular disease risk management: outcomes, challenges & opportunities. PLos One 2014; 9(1):e83594. PMID: 24421894 http://www.ncbi.nlm.nih.gov/pubmed/24421894
2. Verweij LM, Coffeng J, et al. Meta-analyses of workplace physical activity and dietary behavior interventions on weight outcomes. Obes Rev 2011; 12(6):406-429. PMID: 20546142 http://www.ncbi.nlm.nih.gov/pubmed/20546142

Policies & Weight

1. Kahn-Marshall JL, Gallant MP. Making healthy behaviors the easy choice for employees: a review of the literature on environmental and policy changes in worksite health promotion. Health Educ Behav 2012;39(6):752-776. PMID: 22872583 http://www.ncbi.nlm.nih.gov/pubmed/22872583

Appendix E-2.34: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of worksite policies on the dietary intake, quality, behaviors and/or preferences of employees?

Conclusion Statement: Moderate and consistent evidence indicates that worksite nutrition policies, alone and in combination with environmental changes and/or individual-level nutrition and health improvement strategies, can improve the dietary intake of employees. Multi-component interventions appear to be more effective than single-component interventions.

DGAC Grade: Moderate

Key Findings

- This evidence portfolio includes one systematic review (Kahn-Marshall, 2012) which evaluated 27 studies by independent investigators with sufficient sample sizes published between 1985 and 2010. The review examined the evidence for the effectiveness of a variety of worksite health promotion programs using environmental and/or policy changes either alone or in combination with health behavior change strategies focused on individual employees.
- Some interventions were multi-component, with a combination of strategies targeting employees and/or the food environment at the worksite. Strategies included point-of-purchase labeling, increased availability of healthier food items, and/or educational programs and materials. The primary dietary outcome of interest was fruit and vegetable intake.
- In the body of evidence available, the worksite-based policies were diverse, thus identifying the most effective strategies is challenging. Despite this variability, multi-component interventions, and in particular those that targeted individual employees in addition to the environment were more effective than single-component interventions for eliciting significant dietary improvements. Overall, worksite interventions moderately increase fruit and vegetable intakes.
- Some inconsistency is evident across studies assessed for the systematic review in regards to scientific rigor and impact. The inconsistencies may be explained by differences in the populations sampled and methodologies used, including duration, exposure of the intervention, and follow-up periods. Although findings indicate that worksite policies increase consumption of fruits and vegetables, the magnitude of the effect is difficult to assess.

Description of the Evidence

This evidence portfolio includes one systematic review published by Kahn-Marshall and Gallant in 2012. The review includes 27 studies published between 1985 and 2010. Study designs included 10 randomized controlled trials (RCTs), 11 quasi-experimental studies, and 6 studies lacking experimental design. Eleven studies focused on environment or policy alone; sixteen interventions were multi-component. The review had relatively low risk of bias, as evidenced by an AMSTAR score of 8 points out of a possible 11. The methodological quality of the studies included in the review was assessed based on six criteria (sample size, study design, validity of measurement instrument for self-reported data, reliability of measurement instrument for self-reported data, type of data collection, and follow-up). Studies received a plus or a minus depending on whether they met each criterion. Studies were considered of a relatively high quality if five or more of the criteria were scored positively. No studies were excluded due to poor quality. Eight studies were rated high quality.

Population

The studies examined employees of blue- and white-collar worksites. The reported sample sizes ranged from 177 to 26,806 adults. Fourteen studies were conducted in the United States and thirteen were conducted in other highly developed countries. The review did not review or present results by gender or race/ethnicity (refer to the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of worksite environmental policies for targeting the dietary intake of employees and their behaviors related to nutrition. For example, the impact of point-of-purchase nutrition information, increased availability of healthy food options, catering policies, and company policies rewarding employees for healthy behaviors were evaluated. Some worksites also incorporated individual-level strategies (e.g., health education and informational materials).

Outcomes

The primary outcomes of interest were dietary behaviors (e.g., intake of fruits and vegetables), physical activity (e.g., minutes of exercise per week and stair use), and health outcomes (e.g., blood pressure, BMI, and blood cholesterol).

Evidence Synthesis

Kahn-Marshall and Gallant reviewed studies evaluating the effectiveness of worksite health promotion programs using environmental and/or policy changes either alone or in combination with health behavior change strategies focused on individuals. Environmental nutrition policies, alone and in combination with individual strategies, appear effective for increasing consumption of fruits and vegetables. Findings related to other outcomes were limited and inconsistent. The evidence base for multi-component interventions combining strategies on the environmental level as well as the individual level is stronger than for single component interventions.

Overview Table

Summary of systematic review examining the impact of worksite policies on the dietary intake, quality, behaviors and/or preferences of employees			
Author, Year Study Design AMSTAR Score* Number of Included Studies	**Purpose of Review Subject Population Location of Included Studies**	**Independent Variable Outcomes**	**Results**

Kahn-Marshall, 2012 Systematic review AMSTAR Score: 8/11 27 studies: • 10 randomized controlled trials; 11 quasi-experimental; 6 lacking design • 8 deemed high quality • 16 multicomponent; 11 environmental or policy alone	Examine the evidence for the effectiveness of worksite health promotion programs using environmental and/or policy changes either alone or in combination with individually focused health behavior change strategies Employees of blue- and white-collar worksites **Location:** 14 in the US 4 Netherlands 2 Japan 1 each in Scotland, Canada, Mexico, New Zealand, Chile, US+Canada	**Independent variables:** 1. Only environmental and policy changes at the worksite 2. Multicomponent interventions that included changes to the worksite **Outcomes:** • Dietary behaviors (e.g., fruit and vegetable intake, SSB intake, meat intake) • Physical activity behaviors (e.g., stair use, minutes/week) • Health outcomes (e.g., blood pressure, BMI, blood cholesterol)	Nutrition interventions included point-of-purchase labeling, increased availability of healthier food items, and/or educational programs and materials. Multicomponent studies encouraged being more physically active through planned exercise as well as increasing daily activity (e.g., taking the stairs). **Only Environment and/or Policy Changes:** Of the 3 studies evaluating **nutrition** policies alone, 2 saw improvements: 1) increased access to FV at work and co-worker support and 2) increased intake of FV, low-fat dairy products, and whole grain products. One study evaluated a policy targeting **nutrition and physical activity** and did not see any improvements in the targeted behaviors. **Environment & Individual-level Strategies:** Three of the 4 **nutrition** studies demonstrated increased FV consumption. Of the 9 studies targeting **nutrition and physical activity**, 5 studies demonstrated improvement with 4 being significant for self-reported FV intake.
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: The evidence base includes 27 independent studies with 10 randomized controlled studies evaluated in a high-quality systematic review with an AMSTAR score of 8 out of 11 possible points. However, some of the individual studies included in the review lacked scientific rigor.

Consistency: Across individual studies, worksite policies increased fruit and vegetable intakes, in particular when combined with individual-level strategies. Multi-component interventions were more effective than single-component interventions.

Impact: Fruit and vegetable intakes increased significantly in most studies evaluating this outcome; however the magnitude of the change was not quantified and thus the potential health impact of this change cannot be determined.

Generalizability: The studies included in the review were geographically diverse (both nationally and internationally), but information on the characteristics of the participants was very limited. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the systematic review conducted by Kahn-Marshall and Gallant is of high quality, the quality of the studies included in their assessment varied, with only eight studies deemed to be of high quality (out of 27 total studies).

Implications*

Existing evidence indicates that worksite approaches focused on dietary intake can increase fruit and vegetable intakes of employees. Multi-component programs targeting nutrition education in combination with dietary modification interventions are found to be effective. Additionally, environmental modifications in conjunction with a variety of worksite policies targeting dietary modification, including point-of-purchase information, catering policies, and menu labeling are effective. Thus, these evidence-based strategies should be implemented in worksites through a variety of means, such as corporate wellness programs, food service policies, and health benefits programs. Programs should emphasize multi-component approaches targeting diet and physical activity while policies should support behavior changes associated with improving health outcomes such as increasing the availability of healthy foods within the workplace and encouraging more physical activity throughout the workday. Given that approximately 64 percent of adults are employed and spend an average of 34 hours per week at work, the workplace remains an important setting for environmental and behavioral interventions for health promotion and disease prevention.

Research Recommendation*

Assessments of the effectiveness of worksite interventions that emphasize obesity prevention and weight control among workers across racially/ethnically diverse populations, blue and white collar employees, and at risk populations are needed. Scientifically rigorous studies (especially RCTs) addressing long-term health impact of worksite-based approaches and policies that improve employee diet, physical activity, and body weight control would have public health relevance.

Rationale: In light of the high rates of obesity and overweight, worksite interventions targeting obesity prevention and weight control, via enhanced dietary behaviors and increased physical activity among workers is important. The majority of the studies to date have been conducted for a relatively short period of time, and the long-term impact of these approaches and policies may prove beneficial.

*Because the four worksite questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement and research recommendation for all of the questions.

Reference

Kahn-Marshall JL, Gallant MP. Making healthy behaviors the easy choice for employees: a review of the literature on environmental and policy changes in worksite health promotion. Health Educ Behav 2012;39(6):752-776. PMID: 22872583 http://www.ncbi.nlm.nih.gov/pubmed/22872583

Appendix E-2.35: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of worksite-based approaches on the weight status of employees?

Conclusion Statement: Moderate and consistent evidence indicates that multi-component worksite approaches targeting physical activity and dietary behaviors favorably affect weight-related outcomes.

DGAC Grade: Moderate

Key Findings

- This evidence portfolio includes two systematic reviews (Verweij, 2011; Aneni, 2014), one of which included meta-analyses (Verweij, 2011). The systematic reviews examined the impact of worksite-based approaches on the weight status of employees. Collectively, 70 studies published prior to November 2012 were evaluated.
- The studies used a variety of intervention strategies targeting behaviors related to weight status; some were delivered in-person and others were delivered via the internet. The primary outcomes of interest were body weight, BMI, and body fat percentage.
- In the body of evidence available, multi-component interventions, and in particular those that incorporated face-to-face contact and targeted behaviors related to diet and physical activity, were more effective than single-component interventions for eliciting significant improvements in weight-related outcomes. Overall, worksite-based intervention programs significantly decrease body weight, BMI, and body fat percentage. Internet-based programs appear to be the promising approaches for eliciting behavior changes and improving related health outcomes.
- The evidence base includes two reviews evaluating several studies by independent investigators with sufficient sample sizes. Some inconsistencies are evident across studies and may be explained by differences in the populations sampled and methodologies including duration or exposure of intervention and follow-up periods. Although findings indicate that worksite-based approaches effectively improve the weight status of employees, the magnitude of the effect is difficult to assess.

Description of the Evidence

This evidence portfolio includes 2 systematic reviews/meta-analyses published in 2011 and 2014 (Verweij, 2011; Aneni, 2014). Collectively, the reviews included a total of 70 studies published prior to November 2012, with an overlap of two studies between reviews. Study designs included randomized controlled trials (RCTs) and pre/post studies. Verweij *et al* reviewed 43 randomized controlled trials. Aneni *et al* reviewed 29 studies consisting of 18 RCTs and 11 pre/post studies. The systematic reviews had relatively low risk of bias, as evidenced by AMSTAR scores, ranging from 9 and 10 points out of a possible 11 points.

The methodological quality of the studies included in the Verweij *et al* review was independently assessed by two authors using an adapted checklist based on the Cochrane Handbook for Systematic Reviews of Interventions. Twelve criteria for internal validity were included related to selection bias (randomization procedure and similarity of study groups), performance bias (blinding of participants, compliance, and co-intervention), attrition bias (loss-to-follow-up and intention-to-treat), and detection bias (blinding of outcome assessor, timing of outcome assessment, data analyses, data collection methods, and follow-up). For each article, criteria were scored as positive if the criterion was met, negative if the criterion was not met or unclear if insufficient information was provided for assessment. In cases of disagreement, a third reviewer was consulted for a final decision. For articles that did not contain sufficient information, the study investigators were contacted; if unavailable or they did not respond the item was scored as unclear. Finally, each article received a quality assessment based on the number of positively scored criteria: excellent (10-12), good (7-9), fair (5-6), or poor (0-4).

Aneni *et al* evaluated the quality of the studies included in their review based on two criteria: suitability of study design and methodological quality criteria. Each study was assessed for both components. High quality studies were those that received a grade A or B for study design and had at least 4 of 6 methodological criteria (representativeness, randomization, comparability, credibility of data collection instruments, attrition rate, and effects were attributable to intervention). No studies were excluded due to poor quality. Eighteen studies were rated high quality, one was intermediate, and ten were low quality.

Population

The studies examined employees defined as: 1) generally healthy adults and those at risk for chronic disease (Verweij, 2011) and 2) employee/working populations taking part in interventions requiring access to the internet (Aneni, 2014). The sample sizes reported for individual studies ranged from 33 to 10,282 adults. Of the 43 studies included in Verweij *et al*, 20 were conducted in the United States and 23 were conducted in other highly developed countries. The Aneni *et al* review did not report the location for individual studies. The reviews did not review or present results by gender or race/ethnicity (refer to the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of worksite approaches for targeting behaviors related to weight status. The studies included in the Verweij *et al* review/meta-analysis examined the effectiveness of workplace interventions targeting physical activity, dietary behavior, or both on weight outcomes. The Aneni *et al* review assessed the impact of internet-based programs aimed at improving cardiovascular health through a variety of behaviors (i.e., diet and physical activity, alone and in combination).

Outcomes

The primary outcomes of the Verweij *et al* review/meta-analysis were weight-related (i.e., body weight, BMI, body fat percentage, waist circumference, waist-to-hip ratio, and the sum of skin-folds). The studies included in the Aneni *et al* review assessed diet, weight, blood pressure, blood glucose, HbA1c, lipids, physical activity, and smoking.

Evidence Synthesis

Verweij *et al* reviewed studies evaluating the effectiveness of workplace interventions targeting physical activity, dietary behavior, or both on weight outcomes. Overall, this review included a meta-analysis of 22 studies indicating that worksite interventions improve weight-related outcomes. Evidence from nine studies (n = 4514) demonstrated that workplace interventions targeting physical activity and dietary behavior significantly reduce body weight [Mean difference: -1.19 kg (95% CI: -1.64, -0.74)]. Evidence from 11 studies (n = 4638) showed that workplace interventions targeting physical activity and dietary behavior significantly reduce BMI [Mean difference: -0.34 kg/m^2 (95% CI: -0.46, -0.22)]. Findings from three studies (n = 368) indicate that workplace interventions targeting physical activity and dietary behavior significantly reduce body fat percentage as calculated from sum of skin-folds [Mean difference: -1.12% (95% CI: -1.86, -0.38)]. Data from workplace interventions targeting *only* dietary behavior or physical activity were inconsistent with regard to impact on weight-related outcomes.

The Aneni *et al* review aimed to synthesize evidence from internet-based cardiovascular wellness programs in order to guide the implementation and future development of such programs. Seven out of 15 high-quality studies included in the review showed significant improvements in body weight; while seven reported no changes and one study reported an increase in body fat percentage. Four out of five lower-quality studies demonstrated significant improvements in weight. Collectively, the findings regarding the impact of internet-based programs on weight outcomes are inconsistent but promising.

Overview Table

Summary of systematic review examining the impact of worksite-based approaches on the weight status of employees			
Author, Year Study Design AMSTAR Score* Number of Included Studies	**Purpose of Review Subject Population Location of Included Studies**	**Independent Variable Outcomes**	**Results**
Aneni, 2014 Systematic review AMSTAR Score: 9/11 29 studies • 18 high-quality randomized controlled trials • 11 pre/post studies (1 intermediate quality, 10 low quality)	Synthesize evidence from internet-based cardiovascular wellness programs in order to guide the implementation and future development of such programs Employees/working population **Location:** not reported	**Independent variables:** internet-based programs aimed at improving cardiovascular health **Outcomes:** weight, diet, blood pressure, blood glucose, HbA1c, lipids, physical activity, smoking	20 studies reported on weight, BMI/obesity, waist circumference, skin fold thickness, and/or body fat changes. Of the 15 high-quality randomized controlled trials evaluated, 7 studies demonstrated significant improvements: • Weight reduction (n=3) • Reduction in waist circumference (n=5) • Decreased body fat (n=1) Four out of 5 low-quality, nonrandomized studies reported significant improvements in: • Weight (-0.8 to -1.4 kg) • Waist circumference (-2.0 to -2.9 cm)
Verweij, 2011 Systematic review/meta-analysis AMSTAR Score: 10/11 43 randomized controlled trials • Target: only diet (n=3), only physical activity (n=14), diet and physical activity (n=26) • Quality: poor (n=20), fair (n=11), good (n=11), excellent (n=1) Meta-analysis included 22 studies	Critically examine the effectiveness of workplace interventions targeting physical activity, dietary behavior or both on weight outcomes Generally healthy adults and those at risk for chronic disease **Location:** 20 studies in the US 5 each in Australia, England 4 in Japan 3 in Sweden 2 each in Denmark, Belgium 1 each in the Netherlands, Canada	**Independent variables:** worksite interventions targeting diet, physical activity or both **Outcomes:** body weight, BMI, body fat percentage, waist circumference, waist-hip ratio, sum of skin-folds	**Body weight** • 9 studies targeted diet and physical activity; MD = -1.19 kg (95% CI: -1.64, -0.74) • No studies targeted only diet **Body mass index** • 11 studies targeted diet and physical activity; MD = -0.34 kg/m2 (95% CI: -0.46, -0.22) • 1 study targeted only diet thus no conclusion **Body fat percentage** • 4 studies targeted diet and physical activity o 3 studies used sum of skin folds; MD = -1.12% (95% CI: -1.86, -0.38) o 1 study used bioelectrical impedence thus no conclusion • No studies targeted only diet **Waist circumference** • 2 studies targeted diet and physical activity; MD = -1.08 cm (95% CI: -4.18, +2.02) • No studies targeted only diet **Waist-to-hip ratio** • No conclusion due to only one study each targeting diet only and diet and physical activity **Subgroup analyses** • Follow-up duration did not change pooled estimates for body weight or BMI • Studies targeting diet and physical activity with an environmental component (n=3) showed greater reduction in body weight vs. those that did not (n=6); MD = -1.5 kg (95% CI: -1.82, -1.17) vs -1.01 kg (95% CI: -1.63, -0.38)
*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 70 independent studies, mostly randomized controlled trials (n=61), evaluated in two rigorous systematic reviews, one of which included meta-analyses. The reviews are of high-quality with AMSTAR scores of 9 and 10 out of 11 possible points.

Consistency: Across individual studies and reviews, worksite-based approaches fairly consistently improved weight-related outcomes. Multi-component programs, in particular those incorporating physical activity and dietary modification, are more effective than single-component programs.

Impact: Improvements in weight-related outcomes demonstrated by the Verweij *et al* meta-analysis are clinically meaningful; however the public health impact of these changes is difficult to ascertain. Also, the findings related to internet-based programs reviewed by Aneni *et al* were inconsistent and not quantified.

Generalizability: The studies included in the Verweij *et al* review/meta-analysis were geographically diverse (both nationally and internationally), but information on the characteristics of the participants was very limited. Also, the Aneni *et al* review did not provide details regarding race, ethnicity, or geographic location for the included studies. Thus, the generalizability of the findings is not known with confidence.

Limitations: The systematic reviews/meta-analysis are of high quality, as well as most of the individual studies included within each of them. Yet, meta-analyses could not be conducted by Aneni *et al* due to the dissimilarity of interventions, heterogeneity of outcomes, and disparate study designs. Some inconsistencies are evident across studies and may be explained by differences in the populations sampled and methodologies including duration or exposure of intervention and follow-up periods.

Implications*

Existing evidence indicates that worksite approaches focused on dietary intake can increase fruit and vegetable intakes of employees. Multi-component programs targeting nutrition education in combination with dietary modification interventions are found to be effective. Additionally, environmental modifications in conjunction with a variety of worksite policies targeting dietary modification, including point-of-purchase information, catering policies, and menu labeling are effective. Thus, these evidence-based strategies should be implemented in worksites through a variety of means, such as corporate wellness programs, food service policies, and health benefits programs. Programs should emphasize multi-component approaches targeting diet and physical activity while policies should support behavior changes associated with improving health outcomes such as increasing the availability of healthy foods within the workplace and encouraging more physical activity throughout the workday. Given that approximately 64 percent of adults are employed and spend an average of 34 hours per week at work, the workplace remains an important setting for environmental and behavioral interventions for health promotion and disease prevention.

Research Recommendation*

Assessments of the effectiveness of worksite interventions that emphasize obesity prevention and weight control among workers across racially/ethnically diverse populations, blue and white collar employees, and at risk populations are needed. Scientifically rigorous studies (especially RCTs) addressing long-term health impact of worksite-based approaches and policies that improve employee diet, physical activity, and body weight control would have public health relevance.

Rationale: In light of the high rates of obesity and overweight, worksite interventions targeting obesity prevention and weight control, via enhanced dietary behaviors and increased physical activity among workers is important. The majority of the studies to date have been conducted for a relatively short period of time, and the long-term impact of these approaches and policies may prove beneficial.

*Because the four worksite questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement and research recommendation for all of the questions.

References

1. Aneni EC, Robertson LL, et al. A systematic review of internet-based worksite wellness approaches for cardiovascular disease risk management: outcomes, challenges & opportunities. PLos One 2014; 9(1):e83594. PMID: 24421894 http://www.ncbi.nlm.nih.gov/pubmed/24421894
2. Verweij LM, Coffeng J, et al. Meta-analyses of workplace physical activity and dietary behavior interventions on weight outcomes. Obes Rev 2011; 12(6):406-429. PMID: 20546142 http://www.ncbi.nlm.nih.gov/pubmed/20546142

Appendix E-2.36: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of worksite policies on the weight status of employees?

Conclusion Statement: The body of evidence assessing the impact of worksite policies on the weight status of employees is very limited.

DGAC Grade: Not Assignable

Key Findings

- This evidence portfolio includes one systematic review (Kahn-Marshall, 2012) which evaluated 27 studies published between 1985 and 2010. The review examined the evidence for the effectiveness of worksite health promotion programs using environmental and/or policy changes either alone or in combination with individually-focused health behavior change strategies.
- The studies used a variety of policies targeting behaviors which can impact weight status; some studies assessed the impact of policies (e.g., catering policies and company policies rewarding employees for healthy behaviors) combined with individual-level strategies. Some interventions were multi-component, with a combination of strategies targeting employees (e.g., point-of-choice messaging including nutrition information in cafeterias and reminders to use stairs) and/or the food environment at the worksite (e.g., increased availability of healthy food options). The health outcomes of interest included BMI, blood pressure, and cholesterol.
- In the body of evidence available, worksite policies either alone or in combination with individually-focused health behavior change strategies did not impact the weight status of employees. However, interventions incorporating both environmental and individual strategies can lead to significant improvement in behaviors related to weight status (e.g., dietary intake). The lack of impact may be due to length of exposure or the duration of the follow-up period.
- The evidence base includes one review evaluating several studies by independent investigators with sufficient sample sizes. Some inconsistency is evident across studies in regards to scientific rigor. Due to the variability of studies and paucity of data, no consistent associations regarding worksite policies and the weight status of employees were evident.

Description of the Evidence

This evidence portfolio includes one systematic review published by Kahn-Marshall and Gallant in 2012. The review includes 27 studies published between 1985 and 2010. Study designs included 10 randomized controlled trials (RCTs), 11 quasi-experimental studies, and 6 studies lacking experimental design. Eleven studies focused on environment or policy alone; sixteen interventions were multicomponent. The review had relatively low risk of bias, as evidenced by an AMSTAR score of 8 points out of a possible 11. The methodological quality of the studies included in the review was assessed based on six criteria (sample size, study design, validity of measurement instrument for self-reported data, reliability of measurement instrument for self-reported data, type of data collection, and follow-up). Studies received a plus or a minus depending on whether they met each criterion. Studies were considered of a relatively high quality if five or more of the criteria were scored positively. No studies were excluded due to poor quality. Eight studies were rated high quality.

Population

The studies examined employees of blue- and white-collar worksites. The reported sample sizes ranged from 177 to 26,806 adults. Fourteen studies were conducted in the United States and thirteen were conducted in other highly developed countries. The review did not review or present results by gender or race/ethnicity (refer to the Overview Table for review-specific details).

Exposures

The studies included in the review examined a variety of worksite environmental policies, alone and in combination with individual-level strategies (e.g., health education and informational materials) targeting health behaviors. For example, the impact of point-of-choice messages (e.g., nutrition information in cafeterias, reminders to use stairs, etc.), increased availability of healthy food options, catering policies, and company policies rewarding employees for healthy behaviors were evaluated.

Outcomes

The primary outcomes of interest were dietary behaviors (e.g., intake of fruits, vegetables, meat, and sugar-sweetened beverages), physical activity (e.g., minutes of exercise per week and stair use), and health outcomes (e.g., blood pressure, BMI, and blood cholesterol).

Evidence Synthesis

Kahn-Marshall and Gallant reviewed studies evaluating the effectiveness of worksite health promotion programs using environmental and/or policy changes either alone or in combination with individually-focused health behavior change strategies. Only one study evaluated the impact of an environmental change or company policy, without incorporating individual behavior. Although this study reported decreased prevalence in obesity, hypercholesterolemia, hypertension, and smoking four years after initiating a company policy rewarding healthy behaviors, there was no control group. Nine studies assessing environmental and individual strategies in combination did not demonstrate any significant improvements in health outcomes, despite five studies reporting significant improvement in dietary behaviors.

Overview Table

Summary of systematic review examining the impact of worksite policies on the dietary intake, quality, behaviors and/or preferences of employees

Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results

Kahn-Marshall, 2012 Systematic review AMSTAR Score: 8/11 27 studies: • 10 randomized controlled trials; 11 quasi-experimental; 6 lacking design • 8 deemed high quality • 16 multicomponent; 11 environmental or policy alone	Examine the evidence for the effectiveness of worksite health promotion programs using environmental and/or policy changes either alone or in combination with individually focused health behavior change strategies Employees of blue- and white-collar worksites **Location:** 14 in the US 4 Netherlands 2 Japan 1 each in Scotland, Canada, Mexico, New Zealand, Chile, US+Canada	**Independent variables:** 1. Only environmental and policy changes at the worksite 2. Multicomponent interventions that included changes to the worksite **Outcomes:** • Dietary behaviors (e.g., fruit and vegetable intake, SSB intake, meat intake) • Physical activity behaviors (e.g., stair use, minutes/week) • Health outcomes (e.g., blood pressure, BMI, blood cholesterol)	**Only Environment and/or Policy Changes:** One pre/post study evaluated the impact of company policies which rewarded employees for healthy behaviors. After 4 years, prevalence of obesity, high blood cholesterol, smoking, and high blood pressure had decreased. **Environment & Individual-level Strategies:** Compared to environmental-only studies, the 9 studies that included policies and individual-level strategies (targeting nutrition and physical activity) were more likely to address health risk indicators (e.g., BMI) but no significant improvements were reported .

*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)

Assessment of the Body of Evidence

Quality and Quantity: The evidence base includes 27 independent studies with 10 randomized controlled studies evaluated in a high-quality systematic review with an AMSTAR score of 8 out of 11 possible points. However, some of the individual studies included in the review lacked scientific rigor.

Consistency: Across individual studies, worksite policies did not significantly alter health outcomes of interest.

Impact: Due to a lack of effectiveness and limited findings, the impact of worksite policies for health promotion on weight outcomes is relatively unknown.

Generalizability: The studies included in the review were geographically diverse (both nationally and internationally), but information on the characteristics of the participants was very limited. Thus, the generalizability of the findings is not known with confidence.

Limitations: While the systematic review conducted by Kahn-Marshall and Gallant is of high quality, the quality of the studies included in their assessment varied, with only eight studies deemed to be of higher quality (out of 27 total studies).

Implications*

Existing evidence indicates that worksite approaches focused on dietary intake can increase fruit and vegetable intakes of employees. Multi-component programs targeting nutrition education in combination with dietary modification interventions are found to be effective. Additionally, environmental modifications in conjunction with a variety of worksite policies targeting dietary modification, including point-of-purchase information, catering policies, and menu labeling are effective. Thus, these evidence-based strategies should be implemented in worksites through a variety of means, such as corporate wellness programs, food service policies, and health benefits programs. Programs should emphasize multi-component approaches targeting diet and physical activity while policies should support behavior changes associated with improving health outcomes such as increasing the availability of healthy foods within the workplace and encouraging more physical activity throughout the workday. Given that approximately 64 percent of adults are employed and spend an average of 34 hours per week at work, the workplace remains an important setting for environmental and behavioral interventions for health promotion and disease prevention.

Research Recommendation*

Assessments of the effectiveness of worksite interventions that emphasize obesity prevention and weight control among workers across racially/ethnically diverse populations, blue and white collar employees, and at risk populations are needed. Scientifically rigorous studies (especially RCTs) addressing long-term health impact of worksite-based approaches and policies that improve employee diet, physical activity, and body weight control would have public health relevance.

Rationale: In light of the high rates of obesity and overweight, worksite interventions targeting obesity prevention and weight control, via enhanced dietary behaviors and increased physical activity among workers is important. The majority of the studies to date have been conducted for a relatively short period of time, and the long-term impact of these approaches and policies may prove beneficial.

*Because the four worksite questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement and research recommendation for all of the questions.

Reference

Kahn-Marshall JL, Gallant MP. Making healthy behaviors the easy choice for employees: a review of the literature on environmental and policy changes in worksite health promotion. Health Educ Behav 2012;39(6):752-776. PMID: 22872583 http://www.ncbi.nlm.nih.gov/pubmed/22872583

Appendix E-2.37: Evidence Portfolio

Part D. Chapter 5: Food Sustainability and Safety

What is the relationship between population-level dietary patterns and food sustainability and related food security?

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Conclusion Statement: Consistent evidence indicates that, in general, a dietary pattern that is higher in plant-based foods, such as vegetables, fruits, whole grains, legumes, nuts, and seeds, and lower in animal-based foods is more health promoting and is associated with lesser environmental impact (GHG emissions and energy, land, and water use) than is the current average U.S. diet. A diet that is more environmentally sustainable than the average U.S. diet can be achieved without excluding any food groups. The evidence consists primarily of Life Cycle Assessment (LCA) modeling studies or land-use studies from highly developed countries, including the United States.

DGAC Grade: Moderate

Key Findings

- The studies were consistent in showing that higher consumption of animal-based foods was associated with a greater impact on the environment and higher consumption of plant-based foods was associated with lower impact.
- The studies were consistent in showing that dietary patterns that promote health also promote sustainability.
- The studies were consistent in showing that healthier dietary patterns that adhered to dietary guidelines were more environmentally sustainable than diets typically consumed by the respective populations.
- The evidence supports that a sustainable diet can be achieved by following dietary guidance in the U.S. and national dietary guidance in other countries, without eliminating any food groups completely.
- The evidence supports the consumption of current dietary guidelines by increasing consumption of plant-based foods and modestly decreasing animal-based foods.
- Limited evidence showed that just lowering the snacks/sweets component of a dietary pattern benefits health and improves the environmental footprint.

- Overall, there was agreement across the studies regarding environmental footprints of different dietary patterns, despite varied methods of assessing environmental impact and differences in components of environmental impact assessed, e.g. GHG emissions or land use.
- There was limited and inconsistent evidence to indicate whether sustainable diets were more or less expensive than typically consumed diets in some locations.

Methodology

This topic is novel for a DGAC review and involves an emerging area of scientific investigation that is not readily addressed by study designs such as randomized controlled trials. The state-of-the-art of the literature related to sustainable diets and dietary patterns involves a unique combination of food pattern modeling, Life Cycle Assessment (LCA) methodology (examines all processes in the life cycle of each food component - from farm to plate to waste), and determination of the environmental outcomes of the full LCA inventory. Because of the unique nature of these studies, a modified NEL systematic review was conducted for the question on dietary patterns and sustainability. Databases included PubMed, Cochrane, Navigator, and Embase and the search covered from January 2000 to March 2014. For this topic and question, it was necessary to use different methods from those described in an original NEL protocol because not all methods in the protocol could be applied. This is sometimes necessary, according to the Cochrane Collaboration, but requires that methods from the original protocol that could not be implemented in the current review be summarized (Higgins 2011). In the standard NEL six-step protocol, step 3 to extract data and assess the risk of bias was modified. A new data extraction grid was developed with emphasis on modeling studies, LCA methodology, and environmental outcomes. The LCA is a standardized methodological framework for assessing the environmental impact (or load) attributable to the life cycle of a food product. The customized grid was then used by NEL abstractors to extract data from the included articles. In addition, NEL abstractors used a different tool to assess individual study quality or risk of bias, not the NEL Bias Assessment Tool (BAT). This alternative tool, the Critical Appraisal Checklist used by the *British Medical Journal*, was appropriate for studies that used a modeling design. This checklist assesses studies that use modeling to extrapolate progression of clinical outcomes, transform final outcomes from intermediate measures, examine relation between inputs and outputs to apportion resource use, and extrapolate findings from one clinical setting or population to another. To attain a high score, studies must report the variables that have been modeled rather than directly observed; what additional variables have been included or excluded; what statistical relations have been assumed; and what evidence supports these assumptions (Drummond 1996; Eddy 1985; Stevenson 2012). The checklist included key components of the *British Medical Journal* checklist for economic evaluations, together with the Eddy checklist on mathematical models. This Critical Appraisal Checklist was reviewed and tested for applicability by two sustainability experts who served as consultants to the DGAC.

Description of the Evidence

A total of 15 studies met the inclusion criteria for this systematic review. The body of evidence consisted primarily of dietary pattern modeling studies that assessed related environmental outcomes. These studies were conducted between the years 2003 and 2014 in the US (Pimentel & Pimental, 2003, Peters 2014), the UK (Aston 2012, Macdiarmid 2012, Scarborough 2012), Germany (Meier & Christen 2013), the Netherlands (van Doreen 2014), France (Vieux 2013), Spain (Sáez-Almendros

2013), Italy (Baroni 2007), Australia (Barosh 2014, Hendrie 2014), Brazil (de Carvalho 2013), New Zealand (Wilson 2013), and worldwide (Pradhan 2013). Dietary patterns that were examined included vegetarian, lacto-ovo vegetarian, and vegan dietary patterns; the average and dietary guidelines-related dietary patterns of respective countries examined; Mediterranean-style dietary patterns; and sustainable diets. The most frequent comparison diet was the average dietary pattern of the country, although numerous studies made additional comparisons across many of the above dietary patterns. Another approach was to examine diet "scenarios" that modeled different percentage replacements of meat and dairy foods with plant-based foods. The modeling studies used cross-sectional assessment of dietary intake from national nutrition surveys of representative adult populations; for example, the British National Diet and Nutrition Survey (NDNS) from studies in the UK (Aston 2012; Macdiarmid 2012), the National Nutrition Surveys (NNS) in Germany (Meier & Christen 2013), or the Australian National Nutrition Survey (Hendrie 2014) were used to determine the observed average dietary patterns. The average dietary patterns were then compared with other modeled dietary patterns, such as vegetarian or Mediterranean- style patterns, as described in detail below. All of the countries were highly developed countries with dietary guidelines and, therefore, generalizable to the U.S. population. The study quality for the body of evidence ranged from scores of 7/12 to 12/12 (indicating the evidence was of high quality) using the modified critical appraisal checklist.

Health outcomes associated with the dietary patterns were most often documented based on adherence to dietary guidelines-related patterns, variations on vegetarian dietary patterns, or Mediterranean-style dietary patterns. Diet quality was assessed in some studies using an a priori index, such as the Healthy Eating Index (HEI) or the WHO Index. In some studies, health outcomes also were modeled. For example Scarborough et al. used the DIETRON model to estimate deaths delayed or averted for each diet pattern. One study assessed the synergy between health and sustainability scores using the WHO Index and the LCA sustainability score to assess combined nutritional and ecological value (van Dooren 2014).

The environmental impacts that were most commonly modeled were GHG emissions and use of resources such as agricultural land, energy, and water. In many studies, the environmental impact for each food/food category was obtained using the LCA method. The LCA is a standardized methodological framework for assessing the environmental impact (or load) attributable to the life cycle of a food product. The life cycle for a food typically includes agricultural production, processing and packaging, transportation, retail, use, and waste disposal. An inventory of all stages of the life cycle is determined for each food product and a "weight" or number of points is then attributed to each food or food category, based on environmental impacts such as resource extraction, land use, and relevant emissions. These environmental impact results can be translated into measures of damage done to human health, ecosystem quality, and energy resources using programs such as Eco-Indicator (Goedkoop 2000). In addition to the health assessment approaches listed above, some studies used LCA analysis with a standardized approach to determine damages from GHG emissions and use of resources; these damage outcomes included human health as an environmental damage component, such as the number and duration of diseases and life years lost due to premature death from environmental causes.

Few studies assessed food security. These studies assessed food security in terms of the cost difference between an average dietary pattern for the country studied and a sustainable dietary pattern for that population (Barosh 2014, Macdiarmid 2012, Wilson 2013). The basic food basket concept was used in some studies, representing household costs for a two-adult/two-child household.

Evidence Synthesis

<u>Themes and Key Findings</u>

Identified Dietary Patterns and Health and Sustainability Outcomes

Vegetarian and Meat-based Diets

Several studies examined variations on vegetarian diets, or a spectrum from vegan to omnivorous dietary patterns, and associated environmental outcomes (Aston 2012; Baroni 2007; de Carvalho 2013; Peters 2007). Peters et al. examined 42 different dietary patterns and land use in New York, with patterns ranging from low-fat, lacto-ovo vegetarian diets to high fat, meat-rich omnivorous diets; across this range, the diets met U.S. dietary guidelines when possible.[41] They found that, overall, increasing meat in the diet increased per capita land requirements; however, increasing total dietary fat content of low-meat diets (i.e. vegetarian alternatives) increased the land requirements compared to high-meat diets. In other words, although meat increased land requirements, diets including meat could feed more people than some higher fat vegetarian-style diets. Aston et al. assessed a pattern that was modeled on a feasible UK population in which the proportion of vegetarians in the survey was doubled, and the remainder adopted a diet pattern consistent with the lowest category of red and processed meat (RPM) consumers. They found the combination of low RPM + vegetarian diet had health benefits of lowering the risk of diabetes and colorectal cancer, determined from risk relationships for RPM and CHD, diabetes, and colorectal cancer from published meta-analyses. Furthermore, the expected reduction in GHG for this diet was ~3 percent of current total carbon dioxide (CO_2) emissions for agriculture. De Carvalho et al. also examined a high RPM dietary pattern with diet quality assessed using the Brazilian Healthy Eating Index. They found that excessive meat intake was associated not only with poorer diet quality but also with increased projected GHG emissions (~ 4 percent total CO_2 emitted by agriculture). Taken together, the results on RPM intake indicate that reduced consumption is expected to improve some health outcomes and decrease GHG emissions, as well as land use compared to low-fat, vegetarian-style diets. Baroni et al. examined vegan, vegetarian, and omnivorous diets, both organically and conventionally grown, and found that the organically grown vegan diet had the most potential health benefits; whereas, the conventionally grown average Italian diet had the least. The organically grown vegan diet also had the lowest estimated impact on resources and ecosystem quality, and the average Italian diet had the greatest projected impact. Beef was the single food with the greatest projected impact on the environment; other foods estimated to have high impact included cheese, milk, and fish.

Vegetarian diets, dietary guidelines-related diets, and Mediterranean-style diets were variously compared with the average dietary patterns in selected countries (Hendrie 2014; Meier & Christen 2013; Pimentel & Pimental 2003; van Dooren 2014). Overall, the estimated greater environmental benefits, including reduced projected GHG emissions and land use, resulted from vegan, lacto-ovo vegetarian, and pesco-vegetarian diets, as well as dietary guidelines-related and Mediterranean-style dietary patterns. These diets had higher overall predicted health scores than the average diet patterns. Moreover, for the most part, the high health scores of these dietary patterns were paralleled by high combined estimated sustainability scores. According to van Doreen et al., the synergy measured across vegetarian, Mediterranean-style, and dietary guidelines-related scores could be explained by a reduction in consumption of meat, dairy, extras (i.e., snacks and sweets), and beverages, as well as a reduction in overall food consumption.

Mediterranean-Style Dietary Patterns

The Mediterranean-style dietary pattern was examined in both Mediterranean and non-Mediterranean countries (Saez-Almendros 2013; van Dooren 2014). In all cases, adherence to a Mediterranean-style dietary pattern—compared to usual intake—reduced the environmental footprint, including improved GHG emissions, agricultural land use, and energy and water consumption. Both studies limited either red and processed meat (Saez-Almendros 2013) or meat and poultry (van Dooren 2014) to less than 1 serving per week, and increased fish intake. The authors concluded that adherence to a Mediterranean-style dietary pattern would make a significant contribution to increasing food sustainability, as well as increasing the health benefits that are well-documented for this type of diet.

Diet Scenarios

Other studies examined different diet “scenarios” that generally replaced animal foods in various ways with plant foods (Scarborough 2012; Pradham 2013; Vieux 2013). Scarborough et al. found that a diet with 50 percent reduced total meat and dairy replaced by fruit, vegetables, and cereals contributed the most to estimated reduced risk of total mortality and also had the largest potential positive environmental impact. This diet scenario increased fruit and vegetable consumption by 63 percent and decreased saturated fat and salt consumption; micronutrient intake was generally similar with the exception of a drop in vitamin B_{12}.

Pradham et al. examined 16 global dietary patterns that differed by food and energy content, grouped into four categories with per capita intake of low, moderate, high, and very high kcal diets. They assessed the relationship of these patterns to GHG emissions. Low-energy diets had < 2,100 kcal/cap/day and were composed of more than 50 percent cereals or more than 70 percent starchy roots, cereals, and pulses. Animal products were minor in this group (<10 percent). Moderate, high, and very high energy diets had 2,100-2,400, 2,400-2,800, and > 2,800 kcal/cap/day, respectively. Very high calorie diets had high amounts of meat and alcoholic beverages. Overall, very high calorie diets, common in the developed world, exhibited high total per capita CO_{2eq} emissions due to high carbon intensity and high intake of animal products; the low-energy diets, on the other hand, had the lowest total per capita CO_{2eq} emissions.

Lastly, Vieux et al. examined dietary patterns with different indicators of nutritional quality and found that despite containing large amounts of plant foods, not all diets of the highest nutritional quality were those with the lowest GHG emissions. For this study, the diet pattern was assessed by using nutrient-based indicators; high quality diets had energy density below the median, mean adequacy ratio above the median, and a mean excess ratio (percentage of maximum recommended for nutrients that should be limited – saturated fat, sodium, and free sugars) below the median. Four diet patterns were identified based on compliance with these properties to generate one high quality diet, two intermediate quality diets, and one low quality diet. In this study, the high quality diets had higher GHG emissions than did the low quality diets. Regarding the food groups, a higher consumption of starches, sweets and salted snacks, and fats was associated with lower diet-related GHG emissions and an increased intake of fruit and vegetables, was associated with increased diet-related GHG emissions. However, the strongest positive association with GHG emissions was still for the ruminant meat group. Overall, this study used a different approach from the other studies in this review, as nutritional quality determined the formation of dietary pattern categories.

Sustainable Diets and Costs
Three studies examined sustainable diets and related costs (Barosh 2014; Macdiarmid 2012; Wilson 2013). Barosh et al. examined food availability and cost of a health and sustainability (H&S) food basket, developed according to the principles of the Australian dietary guidelines as well as environmental impact. The food basket approach is a commonly used method for assessing and monitoring food availability and cost. The typical food basket was based on average weekly food purchases of a reference household made up of two adults and two children. For the H&S basket, food choices were based on health principles and environmental impact. The H&S basket was compared to the typical Australian basket and it was determined that the cost of the H&S basket was more than the typical basket in five socioeconomic areas; the most disadvantaged spent 30 percent more for the H&S basket. The authors concluded that the most disadvantaged groups at both neighborhood and household levels experienced the greatest inequality in accessing an affordable H&S basket. Macdiarmid et al. examined a sustainable diet (met all energy and nutrient needs and maximally decreased GHG emissions), a “sustainable with acceptability constraints” diet (added foods commonly consumed in the UK; met energy, nutrient, and fish recommendations as well as recommended minimum intakes for fruits and vegetables and did not exceed the maximum recommended for red and processed meat), and the average UK diet. They found that the sustainable diet that was generated would decrease GHG emissions from primary production (up to distribution) by 90 percent, but consisted of only seven foods. The acceptability constraints diet included 52 foods and was projected to reduce GHG emissions by 36 percent. This diet included meat and dairy but less than the average UK diet. The cost of the sustainable + acceptability diet was comparable to that of the average UK diet. These results showed that a sustainable diet that meets dietary requirements and has lower GHG can be achieved without eliminating meat or dairy products completely, or increasing the cost to the consumer. Lastly, Wilson et al. examined 16 dietary patterns modeled to determine which patterns would minimize estimated risk of chronic disease, cost, and GHG emissions. These patterns included low-cost and low-cost + low GHG diet patterns, as well as healthy patterns with high vegetable intakes including Mediterranean or Asian patterns, as well as the average New Zealand pattern. The authors found that diets that aimed to minimize cost and estimated GHG emissions also had health advantages, such as the simplified low-cost Mediterranean-style and simplified Asian-style diets, both of which would lower cardiovascular disease and cancer risk, compared to the average New Zealand diet. However, dietary variety was limited and further optimization to lower GHG emissions increased cost.

Overall, the studies were consistent in showing that higher consumption of animal-based foods was associated with higher estimated environmental impact, whereas consumption of more plant-based foods as part of a lower meat-based or vegetarian-style dietary pattern was associated with estimated lower environmental impact compared to higher meat or non-plant-based dietary patterns. Related to this, the total energy content of the diet was also associated with estimated environmental impact and higher energy diets had a larger estimated impact. For example, for fossil fuel alone, one calorie from beef or milk requires 40 or 14 calories of fuel, respectively, whereas one calorie from grains can be obtained from 2.2 calories of fuel (Pimental & Pimental 2003). Additionally, the evidence showed that dietary patterns that promote health also promote sustainability; dietary patterns that adhered to dietary guidelines were more environmentally sustainable than the population's current average level of intake or pattern. Taken together, the studies agreed on the environmental impact of different dietary patterns, despite varied methods of assessing environmental impact and differences in components of environmental impact assessed (e.g. GHG emissions or land use). The evidence on whether sustainable diets were more or less expensive than typically consumed diets in some locations was limited and inconsistent.

Qualitative Assessment of the Collected Evidence:

Quality and Quantity

This was a reasonable body of consistent evidence with studies that directly addressed the question. The study quality for the body of evidence ranged from 7/12 to 12/12, using the critical appraisal checklist for economic evaluations (including key components of the British Medical Journal checklist for economic evaluations, together with the Eddy checklist on mathematical models (NIHR Evaluation, Trials and Studies Coordinating Centre (UK)).

Consistency

There was remarkable agreement between the fifteen studies regarding environmental footprints of different dietary patterns, despite varied methods and designs to answer the question.

Impact

The evidence supports Americans consuming the current Dietary Guidelines by increasing consumption of plant-based foods, modestly decreasing animal-based foods and decreasing excessive snacks/sweets. Promoting sustainable diets will contribute to food security for present and future generations by conserving valuable resources. Moving forward, care and attention will be needed to be sure that Americans have access to and can afford a sustainable pattern of eating.

Generalizability/External Validity

Studies were conducted in the US, the UK, Germany, the Netherlands, France, Spain, Italy, Australia, Brazil, and New Zealand. These are all high HDI countries with systems of national dietary guidance similar to the US. Most of the studies based their modeling on assumed average adult diets with average caloric intake to meet energy needs, i.e. general populations of healthy adults. Taken together, the evidence from the general healthy populations in the U.S. and primarily European countries is highly generalizable to the U.S. population.

Limitations

A limitation that was common to most of the studies was that health outcomes were not assessed in the available study, but were based on earlier work on specific dietary patterns, e.g. vegetarian, Mediterranean, Western, etc. There are also known limitations to the complex process of assessing the environmental impact of foods using the Life Cycle Assessments method.

Research Recommendations

1. Develop and test communication strategies to help motivate people of all ages to consume increasingly sustainable diets. This strategy will provide further rationale for the U.S. population to

consume a dietary pattern closer to the Dietary Guidelines for Americans than is currently being consumed.

2. Develop and test systems to ensure that sustainable diets are affordable and available to all sectors of the population.
3. Develop more in-depth analysis of U.S. domestic dietary patterns and enhanced environmental sustainability with different production regimens for animal products, especially dairy and beef.
4. Develop updated analysis of environmental sustainability of dietary patterns with respect to fish consumption, nutrient profiles, and different production regimens (e.g. wild caught versus farm raised.

Table 1. Summary of Studies on Dietary Patterns and Sustainability

Author, Year Study Design, Location	Diet Exposure	Results Health Outcomes	Results Sustainability or Food Security	Results Food Components	Summary of Findings
Aston et al., 2012 Modeling/ Data Analysis UK	• Reduced red & processed meat (RPM) dietary pattern • Vegetarian • Counterfactual (combination of lowest RPM + Vegetarian) RPM consumption from National Diet and Nutrition Survey of British Adults Counterfactual UK diet: vegetarians in the survey population doubled, and remainder adopted diet of lowest 5th RPM consumers	Counterfactual diet: reduced risk from 3.2% (95% CI 1.9-4.7) for diabetes in women to 12.2% (6.4-18.0) for colorectal cancer in men	Diet-related GHG decreased by 0.47 kg CO2-e/person/day (12%) to 3.96 kg CO2-e/ person/ day in men and 3.02 kg CO2-e/person/day in women For 2009 UK population of 61,792,000, this amounts to a total GHG reduction of 27.8 million tonnes/year (3% of current total)	**Red meat** accounted for 31% of dietary CO2-e emissions in men and 27% in women **Processed meat** accounted for an additional 10% and 8% in men and women, respectively (Habitual RPM 2.5X higher in top vs bottom 5th)	Reduced consumption of RPM would result in multiple benefits to health and the environment
Baroni et al., 2007 Modeling/ Data Analysis Italy	**7 dietary patterns**: • Omni-Conv (omnivorous, conventional farming) • Omni-Org (omnivorous, organic farming) • Veg-Conv (vegetarian, conventional) • Veg-Org (vegetarian, organic) • Vegan-Conv (vegan, conventional) • Vegan-Org (vegan, organic) • Average Italian-Conv (ave. Italian diet, conventional)	**Ave impact (points): Health** Omni-Conv - 0.46; Omni-Org - 0.20; Veg-Conv - 0.34; Veg-Org - 0.18; Vegan-Conv - 0.15; Vegan-Org - 0.04; Ave Italian - 1.06; From omnivorous diets: 15-18% of impact due to damage to respiration from inorganic chemicals	**Ave impact (points): Resources** Omni-Conv - 1.42; Omni-Org - 0.80; Veg-Conv - 0.88; Veg-Org - 0.59; Vegan-Conv - 0.54; Vegan-Org - 0.46; Ave Italian - 3.70; From omnivorous diets: 20-26% of impact due to fossil fuels 5-13% due to land use 41-46% due to water **Ave impact (points): Ecosystem** Omni-Conv - 0.27 Omni-Org - 0.27 Veg-Conv - 0.17 Veg-Org - 0.18 Vegan-Conv - 0.11 Vegan-Org - 0.07 Ave Italian - 0.65 From omnivorous diets: 3-4% of impact due to eutrophication process	Beef is the single food w/ greatest impact on environment Other high impacting foods were cheese, milk, and fish	Ave Italian-Conv diet had the greatest environmental impact The Vegan-Org diet had the lowest environmental impact Within the same method of production, a greater consumption of animal products translated to a greater impact on the environment Within the same dietary pattern, conventional production methods had a greater environmental impact than organic methods

Barosh et al., 2014 Cross-sectional survey of food availability & cost Australia	• Health & Sustainability (H&S) basket • Typical basket 2 food baskets (typical and sustainable H&S basket) developed for 2-adult/2-child household in 5 socio-economic districts,estimated food cost, food availability, food accessibility	H&S basket 1st - developed according to health principles of Australian Dietary Guidelines 2nd - food items chosen w lower environ impact	Cost of H&S basket more than typical basket in 5 socio- economic areas Most disadvantaged spent more (30%) for H&S basket	NR	Most disadvantaged groups in the region, both at the neighborhood and household levels, experienced the greatest inequality in affordability of the H&S diet
de Carvalho et al., 2013 Cross-sectional health survey Brazil	• Red & processed meat Study measured RPM intake in San Paulo, Brazil and assessed impact on diet quality and environment	Diet quality assessed using the Brazilian Healthy Eating Index Revised	GHG emissions from meat were estimated at 18,071,988 tons of CO_2 equivalents, or 4% of total emitted by agriculture	81% of men and 58% of women consumed more meat than recommended of red and processed meat Diet quality was inversely associated with excessive meat intake in men	Excessive meat intake, associated with poorer diet quality, support initiatives and policies advising to reduce red and processed meat to recommended amounts as part of healthy and environmentally sustainable diet
Hendrie et al., 2014 Modeling/ Data Analysis/ Survey Australia	**4 dietary patterns**: • Average diet (average Australian diet); • Average diet with minimal non-core foods (similar to average diet with minimal inclusion of energy-dense, processed non-core foods); • Total diet (recommended dietary pattern consistent with Australian Dietary Guidelines); • Foundation diet (recommended dietary pattern that meets the minimum nutrient and energy needs requirements for the population)	Health benefits of adhering to Australian Dietary Guidelines Core foods = red meat, chicken, fish, eggs, breads & cereals, fruit, vegetables, dairy foods and unsat oils Non-core foods = snacks, soft drinks, coffee/tea, desserts/ sweets, processed meats, SFA, and alcohol	**Highest GHG:** Ave Australian diet -14.5 kg CO_2/ person/d **Lowest GHG:** Foundation diet - 10.9 kg CO_2/person/d (~25% lower than ave diet) GHG from diets assessed using the input-output model of Australian economy (Australian Multi Regional Input-Output (MRIO) model)	Food groups with greatest contribution to diet-related GHG were red meat (8.0 kg CO_2 /person/d) and energy-dense, nutrient poor "non-core" foods (3.9 kg CO_2) Non-core foods accounted for 27% diet-related GHG	Reduction in non-core foods and consuming recommended servings of core foods are strategies to benefit population health and environment

Macdiarmid et al 2012 Modeling/ Data Analysis UK	**3 dietary patterns:** • Sustainable • Sustainalbe w/ Acceptability Constraints • Average UK Iterative modeling to produce a diet that met dietary requirements while minimizing GHGEs Acceptability constraints based on average UK diet 7-d sample diet was generated to ensure diet was realistic and acceptable	Benefits from dietary recommendations: Modeled for nutrient intake based on UK diet recommendations for women 19-50y, Constraints set for energy, macronutrients, and 6 micronutrients (iron, folate, B12, zinc, calcium, and sodium)	GHG: sustainable diet gave 90% reduction in GHG, but only 7 foods Acceptability constraints gave 52 foods and reduced GHG 36%; diet included meat but less than average UK diet Diet cost: cost of Sustainable + acceptability diet was comparable to average UK cost	Meat in sustainable w/ Acceptability diet was 60% of current intake for UK women and 48% of red meat intake Proportion of dairy was similar to current intakes, but lower in fat	A sustainable diet that meets dietary requirements for health with lower GHG can be achieved without eliminating meat or dairy products or increasing the cost to the consumer

Meier & Christen, 2013 Modeling/ Data Analysis Germany	**6 dietary patterns:** • Ave German Diet 1985-89 • Ave German Diet 2006 • German Dietary Guidelines Diet (D-A-CH) • Alternative recommendations w/ less meat, more legumes & vegetables (UGB) • Lacto-ovo vegetarian • Vegan	Dietary guidelines and vegetarian/ vegan related health benefits	Environmental impacts per capita **CO_2 emissions, t/y:** •1985-89 mean: 2.28; •2006 mean: 2.05; •D-A-CH: 1.82; •UGB: 1.81; •vegetarian: 1.56; •vegan: 0.96 **NH_3 emissions, kg/y:** •1985-89 mean: 7.7; •2006 mean: 6.5; •D-A-CH: 5.1; •UGB: 4.7; •vegetarian: 3.8; •vegan: 0.7 **Land use, m^2/y:** •1985-89 mean: 2,444; •2006 mean: 2,098; •D-A-CH: 1,786; •UGB: 1,740; •vegetarian: 1,527; •vegan: 1,052 **Blue water** use, m^3/y:** •1985-89 mean: 24.9; •2006 mean: 28.4; •D-A-CH: 20.9; •UGB: 20.8; •vegetarian: 52.5; •vegan: 58.8 **Phosphorus use, kg/y:** •1985-89 mean: 7.7; •2006 mean: 6.5; •D-A-CH: 5.7; •UGB: 5.6; •vegetarian: 4.5; •vegan: 2.4 **Primary Energy use, GJ/y:** •1985-89 mean: 14.0; •2006 mean: 13.5; •D-A-CH: 12.5; •UGB: 12.9; •vegetarian: 11.2; •vegan: 9.4	In comparison to the dietary guidelines and diets characterized by increasing legumes, nuts/seeds and vegetables, instead of meat, butter, egg and fish products (D-A-CH > UGB > vegetarian > vegan) could reduce impact of diet if more in line with guidelines GHG emissions and phosphorus use related to dairy are increasing, while those related to meat are declining Ammonia emissions and land use also largely driven by meat and dairy, and would be reduced w/ shift to vegan diet Increased blue water use since 1985-89 is associated w/ higher fruits, nuts, and seeds	Highest environmental impact changes would be from the vegan and lacto-ovo vegetarian diets The impact of recommendations of UGB and D-A-CH ranked 3rd and 4th All four diets achieved significant reductions compared with the average intake in 2006 Changes since 1985-89 are largely due to changes in diet

Peters et al., 2007 Modeling/ Data Analysis New York State	**42 dietary patterns** varying in total fat and meat servings: • Range of food patterns—from low-fat, lacto-vegetarian to high fat, meat-rich omnivorous • 7 quantities of meat and eggs—0 to 381 g/d and 6 levels of fat—20 to 45% of energy • 2308 kcal/d • Excludes foods not produced in NY state • Assumes seasonal limitations on fruits & veg	All diets met USDA Food Guide Pyramid where possible	**Annual per capita land requirements:** ranged from 0.18 ha (0g meat, 52g fat) to 0.86 ha (381g meat, 52g fat); meat was the primary driver of increasing land use; increasing dietary intake of fat increased land requirements for low-meat diets but reduced land requirements for high-meat diets; 97.2% of the variability between diets was attributable to the quantity of meat in the diet **Carrying capacity:** ranged from 6.08 million persons (0g meat, 52g fat) to 2.04 million persons (381g meat, 52g fat); lower meat diets generally supported more people, but as fats increased, there was less difference between diets with different meat levels; 87.2% of the variability between diets was attributable to the quantity of meat in the diet	Meat was most land-intensive food, followed by eggs, dairy, fruits, oilseeds, vegetables, beans, then grains (Ruminant meat and milk required less land devoted to annual crop production relative to other meats)	Increasing meat in the diet increased per capita land requirements, while increasing total dietary fat increased the land requirements of low meat diets but reduced the land needed for high meat diets These results support the assertion that diet should be considered in its entirety when assessing environmental impact

Pimentel & Pimentel, 2003 Modeling/ Data Analysis US	2 energy-equivalent diets: • Lacto-ovo vegetarian • Average US (Meat based diet) Meat-based diet based on food balance sheets for US from FAOSTAT Composition of the lactoovovegetarian diet estimated by replacing meat and fish calories by proportionately increasing other foods consumed, except sugar and sweeteners, fats, and vegetable oils	Health benefits of lacto-ovo vegetarian diet	Cropland per capita needed for production: meat-based: 0.5 ha; vegetarian: 0.4 ha Producing 1 kg of animal protein requires 100 times more water than producing 1 kg of grain protein	Fossil energy required to produce 1 kcal of animal protein, kcal: lamb: 57; beef: 40; eggs: 39;swine:14; dairy (milk): 14; turkeys: 10; broilers: 4 Grain/forage required to produce 1 kg of animal product, kg: lamb: 21/30; beef: 13/30; eggs: 11/0; swine: 5.9/0; turkeys: 3.8/0; broilers: 2.3/0; dairy (milk): 0.7/1 Red meat generally requires more resources to produce than non-meat animal proteins (eggs, milk)	Meat-based diet requires more energy, land, and water resources, making the lactoovovegetarian diet more sustainable than the current average US diet

Pradham et al., 2013 Modeling/ Data Analysis Global	16 dietary patterns, grouped according to energy content: low-calorie (patterns 1-3), moderate-calorie (patterns 4-8), high-calorie (patterns 9-11), and very high-calorie (patterns 12-16). Within each group, dietary patterns differed in the composition of food groups Dietary patterns were characterized using global time series data on food consumption and composition per country from FAOSTAT during 1961-2007 Data included 11 food groups: animal products, cereals, pulses, starchy roots, oilcrops, vegetable oils, vegetables, fruits, sugar-sweeteners, sugarcrops, and alcoholic beverages	NR	High-calorie diets required high per-capita energy inputs (1,800-3,500 kcal/d) Per-capita fossil-fuel related GHGEs ranged from 0.64 to 1.35 kg CO2eq/d for very high-calorie diets, to between 0.03 and 0.05 kg CO2eq/d for low-calorie diets Non-CO2 GHGEs were generally high for low- and moderate-calorie diets, and resulted in high total GHGEs for those patterns For high- and very high-calorie patterns, non-CO2 GHGE intensities for crop and livestock were smaller, indicating high-energy input and management strategies make agriculture more productive in developed countries, which were generally associated with higher-calorie patterns Total GHGEs only slightly higher for high- and very high-calorie diets (2.48-6.10 kg CO2eq/d) compared to low- and moderate-calorie diets (1.43-4.48 kg CO2eq/d)	Non-CO2 GHGE intensities were higher for livestock (1.44-13.06 g CO2eq/kcal) than for crops (0.31-1.81 g CO2eq/kcal), indicating that a dietary shift towards consuming fewer animal products would help reduce GHGEs	Low-calorie diets showed a similar emission burden to moderate- and high-calorie diets, which could be explained by a less efficient calorie production per unit of GHGEs in developing countries, which were mainly associated with low-calorie diets Very high-calorie diets were prevalent in developed countries and were associated with high total per-capita GHGEs due to high carbon intensity and high intake of animal products

Sáez-Almendros 2013 Model/ Data Analysis Spain	**4 Diets** (comparable in energy content): - Mediterranean (MDP) - Current Spanish w/ food balance (SCP-FB) - Current Spanish w/ consumption surveys (SCP-CS) - Western (WDP) Mediterranean DP was obtained from the new MDP pyramid Spanish dietary pattern was estimated from the FAOSTAT food balance sheets for 2007, and also independently from the Household Consumption Surveys of the Spanish Ministry of Agriculture, Food and Environment WDP was also obtained from FAOSTAT food balance sheets for 2007	Documented health benefits of Med Diet Pattern (MDP)	**Agricultural land use, 10^3Ha/y:** MDP: 8,365; SCP-FB: 19,874; SCP-CS: 12,342; WDP: 33,162; Current real pressure: 15,400 **Energy consumption, TJ/y** MDP: 239,042; SCP-FB: 493,829; SCP-CS: 285,968; WDP: 611,314; Current real pressure: 229,178 **Water consumption, km^3/y** MDP: 13.2; SCP-FB: 19.7; SCP-CS: 13.4; WDP: 22.0; Current real pressure: 19.4 **GHG emissions, Gg CO_2eq/y** MDP: 35,510; SCP-FB: 125,913; SCP-CS: 72,758; WDP: 217,128; Current real pressure: 62,389 Adherence to MDP: decrease GHG 72% land use 58% energy 52% water 33% Adherence to a WDP: increase all by 12-72%	Animal products contributed significantly to increasing diet pattern footprints Energy consumption: dairy had highest contribution for all diets, followed by meat for WDP, fish for SCP, and vegetables for MDP Water consumption: dairy and vegetable oils both had the highest contribution GHG emissions: meat contributed most for WDP and SPC, while dairy most for MDP For land use: cereals and vegetable oils most after dairy and meat.	The MDP in Spain would reduce GHG (72%), agricultural land use (58%) and energy consumption (52%), and water consumption (33%) Adherence to a WDP would increase all of these between 12% - 72% Adherence to a Mediterranean dietary pattern would make a significant contribution to increasing both food sustainability and the well-known benefits for public health

Scarborough et al., 2012 Modeling/ Data Analysis UK	Baseline diet, plus 3 dietary scenarios from the UK Committee on Climate Change (CCC): • Baseline (Current UK dietary intake based on food purchase data), • Scenario 1 (50% reduction in meat and dairy, replaced by fruit, vegetables, and cereals); • Scenario 2 (75% reduction in red meat, replaced by pigs and poultry); • Scenario 3 (50% reduction in pigs and poultry, replaced by fruits, vegetables, and cereals)	Total deaths delayed or averted per year compared with baseline diet [95% credible interval]: • Scenario 1 - 36,910 [30,192-43,592]; • Scenario 2 - 1,999 [1,739-2,389]; • Scenario 3 - 9,297 [7,288-11,301] CHD, stroke, and cancer mortality DIETRON model used to estimate deaths delayed or averted under each diet	Diet 1: 19% decrease GHG 42% decrease LU Diet 2: 9% decrease GHG 39% decrease LU Diet 3: 3% decrease GHG 4% decrease LU	For Diet 1, increased fruits & vegetables was biggest contributor to deaths delayed Reductions in salt or changes in FAs made smaller contribution	Diet 1 was largest contributor to deaths delayed or averted and largest environmental impact
van Doreen et al., 2014 Modeling/ Data Analysis The Netherlands	**6 dietary patterns:** • Average Dutch • Dutch DG • Semi-Veg • Vegetarian • Vegan • Mediterranean Average Dutch diet based on Dutch National Food Consumption Survey 1998 DDG diet based on the 2006 Dutch Dietary Guidelines for adult women Vegetarian diet replaced meat with eggs, pulses and nuts, and meat substitutes Vegan diet substituted milk with calcium-enriched soy drinks and eggs with pulses Semi-vegetarian, average of DDG + vegetarian diets Mediterranean diet based on the Med pyramid, lower in meat and high in fish, fruits, vegetables, plant oils	**Health scores**: Average Dutch: 75; DDG: 105; semi-vegetarian: 103; vegetarian: 100; vegan: 118; Mediterranean: 122 Omega-3 fish oils were lacking in the vegan and vegetarian diet Compared with the average Dutch diet, all other diets had significant health benefits in terms of reducing chronic disease risk	**Sustainability scores:** Average Dutch: 68; DDG: 90; semi-vegetarian: 98; vegetarian: 109; vegan: 130; Mediterranean: 102 GHG index: Average Dutch: 80 (4.1 CO2e/d); DDG: 90 (3.6 CO2e/d); semi-vegetarian: 96; vegetarian: 102; vegan: 123; Mediterranean: 96 LU index: Average Dutch: 56 (5.34 m^2*y/d); DDG: 89; semi-vegetarian: 100; vegetarian: 115; vegan: 137; Mediterranean: 107	Foods contributing most to GHG emission of the Dutch diet are: meat products (32%), dairy (19%), extras (13%), and drinks (7%) Foods contributing most to LU are: meat (54%), extras (18%), dairy (11%), and drinks (9%) Greatest reduction in GHG and LU can be obtained by reducing consumption of meat, dairy products, extras, and drinks (alcoholic, juices, soft drinks, coffee, and tea), in that order	Compared with the average Dutch diet, a healthy diet that is in compliance with the DDG is likely to result in a higher sustainability score The Mediterranean diet, which had the highest health score, also had a higher sustainability score than the average dutch Diet The diets with the optimal synergy between health and sustainability were those that were oriented in between a health focus and animal protein reduction (eg. semi-vegetarian or pesco-vegetarian)

Vieux et al., 2013 Modeling/ Data Analysis France	Self-selected diets of 1,918 French adults, classified into 4 patterns based on nutritional quality: High, Intermediate+ (I+), Intermediate- (I-), Low Based on indicators of nutritional quality: • MAR = Mean Adequacy Ratio • MER = Mean Excess Ratio • ED = Energy Density	Highest nutrition quality diets have MAR above median, MER and ED below median	Without adjustment, diet-related GHG were not significantly different between the 4 classes for men, but were significantly greater in the High class for women (p<0.0001) After adjusting for diet weight, GHG no longer significantly different across classes for either sex After adjusting for energy intake, high-quality diets were associated with higher GHG for both men and women (+9% and +22%, respectively; P<0.0001 for both)	Ruminant meat associated with the greatest GHG **GHG per 100 g, gCO2e/d** (in decreasing order): ruminant meat (1,627); fish (612); pork, poultry, and eggs (610); mixed dishes (369); fats (342); dairy (283); sweets and salted snacks (197); starches (114); fruit and vegetables (114) **GHGEs per 100 kcal, gCO2e/d** (in decreasing order): ruminant meat (857); fish (517); mixed dishes (312); pork, poultry, and eggs (308); fruit and vegetables (290); dairy (216); sweets and salted snacks (91); starches (61); fats (55)	More nutrient-dense diets were associated with higher levels of GHG, even though they contained more plant-based products Food groups such as sweets and salted snacks were negatively associated with diet-related GHG, while fruits and vegetables were positively associated with diet-related GHG.

Wilson et al 2013 Modeling/ Data Analysis New Zealand	**16 dietary patterns** (4 groups: low-cost, minimize GHG emissions, "relatively healthy", and "more familiar meals") with equivalent in energy and met dietary requirements: • lowest-cost (C1); • low-cost, including porridge and rotis to ensure realistic preparation methods (C2); • low-cost, requiring minimal cooking skills (C3); • low-cost, with relatively high vegetable intake (C4); • lowest GHG emissions, low-cost (G1); • same as G1, with higher cost/day (G2); • same as G2, including porridge as standard meal (G3); • same as G2 but vegan; • Mediterranean style diet (MED); • Mediterranean style diet, but minimizing GHG emissions (MED-G); • Asian style diet (ASIAN); • Asian style diet, but minimizing GHG emissions (ASIAN-G); • More familiar NZ diet, main meal - mince (NZ-M); • More familiar NZ diet, main meal - sausages (NZ-S); • More familiar NZ diet, main meal - fish (NZ-T); • More familiar NZ diet, main meal - Pacific theme (NZ-P)	All diets likely to be healthier than current average NZ diet for preventing non-communicable diseases Compared with the typical NZ dietary pattern, the low-cost and low-GHG optimized dietary patterns provide advantages for cardiovascular disease prevention Benefits included higher PUFA/SFA ratio, less SFA from meat, lower sodium and higher potassium intake High vegetable diets (C4, MED, ASIAN) also provided benefits against colon cancer due to higher fiber intake	**GHG emissions, kg CO2e/d** (asterisk indicates that scenario minimized this variable): C1: 2.72; C2: 2.63; C3: 2.2; C4: 4.33; G1*: 1.67; G1 with NZ GHG values*: 1.39; G2*: 1.31; G3*: 1.56; G4*: 1.9; ASIAN: 4.03; ASIAN-G*: 3.29; MED: 4.68; MED-G*: 2.17; NZ-M: 5.25; NZ-S: 4.54; NZ-T: 4.24; NZ-P: 5.98 Scenario G2 (low GHG, higher cost) associated with the lowest GHG emissions Scenario G4 (low GHG, vegan) had slightly higher GHGs than the other GHG-reduction scenarios "Healthier diets" scenarios, ASIAN-G (Asian diet, low GHG) and MED-G (Mediterranean diet, low GHG) associated with higher GHGs than those that aimed to reduce GHGs without following a healthier diet Increasing dietary variety and acceptability increased the daily cost; however, only 2 scenarios cost more than $7/d, and all scenarios cost less than half the estimated cost of current average NZ diet	Compared with scenario C1 (low-cost), scenario G1 (low-cost, low-GHGs [NZ values]) resulted in: •increases in fruit and vegetable consumption (except carrots), •increases in pulse, seed, and nut consumption (except dry peas), •increases in oat and white flour consumption, but decreases in wholemeal flour and pasta consumption, •increase in whole milk consumption but decrease in milk powder consumption, •increases in vegetable oils including margarine and peanut butter, but decreases in egg and added sugar consumption	All diets that aimed to minimize cost or GHGs were both less expensive and more healthy than the current average NZ diet Low-cost and low-GHG diets were generally complementary, with scenario G2 (low GHG, higher cost) being associated with the lowest GHG emissions "Healthier diets" that minimized GHGs achieved smaller GHG reductions than scenarios that aimed to reduce GHGs without following a healthier diet

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Supplementary Material: Food Components/Individual Foods for Sustainability Studies
High vs Low Sustainable Diets

(*Individual foods provided when reported)*

Study **Dietary Patterns** (High vs Low Sustainable)	**Vegetables**	**Fruits**	**Cereals/Grains**	**Legumes Nuts/Seeds**	**Meat**	**Seafood**	**Beverages**	**Dairy/ Eggs**	**Fats/ Oils**	**Sweets/ Snacks**
Aston 2012 **UK** Counterfactual (combination of lowest RPM + Vegetarian) diet vs current intake British National Diet and Nutrition Survey (NDNS)	**Fruit and vegetables:** Vegetables (1) (Roots, onions, brassicas) Vegetables (2) (All other) Tomato	**Fruit and vegetables:** Fruit	**Starchy staples:** Bread Breakfast Pasta Rice Unprocessed potato Frozen potato Other potato Flour/other grains	**Fruit and vegetables:** Pulses	**Unprocessed Red meat[‡]:** Beef, veal, pork, lamb, other **White Meat** **Processed meat:** Primarily beef **↓Red & Processed Meat (RPM)** **91 -> 53 g/day** (42%) in men **54 -> 30 g/day** (44%) in women	**Fish:** Fresh fish Shell fish Frozen fish	**Beverages:** Soft bev Mineral water Alcoholic bev Fruit juice Coffee Tea Cocoa Tap water	**Dairy/Eggs:** Milk Cheese Ice Cream Eggs	**Fats:** Butter Margarine Cooking oil	**Other:** Crispbread Biscuits Buns/cakes Chocolate/ Sweets Sugar/honey Jam/ Marmalade
Baroni 2009 **Italy** Vegan vs Ave Italian diet Ave Italian (Eurostat, Euromeat, FAO) 'Vegan' defined a plant only diet, which excludes any food of animal origin, such as meat, fish, milk, dairy products and eggs	**Descending order of environmental impact:** Beef Sole fish Fresh cheese Aged cheese Milk Yogurt **Vegetables** Tuna fish Poultry Rice Whole bread White bread Pasta Fruit Crisp bread Jam Sugar	**Descending order of environmental impact:** Beef Sole fish Fresh cheese Aged cheese Milk Yogurt Vegetables Tuna fish Poultry Rice Whole bread White bread Pasta **Fruit** Crisp bread Jam Sugar	**Descending order of environmental impact:** Beef Sole fish Fresh cheese Aged cheese Milk Yogurt Vegetables Tuna fish Poultry **Rice** **Whole bread** **White bread** **Pasta** Fruit Crisp bread Jam Sugar		**Vegan** excluded any type of animal flesh, including meat and fish **↓0 g/day** Beef Poultry	**Vegan** excluded any type of animal flesh**,** including meat and fish **↓0 g/day** Sole fish Tuna fish		**Vegan** excluded any food of animal origin, such as milk, dairy products and eggs **↓0 g/day** Fresh cheese Aged cheese Milk Yogurt		**Descending order of environmental impact:** Beef Sole fish Fresh cheese Aged cheese Milk Yogurt Vegetables Tuna fish Poultry Rice Whole bread White bread Pasta Fruit **Crisp bread** **Jam** **Sugar**

Barosh 2014 Australia H&S basket[§] (based on Australian DGs & environment) vs typical basket (hypothetical household purchases) (weekly)	**Food Group: Vegetables:** Typical – zucchini Sustainable – carrots	**Food Group: Fruit**: Typical –apples Sustainable - oranges	**Food Group: Grains (cereal):** Typical –white bread Sustainable – whole meal	**Food Group: Meats & poultry, fish, eggs, tofu, nuts, and seeds, legumes/beans** No examples of typical vs sustainable choices for tofu, nuts, and seeds, legumes/beans	**Food Group: Meats & poultry, fish, eggs, tofu, nuts, and seeds, legumes/beans** : Typical –beef Sustainable - kangaroo	**Food Group: Meats & poultry, fish** No examples of typical vs sustainable choices for fish		**Food Group: Milk, yogurt, cheese** Typical –cheese Sustainable - yogurt		
de Carvalho 2013 Brazil Red and Processed Meat (RPM) pattern ISA-Capital 2003 study Health Survey for Sao Paulo Multiple Source Method used to model RPM intake					**RPM:** Sum of red meat (beef and pork) and processed meat (cured, salted, smoked or with chemical preservatives) **RPM intake = 106 g/d** 73 g beef 8 g pork 25 g processed meat (High intake = >500g/wk)					
Hendrie 2014 Australia Foundation diet: reduced energy Australian DG diet w/ only core foods vs average Australian diet Australian Nat Nutrition Survey	**Core foods:** ↑Vegetables 331 -> 432 g/d	**Core foods:** ↑Fruit 210 -> 300 g/d	**Core foods**: ↑ Breads/ cereals 244 –> 324 g/d		**Core foods**: ↓ **Red meat** 73 -> 65 g/d ↑ Poultry 35 -> 50 g/d **Non-Core foods:** ↓Processed meats 27 -> 0 g/d	**Core foods**: ↑Fish 24 ->30 g/d	**Non-core foods:** ↓Soft drinks, coffee/tea 298 -> 0 ↓ Alcohol 254 -> 0 g/d	**Core foods**: ↑ Dairy foods 263 -> 408 g/d ↓Eggs 14 -> 8 g/d	**Core foods**: ↑Unsat oils 16 -> 26 g/d **Non-core foods:** ↓SFA 4 -> 0 g/d	**Non-core foods:** ↓Snacks, desserts/ sweets 172 ->0 g/d
Macdiarmid 2012	↑**Fruit & Vegetables:**	↑**Fruit & Vegetables:**	↑**Starchy foods w/**	↑**Legumes:** 385 g/wk	↓**Red Meat:** 392 ->190 g/wk	↑**Fish:** 161 -> 223 g/wk		**Dairy products:**		↓**High-fat and sweet foods:**

UK Sustainable w/ Acceptability Constraints vs average UK diet Diet modeled on UK dietary requirements for adult women National Diet & Nutrition Survey	330 -> 555 g/d Carrots, turnips (cooked) Tomatoes Peas Brassicas Cauliflower, broccoli, spinach Sweet corn Cucumber Lettuce Mushrooms (fried) Onions (fried) Peppers	330 -> 555 g/d Apples, pears Bananas Grapes, kiwi, cherries Peaches, nectarines, apricots Raspberries, strawberries, blueberries Fruit juice	**potatoes:** 2,936 g/wk Pasta, noodles (cooked) Rice (cooked) White bread Whole-grain bread Whole-grain, high-fiber cereals Other cereals Porridge oats Nonfried potato products Potatoes (no added fat)	Beans Baked beans Lentils (cooked) **↑Nuts and seeds:** 35 g/wk Sesame seeds Mixed nuts Beans and	Beef Pork Lamb Chicken 182 g/wk	White fish Shellfish Oily fish		2,366 g/wk Skim milk Other cheese (reduced fat) Yogurt (low fat) ↓Eggs 119 g/wk		735 g/wk Biscuits Buns, cakes, pastries Desserts Low-fat spread Fried, roasted potatoes Crisps, savory snacks Sugar Chocolate Preserves
Meier & Christen, 2013 Germany Lacto-ovo or Vegan vs average German diet National Nutrition Surveys (NNS) I & II (NNS II shown) Lacto-ovo or Vegan from USDA food patterns	**↑Vegetables:** 231 -> 245 g/d ↑Potato products 80 -> 107 g/d	**↓Fruit:** 347 -> 250 g/d	**↑Grains:** 278 -> 295 g/d	**↑Legumes:** 124 or 128 g/d **↑Nuts/Seeds** 3 -> 21 or 26 g/d	**↓Meat:** 103 -> 0 g/d beef, veal pork poultry other meat	**↓Fish:** 25 -> 0 g/d		**↓Butter** 12-> 8 or 0 g/d **↑Dairy** 253-> 732 or 0 g/d **↑Vegan milk products:** 0 -> 0 or 732 g/d **↓Egg products:** 18-> 16 or 0 g/	**↑Vegetable oils,margarine** 15-> 27 or 34 g/d	**↓Sugar:** 70 -> 32 g/d
Peters 2007 US 42 diets from 0 - 381 g/d meat and eggs and 20 - 45% fat calories NE US Food Commodity Intake Database Food Guide	**Vegetables:** Meet or exceed recommendations (unless total kcal limit would be exceeded) USDA Food Guide Pyramid	**Fruit:** Meet or exceed recommendations (unless total kcal limit would be exceeded) USDA Food Guide Pyramid	**Grains:** Meet or exceed recommendations (unless total kcal limit would be exceeded) USDA Food Guide Pyramid	**Pulses:** Meets recommendation	**↓Meat:** 7 different quantities of cooked meat and eggs, ranging from 0-381 g/d in 63.5 g/d increments Beef, pork, chicken Low fat – lean cuts High fat – all cuts			**Dairy:** Meets recommendation **Dairy:** Low fat - Milk, skim High fat - Milk, whole	**Fat:** 6 different levels of fat, ranging from 20-45% total calories, in 5% increments	**Sugar:** Limited to 10% of total kcal

Pyramid recommended servings					**Most Sustainable: Lowest meat and eggs (0 g/d)** at all 3 fat intake levels					
Pimentel & Pimentel, 2003 US Lacto-ovo vegetarian diet vs meat-based FAOSTAT Lacto-ovo estimated	**↑Vegetables:** 239 ->286 kg/y	**↑Fruit:** 109 ->112 kg/y	**↑Food grain:** 114 ->152 kg/y	**↑Legumes:** 4.3 ->7.5 kg/y **↑Nuts:** 3.1 ->4.0 kg/y	**↓Meat:** 124 ->0 kg/y Lamb Beef cattle Swine Turkeys Broilers	**↓Fish:** 20 ->0 kg/y		**↑Dairy Products:** Dairy (milk) 256 ->307kg/y **↑Eggs:** 14.5 ->19.2 kg/y	**↑Vegetable oils:** 24 ->25 kg/y **Animal fats** 6.7 ->6.7 kg/y **↑Oil crops:** 6 -> 8 kg/y	**Sugars & sweeteners:** 74 ->74kg/y
Pradham 2013 Global Low energy diet vs. Very high energy diet (per capita intake 1870 - >3400 kcal/day (from 16 DP in 4 categories: low, mod, high, and very high kcal diets) FAOSTAT	**Low energy diet[¶]:** < 2,100 kcal/cap/day >50% cereals (pattern#1) or > 70% starchy roots, cereals, and pulses (pattern #3) <10% animal products				**Very high energy diets[‡‡]:** >2,800 kcal/cap/day, high amount of meat and alcohol (pattern #14 & 15)					
Sáez-Almendros 2013 Spain Mediterranean Dietary Pattern (MDP) vs Western DP (WDP) MDP: from Updated	**↑Vegetables:** 49 -> 269 kg/y MDP: ≥ 2 serv/ meal Variety of colors/textures	**↑Fruit:** 111 -> 175 kg/y MDP: 1-2 serv/ meal Variety of colors/textures	**↓Cereals/Grain:** 112 -> 75 kg/y MDP: 1-2 serv/meal (Preferably whole grain)	**Legumes:** MDP: >2 serv/wk **Nuts** **Seeds** **Olives:** MDP: 1-2 serv/d	**↓Meat:** 133 -> 16 kg/y MDP: Red meat <1 serv/wk Processed meat <1 serv/wk	**Fish:** 54 -> 14 kg/y MDP: >2 serv/wk	**↓Dairy:** 254 -> 71 kg/y MDP: 2 serv/d (lowfat) **Eggs:** MDP: 2-4 serv/wk		**Vegetable oils and fats:** 29 -> 11 kg/y MDP: Olive oil 1-2 serv/meal .	**↓Sweets:** 68 -> <1% kg/y MDP: <2 serv/wk

Mediterranean Diet Pyramid (2011) WDP: from US food pattern & FAOSTAT										
Scarborough 2012 UK Diet Scenario 1 vs 3 (% 2005 levels ave UK diet) Level of substitution based on food energy at the commodity level from UK food data	**Scenario 1:** ↓Milk & eggs - 60% ↓All Meat - 36% ↓Sugar - 70% ↑Vegetables/ fruits -160% ↑Cereals/ potatoes -133% ↑Vegetable oils (not palm) - 133% Other groups - 100%				**Scenario 3:** Milk and eggs- 100% Cow & sheep- 100% ↓Pig & poultry- 50% ↓Sugar-90% ↑Vegetable/ fruits -110% ↑Cereals/ potatoes -110% ↑Vegetable oils (not palm) - 110% Other groups - 100%					
van Doreen 2014 Netherlands Vegan or Mediterranean vs average Dutch (g/day) Dutch National Food Consumption Survey Vegan: ADA 2009 Mediterranean: Updated Mediterranean Diet Pyramid (2011)	↑**Vegetables**: 127 ->400 or 300 g/d Fresh Other	↑**Fruit:** 103->200 or 250 g/d	↑**Breads:** 119 ->210 g/d ↑**Grain products:** 51 ->53 or 100 g/d **Potatoes:** 101 ->105 or 25 g/d	↑**Pulses:** 4 ->21 or 75 g/d	↓**Meat, meat products, poultry:** 102 ->0 or 30 g/d ↑**Soy products & meat substitutes:** 2 -> 43 or 4 g/d	↑**Fish:** 9 ->0 or 37 g/d **Mediterranean Diet:** lower in meat, high in fish, fruits, and vegetables, w/ fewer extras, and plant oils instead of animal fats	↑**Drinks**: Non-alcoholic: 1,487-> 1,500 ml/d Alcoholic: 94 ->150 g/d	↓**Dairy:** Milk & milk products 332 ->0 or 300 g/d **Eggs:** 13 -> 0 or 29 g/d **Soy drink:** 0 ->450 or 0 g/d **Vegan diet:** milk replaced by calcium-enriched soy drinks. Protein similar to vegetarian, but eggs replaced by extra portion of pulses. Vegetables increased 200 g	**Oils & Fats**: 46 ->45 g/d ↓Butter 3->0 g/d	↓**Other** (extras) 859 ->300 or 200g/d

								w/ calcium rich		
Vieux 2013 France Dietary patterns w/ indicators of nutritional quality National Survey on Food Consumption	**Fruit and vegetables** (including fruit juices and nuts) **Most sustainable on weight basis**	**Fruit and vegetables** (including fruit juices and nuts) **Most sustainable on weight basis**	**Starchy foods** (refined grains and unrefined starches such as whole grains, potatoes, and legumes) **Most sustainable on weight basis**		**Ruminant meat** (beef and lamb): **Least sustainable on weight basis** Pork, poultry, and eggs (including pork meat and deli meat such as bacon/sausage) :	**Fish** (including shellfish)	**Drinks** (including water, alcohol, and hot and light drinks)	**Dairy products** (milk, fresh dairy products, and cheese)	**Fats** (animal and vegetable)	**Sweets and salted snacks** (including sweet drinks)
Wilson 2013 New Zealand Scenario G2 – minimize GHG + achieve nutrient levels w/ low (not lowest) cost vs Average NZ diet NZ Adult Nutrition Survey (NZANS) (men) + Diet scenarios∞ (16 DPs)	**↓Fruit and vegetables:** ↓Potatoes 255 ->0 or 52 g/d ↓Carrots 97 ->52 g/d ↓Brocolli 18 -> 0 g/d ↓Peas (frozen) 24 -> 0 g.d	**↓Fruit and vegetables:** ↓Kiwifruit 29 ->16 g/d ↓Sultanas 2 ->0 g/d ↓Oranges 50 -> 0 g/d	**Cereals and grains:** ↑Oats (wholegrain) 14 ->81 g/d ↓Flour (wholemeal) 3 ->0 g/d ↓White flour 6 -> 0 g/d	**↑Pulses, seeds and nuts:** Sunflower seeds 210 g/d Peanuts 180 g/d	**↓Meat:** **↓Beef:** 35 ->0 g/d **↓Poultry:** 61 ->0 g/d **↓Processed meat:** 136 ->0 g/d	**↓Fish:** 65 ->0 g/d		**Dairy products**: ↑Milk powder 4 -> 22 g/d ↓Milk (whole, homogenized) 271 ->0 g/d **↓Eggs:** 43 ->0 g/d	**↑Veg oil:** 60 g/d **↓Margarine:** 13 -> 0 g/d	**↓Added sugars** 22 -> 0 g/d

‡Red meat as beef, veal, pork, lamb, mutton and goat, either fresh, minced (including hamburgers) or frozen, but unprocessed other than by cooking with heat. Although processed meats were primarily red meats, the term 'red meat' was used to refer to 'unprocessed red meat'. White meat as meat from poultry, fresh, minced or frozen, but unprocessed other than by cooking with heat. Processed meat as meat preserved by smoking, curing, salting or addition of nitrates, nitrites or other preservatives. Under this definition, processed meats were primarily red, but included white meats, and included ham, bacon, pastrami, salami, sausages and processed deli or luncheon meats.

§ The H&S diet was based on three overarching principles: (i) any food that is consumed above a person's energy requirement represents an avoidable environmental burden in the form of greenhouse gas emissions, use of natural resources and pressure on biodiversity; (ii) reducing the consumption of discretionary food choices, which are energy-dense and highly processed and packaged, reduces both the risk of dietary imbalances and the use of environmental resources; and (iii) a diet comprising less animal- and more plant-derived foods delivers both health and ecological benefits.

¶Countries characterized by high calorie diets exhibit a production mode that needs high fossil energy inputs (1,800– 3,500 kcal/cap/day). In countries with low calorie diets, the energy input can be as low as 80–150 kcal/cap/day. But non-CO2 GHG emission intensities are relatively high for low and the moderate calorie diets. Therefore, total GHG emissions are only slightly higher for high and very high calorie diets (2.48–6.10 kg CO2eq./cap/day) compared to low and moderate calorie diets (1.43–4.48 kg CO2eq/cap/day).

∞Obtained data on a wide range of individual food items and optimized towards a diet meeting nutritional requirements ("bottom-up" approach).

Supplementary Material: Search Plan and Results—Dietary Patterns & Sustainability

Search Strategy

Dates Searched: 02/20/2014 – 02/21/2014

Databases: Pubmed, Embase, Cochrane, Navigator

Year Range: 01/2000 – 02/2014

Search Terms and Dates): Total: 1685 (+ 5 dupes = 1690)

PubMed 1449 hits; 2/20/2014

(environmental footprint* OR Carbon Footprint*[tiab] OR environmental impact* OR food security* OR food insecurity* OR "Conservation of Natural Resources"[Mesh] OR "Greenhouse Effect"[Mesh] OR "Carbon Footprint"[Mesh] OR "Environmental Monitoring"[Mesh] OR ((environment*[tiab] OR food[major:noexp] OR food[ti] OR diet[major]) AND sustainab*[tiab])) OR ("Conservation of Natural Resources"[major:noexp] OR "Greenhouse Effect"[major:noexp] OR "Carbon Footprint"[major:noexp] OR
"Environmental Monitoring"[major:noexp]) OR ("Ecosystem"[Mesh] OR ecological system*[tiab] OR greenhouse*[tiab] OR "Ecosystem"[major] OR ecological system*[tiab] OR greenhouse*[tiab] OR “land use”[tiab] OR “water use”[tiab])
Eng/hum AND ("Study Characteristics" [Publication Type] OR “clinical trial”[ptyp] OR "Epidemiologic Studies"[Mesh] OR "Support of Research"[ptyp]) NOT (editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR letter[ptyp] OR review[ptyp])

Embase 170; 2/20/2014

(MedDietScore OR adequacy index* OR kidmed OR “healthy eating index”) OR
((index OR score OR scoring) NEAR/3 ('diet quality' OR dietary OR nutrient* OR eating OR food OR dieti)):ti,ab
OR
(‘diet quality’ OR 'eating habit'/exp OR 'Mediterranean diet'/exp OR nordiet:ti,ab OR ‘nordic diet’:ti,ab OR DASH:ti,ab OR ‘dietary approaches to stop hypertension’:ti,ab OR vegan*:ab,ti OR vegetarian*:ab,ti OR 'vegetarian diet'/exp OR 'vegetarian'/exp OR ‘prudent diet’:ti,ab OR ‘western diet’:ti,ab OR omniheart:ti,ab OR omni:ti OR ‘plant based diet’) OR ((dietary OR eating OR food OR diet) NEAR/2 (pattern? OR habit? OR profile? OR recommendation? OR guideline?)) OR (('ethnic, racial and religious groups'/exp or Okinawa* OR ‘mediterranean') AND (diet/exp OR eating/exp OR 'food intake'/de))
AND
'environmental sustainability'/exp OR 'food security'/exp OR 'carbon footprint'/exp OR 'human impact (environment)'/exp OR 'greenhouse effect'/exp OR 'ecosystem'/de OR 'land use'/de OR 'plant water use'/exp OR (food NEAR/5 sustainab*) OR 'food insecurity'/exp OR ‘environmental impact’ OR (environment* NEAR/2 footprint) OR diet* NEAR/5 sustainab* AND [humans]/lim AND [english]/lim AND [embase]/lim
NOT [medline]/lim

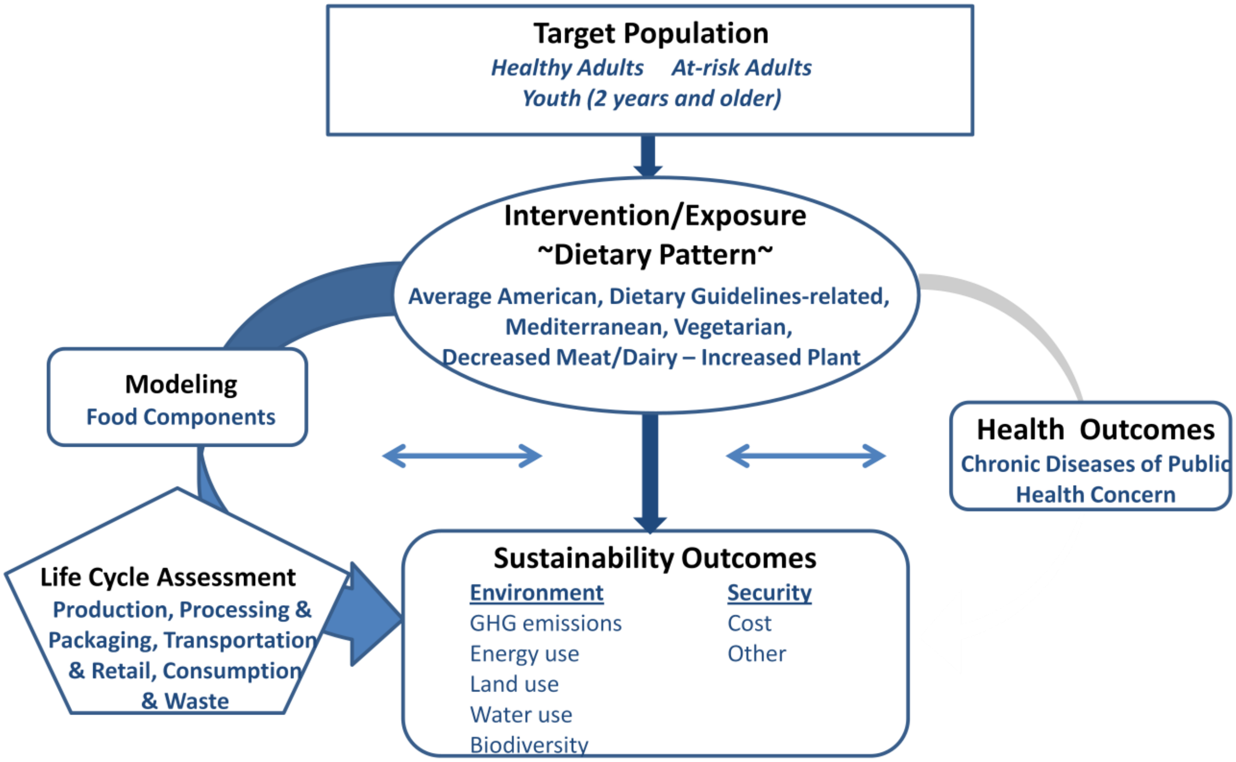
Cochrane 8; 2/21/2014

(“diet quality” OR (dietary NEXT guideline*) OR (dietary NEXT recommendation*) OR ((food OR eating OR diet OR dietary) NEAR/3 (pattern OR profile OR habit)) OR (eating NEXT style*) OR (“dietary approaches to stop hypertension” OR vegan* OR vegetarian* OR “prudent diet” OR “western diet” OR nordiet OR “Nordic diet” OR omniheart OR "Optimal Macronutrient Intake Trial to Prevent Heart Disease" OR ((asia* OR western OR Okinawa* OR “plant based” OR Mediterranean OR DASH) AND (diet* OR food))) OR ((Index OR score OR indices OR scoring) NEAR/3 (dietary OR diet OR food OR eating)) OR “adequacy index” OR kidmed OR MedDietScore)
AND
((Food OR environment* OR diet) NEAR/4 (sustainab*)) OR ((carbon OR environment*) NEAR/2 footprint) OR “food insecurity” OR “food security” OR (greenhouse NEAR/1 effect*) OR (“greenhouse gas” NEAR/1 emission*) OR “land use” OR “water use”

Navigator (FSTA/BIOSIS/CAB Abstracts) 63; 2/21/2014

(MedDietScore or "adequacy index" or kidmed or ((index or score) near/2 (("diet quality") or dietary or nutrient* or eating or food or diet)) or ((Diet or dietary or eating or food) near/2 (pattern* or profile* or habit* or guideline* or recommendation*) or "diet quality") or “dietary approaches to stop hypertension” or vegan* or vegetarian* or "prudent diet" or "western diet" or omniheart or "Optimal Macronutrient Intake Trial to Prevent Heart Disease" or nordiet or “Nordic diet” OR ((Okinawa* or asia* or Chinese or japan* or Hispanic* or ethnic or "plant based" or title:omni or title:Mediterranean or DASH) near/3 (title:diet* or abstract:diet*)))
AND
((Food OR environment* OR diet) NEAR/4 sustainab*) OR ((carbon OR environment*) NEAR/2 footprint) OR “food insecurity” OR “food security” OR (greenhouse NEAR/1 effect*) OR (“greenhouse gas” NEAR/1 emission*) OR “land use” OR “water use”

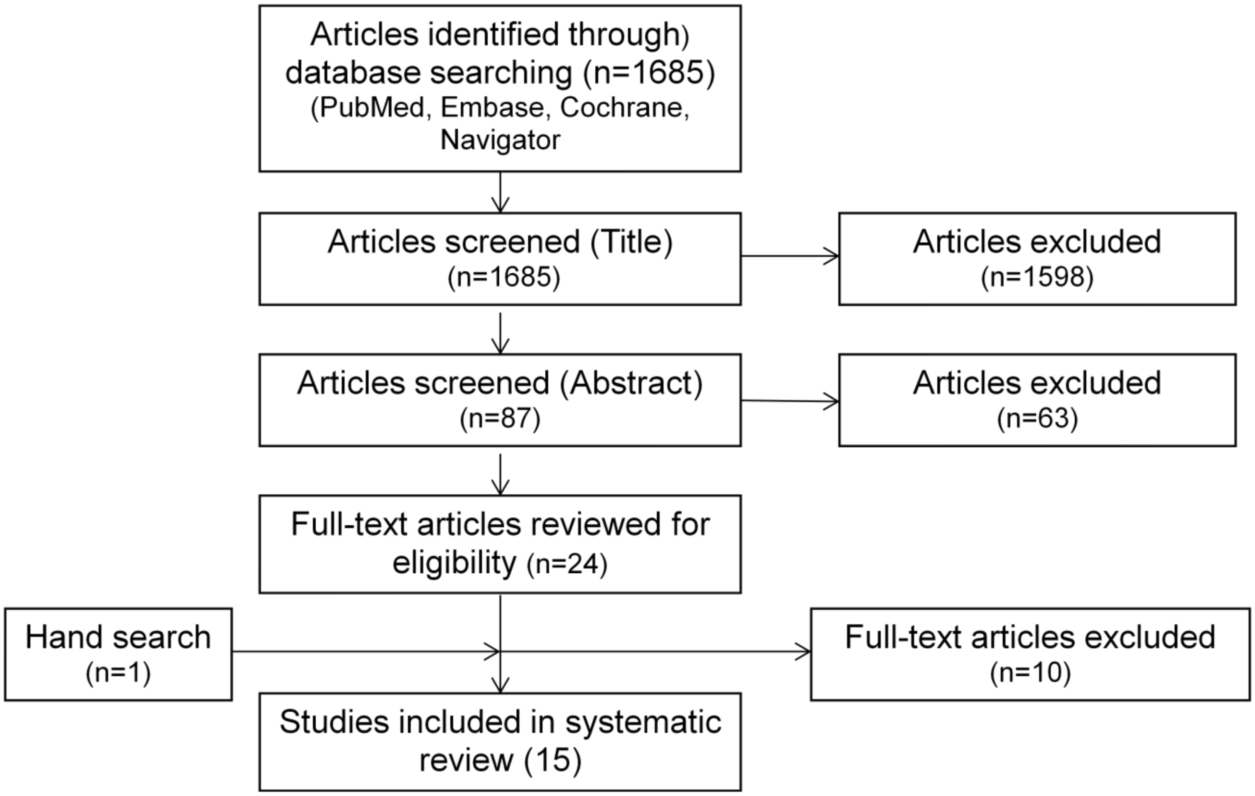
Analytical Framework



Inclusion Criteria

PubMed, Cochrane, Embase, and Navigator were searched for original research articles published in English in peer-reviewed journals. Studies published since January 2000 with subjects who were healthy or at elevated chronic disease risk from countries with high or very high human development were considered. Study designs included in the review were randomized and non-randomized controlled trials, prospective cohort studies, cross-sectional studies, before and after studies, and case-control studies. Only systematic reviews, meta-analyses, and narrative reviews were excluded. Trials were required to have ≥10 subjects per arm and a follow-up of ≥80%. Studies that examined low-calorie diets and other treatment diets were excluded. Finally, studies were required to include a description of the dietary pattern along with sustainability or food security outcomes.

Search Results



Included Articles

The following articles have been determined to be relevant for inclusion in the body of evidence:

1. Aston LM,Smith JN,Powles JW. Impact of a reduced red and processed meat dietary pattern on disease risks and greenhouse gas emissions in the UK: a modelling study. BMJ Open. 2012. 2:#pages#. PMID:22964113. Department of Public Health and Primary Care, Cambridge, Institute of Public Health, University of Cambridge, Cambridge, UK.
2. Baroni L,Cenci L,Tettamanti M,Berati M. Evaluating the environmental impact of various dietary patterns combined with different food production systems. Eur J Clin Nutr. 2007. 61:279-86. PMID:17035955. Department of Neurorehabilitation, Villa Salus Hospital, Mestre-Venice, Italy.
3. Barosh L,Friel S,Engelhardt K,Chan L. The cost of a healthy and sustainable diet - who can afford it?. Aust N Z J Public Health. 2014. 38:7-12. PMID:24494938. National Centre for Epidemiology and Population Health, Australian National University, Australian Capital Territory.
4. de Carvalho AM,Cesar CL,Fisberg RM,Marchioni DM. Excessive meat consumption in Brazil: diet quality and environmental impacts. Public Health Nutr. 2013. 16:1893-9. PMID:22894818. Department of Nutrition, School of Public Health, University of Sao Paulo, Sao Paulo, SP, Brazil.
5. Hendrie GA,Ridoutt BG,Wiedmann TO,Noakes M. Greenhouse gas emissions and the Australian diet--comparing dietary recommendations with average intakes. Nutrients. 2014. 6:289-303. PMID:24406846. Animal, Food and Health Sciences, Commonwealth Scientific Industrial Research Organisation (CSIRO), P.O. BOX 10041, Adelaide 5000, Australia. gilly.hendrie@csiro.au. Animal, Food and Health Sciences, Commonwealth Scientific Industrial Research Organisation (CSIRO), P.O. BOX 10041, Adelaide 5000, Australia. brad.ridoutt@csiro.au. Animal, Food and Health Sciences, Commonwealth Scientific Industrial Research Organisation (CSIRO), P.O. BOX 10041, Adelaide 5000, Australia. t.wiedmann@unsw.edu.au. Animal, Food and Health Sciences, Commonwealth Scientific Industrial Research Organisation (CSIRO), P.O. BOX 10041, Adelaide 5000, Australia. manny.noakes@csiro.au.
6. Macdiarmid JI,Kyle J,Horgan GW,Loe J,Fyfe C,Johnstone A,McNeill G. Sustainable diets for the future: Can we contribute to reducing greenhouse gas emissions by eating a healthy diet?. Am J Clin Nutr. 2012. 96:632-9. PMID:22854399. Rowett Institute of Nutrition and Health, University of Aberdeen, Aberdeen, UK. j.macdiarmid@abdn.ac.uk
7. Meier T,Christen O. Environmental impacts of dietary recommendations and dietary styles: Germany as an example. Environ Sci Technol. 2013. 47:877-88. PMID:23189920. Institute of Agricultural and Nutritional Sciences, Martin-Luther-University Halle-Wittenberg, Betty-Heimann-Strasse 5, 06120 Halle (Saale), Germany. toni.meier@nutrition-impacts.org
8. Peters CJ,Wilkins JL,Fick GW. Testing a complete-diet model for estimating the land resource requirements of food consumption and agricultural carrying capacity: The New York State example. Renewable agriculture and food systems. 2007. 22:145-153.
9. Pimentel D,Pimentel M. Sustainability of meat-based and plant-based diets and the environment. Am J Clin Nutr. 2003. 78:660S-663S. PMID:12936963. Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY 14853, USA. dp18@cornell.edu
10. Pradhan P,Reusser DE,Kropp JP. Embodied greenhouse gas emissions in diets. PLoS One. 2013. 8:e62228. PMID:23700408. Potsdam Institute for Climate Impact Research, Potsdam, Germany. pradhan@pik-potsdam.de
11. Saez-Almendros S,Obrador B,Bach-Faig A,Serra-Majem L. Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet. Environ Health. 2013. 12:118. PMID:24378069. Department of Clinical Sciences, University of Las Palmas de Gran Canaria, Luis Pasteur s/n, Las Palmas de Gran Canaria 35016, Spain. lserra@dcc.ulpgc.es.
12. Scarborough P,Allender S,Clarke D,Wickramasinghe K,Rayner M. Modelling the health impact of environmentally sustainable dietary scenarios in the UK. Eur J Clin Nutr. 2012. 66:710-5. PMID:22491494.

British Heart Foundation Health Promotion Research Group, Department of Public Health, University of Oxford, Oxford, UK. peter.scarborough@dph.ox.ac.uk
13. van Dooren, C.; Marinussen, Mari; Blonk, Hans; Aiking, Harry; Vellinga, Pier. Food Policy. Feb2014, Vol. 44, p36-46. 11p.
14. Vieux F,Soler LG,Touazi D,Darmon N. High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults. Am J Clin Nutr. 2013. 97:569-83. PMID:23364012. Institut National de Recherche Agronomique UR 1303, Ivry sur Seine, France.
15. Wilson N,Nghiem N,Ni Mhurchu C,Eyles H,Baker MG,Blakely T. Foods and dietary patterns that are healthy, low-cost, and environmentally sustainable: a case study of optimization modeling for New Zealand. PLoS One. 2013. 8:e59648. PMID:23544082. Department of Public Health, University of Otago, Wellington, Wellington South, New Zealand. nick.wilson@otago.ac.nz

Excluded Articles

The table below lists the excluded articles with at least one reason for exclusion, but may not reflect all possible reasons.

Excluded Citations	Study design excluded	Low or medium HDI country	Does not assess independent variable/exposure as defined	Outcomes of interest not studied
1. Beeton R. Sustainably managing food production resources to maximise human nutritional benefit. Asia Pac J Clin Nutr. 2003. 12:S50. PMID:15023667. #Author Address#	Review			
2. Bere E,Brug J. Towards health-promoting and environmentally friendly regional diets - a Nordic example. Public Health Nutr. 2009. 12:91-6. PMID:18339225. Faculty of Health and Sport, University of Agder, Serviceboks 422, 4604 Kristiansand, Norway. elling.bere@uia.no				X
3. Boer JD,Schosler H,Aiking H. "Meatless days" or "less but better"? Exploring strategies to adapt Western meat consumption to health and sustainability challenges. Appetite. 2014. #volume#:#pages#. PMID:24530654. Institute for Environmental Studies, VU University, Amsterdam, The Netherlands. Electronic address: joop.de.boer@vu.nl. Institute for Environmental Studies, VU University, Amsterdam, The Netherlands.	X			X
4. Burlingame B,Dernini S. Sustainable diets: the Mediterranean diet as an example. Public Health Nutr. 2011.				

14:2285-7. PMID:22166185. Nutrition and Consumer Protection Division, FAO, Viale delle Terme di Caracalla, Rome, Italy.	Review			
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Appendix E-2.38: Evidence Portfolio

Part D. Chapter 5: Food Sustainability and Safety

Seafood and Sustainability

SYSTEMATIC REVIEW QUESTION 1: What are the comparative nutrient profiles of current farm-raised versus wild caught seafood?

Conclusion Statement: For commonly consumed fish species in the United States, such as bass, cod, trout, and salmon, farmed-raised fish have as much or more of the omega-3 fatty acids EPA and DHA as the same species captured in the wild. In contrast, farmed low-trophic species, such as catfish and crawfish, have less than half the EPA and DHA per serving than wild caught, and these species have lower EPA and DHA regardless of source than does salmon. Farm-raised fish have higher total fat than wild caught. Recommended amounts of EPA and DHA can be obtained by consuming a variety of farm-raised fish, especially high-trophic species, such as salmon and trout.

Not Graded

Key Findings:

- The U.S. population should be encouraged to eat a wide variety of seafood that can be wild caught or farmed, as they are nutrient dense foods that are uniquely rich sources of healthy fatty acids.
- It should be noted that low trophic fish such as catfish and crayfish have lower EPA and DHA levels than wild-caught.
- Nutrient profiles in popular low trophic level farmed species should be improved through feeding and processing systems that produce and preserve nutrients similar to those delivered by wild capture in the same species.

Background

The terms “seafood” and “fish” are used interchangeably in this report to refer to animal-based foods harvested from aqueous environs. There are more than 500 species in the major groups commonly referred to as finfish, shellfish, and crustaceans and thus generalizations to all seafood must be made with caution. Seafood is recognized as an important source of key macro- and micronutrients. The health benefits of seafood, including optimal neurodevelopment and prevention of cardiovascular disease, are likely due in large part to long-chain n-3 polyunsaturated fatty acids (PUFA), docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), although fish are good sources of other nutrients including protein, selenium, iodine, vitamin D, and choline (FAO/WHO report). Currently, seafood production is in the midst of rapid expansion to meet growing worldwide demand, but the collapse of some fisheries due to overfishing in past decades raises concerns about the ability to produce safe and affordable seafood to supply the population and meet current dietary intake recommendations of 8 ounces per week. Capture fisheries (wild caught) production has stabilized in the proportion of fully exploited stocks, and this is due in part to national and international efforts to fish sustainably, e.g., the U.S. Magnuson-Stevens Fishery Conservation and Management Act (2006) mandating annual catch limits, managed by the U.S. National Oceanographic and Atmospheric Administration. In contrast, the increased productivity of worldwide aquaculture (farm-raised) is expected to continue and will play a major role in expanding the supply of seafood (FOA/WHO report). Growing aquaculture has the potential to provide for Americans consuming the recommended amount of seafood, without running out of the recommended amounts (NOAA). Productivity gains should be implemented in a sustainable manner with attention to maintaining or enhancing the high nutrient density characteristic of captured seafood. Consistent with this, finfish aquaculture is more sustainable that terrestrial animal production in terms of GHG emissions and land/water use (Hall et al 2011; Bouman et al 2013). Currently, the US imports the majority of its seafood (~90%), and approximately half of that is farmed (NOAA).

Description of the Evidence

The USDA-Agricultural Research Service (ARS) National Nutrient Database (NND) for Standard Reference, Release 27 was used to address this question (http://www.ars.usda.gov/ba/bhnrc/ndl). The section on finfish and shellfish products included nutrient profiles for both farm-raised and wild-caught seafood for some species. This data was augmented using a USDA-funded report on fatty-acid profiles of commercially available fish in the US that assessed more farmed species and compared results with the USDA-ARS NND (Cladis 2014).

The NND provides nutrient profiles for six seafood species with data on both wild-caught and farm-raised versions: four finfish (Rainbow Trout, Atlantic and Coho Salmon, catfish), eastern Oysters, and mixed species crayfish. Data from both sources on different species comparisons is compiled in Figure A. Key nutrients EPA and DHA are on average comparable or greater for farmed trout, salmon, and oysters than for wild capture. On the other hand, low trophic level species catfish and crayfish, when farmed, were lower in EPA and DHA compared to wild capture (Figure A, *). In general, wild low trophic species have lower EPA and DHA than carnivorous fish but those harvested by wild capture have EPA and DHA that support existing DGAC recommendations for consumption of a variety of fish. Cladis et al (Cladis 2014) determined EPA and DHA levels for five finfish (rainbow trout, white sturgeon, chinook salmon, Atlantic cod, striped bass) and presents similar results for these carnivorous species.

SYSTEMATIC REVIEW QUESTION 2: What are the comparative contaminant levels of current farm-raised versus wild caught seafood?

Conclusion Statement: The DGAC concurs with the Joint WHO/FA) Consultancy that, for the majority of commercial wild and farmed species, neither the risks of mercury nor organic pollutants outweigh the health benefits of seafood consumption, such as decreased cardiovascular disease risk and improved infant neurodevelopment. However, any assessment evaluates evidence within a time frame and contaminant composition can change rapidly based on the contamination conditions at the location of wild catch and altered production practices for farmed seafood.

DGAC Grade: Moderate

Key Findings

- Based on risk/benefit comparisons, either farmed or wild-caught seafood are appropriate choices to consume to meet current Dietary Guidelines for Americans for increased seafood consumption.
- The DGAC supports the current FDA and EPA recommendations that women who are pregnant (or those who may become pregnant) and breastfeeding should not eat certain types of fish—tilefish, shark, swordfish, and king mackerel—because of their high methyl mercury contents.
- ttention should be paid to local fish advisories when eating fish caught from local rivers, streams, and lakes.

Description of the Evidence

To address the question, the DGAC used the Report of the Joint United Nations Food and Agriculture Organization/World Health Organization Expert Consultation on the Risks and Benefits of Fish Consumption, Rome, 25–29 January 2010. FAO Fisheries and Aquaculture Report No. 978

The Report of the FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption was used to address this question. This report was chosen as the most current and comprehensive source on contaminants in wild-caught and farm-raised fish, and the DGAC focused on data that addressed the specific comparison between the two. The sections of the report that were used to address the question were “Data on the composition of fish” and “Risk-benefit comparisons.” The consultancy took a net effects approach, balancing benefits of seafood, especially benefits associated with EPA and DHA, against the adverse effects of mercury and persistent organic pollutants (POPs), including polychlorinated biphenyls, polychlorinated dibenzo-*p*-dioxins, and polychlorinated dibenzofurans, collectively referred to as dioxins. The Expert Consultancy compiled EPA and DHA, mercury, and dioxins compositional data from national databases of the United States, France, Norway, and Japan, as well as an international database. Together, these provided information on total fat, EPA and DHA, total mercury, and dioxins for a large number of seafood species, including three farmed and wild species (salmon, rainbow trout, and halibut). Two specific outcomes were considered for risk/benefit: 1) prenatal exposure and offspring neurodevelopment, and 2) mortality from cardiovascular diseases and cancer.

Overall, for the species examined, levels of mercury and dioxins were in the same range for farmed and wild fish. Related to risk/benefit, at the same level of mercury content (lowest [≤ 0.1 mg/g] and 2nd lowest [0.1 - 0.5 mg/g] levels), farmed fish had the same or higher levels of EPA and DHA as wild-caught. At the same level of dioxin content (2nd lowest [0.5 – 4 pg toxic equivalents (TEQ)/g] level), farmed fish had the same or higher levels of EPA and DHA as wild-caught. Only wild-caught Pacific salmon had the lowest level of dioxins (<0.5 pg TEQ/g). Overall, the quantitative risk/benefit analysis was not different for farmed compared to wild-caught fish. For both, using the central estimate for benefits of DHA and for harm from mercury, the neurodevelopmental risks of not eating fish exceeded the risks of eating fish. Similarly, for coronary heart disease (CHD) in adults, there were CHD mortality benefits from eating fish and CHD risks from not eating fish, except for fish in the highest dioxin category and lowest EPA and DHA category, which did not include any of the farm-raised species considered.

Albacore tuna, produced only from wild marine fisheries, is a special case of a popular fish highlighted by the 2004 FDA and EPA advisory.[61, 62] For all levels of intake including more than double the 12 ounces per week recommendation, all evidence was in favor of net benefits for infant development and CHD risk reduction.

Limitations in the evidence included the small number of farmed and wild seafood species comparisons considered by the Expert Consultancy, and the possibility of rapid change that may occur in the concentration of contaminants locally. In addition, seafood contaminants are closely linked to levels of contaminants in feed.

For additional details on this body of evidence, visit: *Report of the Joint Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) Expert Consultation on the Risks and Benefits of Fish Consumption, 2011*. http://www.fao.org/docrep/014/ba0136e/ba0136e00.pdf

SYSTEMATIC REVIEW QUESTION 3: What is the worldwide capacity to produce farm-raised versus wild-caught seafood that is nutritious and safe for the U.S. population?

Conclusion Statement: The DGAC concurs with the FAO report that consistent evidence demonstrates that capture fisheries increasingly managed in a sustainable way have remained stable over several decades. However, on average, capture fisheries are fully exploited and their continuing productivity relies on careful management to avoid over-exploitation and long-term collapse.

DGAC Grade: Strong

The DGAC endorses the FAO report that capture fisheries production plateaued around 1990 while aquaculture has increased since that time to meet increasing demand. Evidence suggests that expanded seafood production will rely on the continuation of a rapid increase in aquaculture output worldwide, projected at 33 percent increase by 2021, which will add 15 percent to the total supply of seafood.[20] Distributed evenly to the world's population, this capacity could in principle meet DGA recommendations for consumption of at least 8 ounces of seafood per week. Concern exists that the expanded capacity may be for low-trophic level fish that have relatively low levels of EPA and DHA compared to other species. Under the current production, Americans who seek to meet U.S. Dietary Guidelines recommendations must rely on significant amounts of imported seafood (~90%).

DGAC Grade: Moderate

Key Findings

- Both wild and farmed seafood are major food sources available to support DGAC recommendations to regularly consume a variety of seafood.
- Responsible stewardship over environmental impact will be important as farmed seafood production expands.
- Availability of these important foods is critical for future generations of Americans to meet their needs for a healthy diet.
- Therefore, strong policy, research, and stewardship support are needed to increasingly improve the environmental sustainability of farmed seafood systems.
- From the standpoint of the dietary guidelines this expanded production needs to be largely in EPA and DHA rich species and supporting production of low-trophic level species of similar nutrient density as wild-caught.

Description of the Evidence

The DGAC used the United National (UN) Food and Agriculture Organization (FAO) report on *The State of World Fisheries and Agriculture* to address this question. The UN FAO report on *The State of World Fisheries and Agriculture* issued in 2012 formed the basis of the DGAC's evidence review on this topic. The FAO report addresses a wide variety of issues affecting capture fisheries and aquaculture, including economics, infrastructure, and labor and government policies. The DGAC focused on matters that directly address the world production of one important food—seafood—as a first attempt by a DGAC committee to consider the implications of dietary guidelines for production of a related group of foods.

The production of capture fisheries has remained stable at about 90 million tons from 1990-2011. At the same time, aquaculture production is rising and will continue to increase. FAO model projections indicate that in response to the higher demand for fish, world fisheries and aquaculture production is projected to grow by 15 percent between 2011 and 2021. This increase will be mainly due to increased aquaculture output, which is projected to increase 33 percent by 2021, compared with only 3 percent growth in wild capture fisheries over the same period. It is predicted that aquaculture will remain one of the fastest growing animal food-producing sectors and will exceed that of beef, pork, or poultry. Aquaculture production is expected to expand on all continents with variations across countries and regions in terms of the seafood species produced. Currently, the United States is the leading importer of seafood products world-wide, with imports making up about 90 percent of seafood consumption. Continuing to meet Americans needs for seafood will require stable importation or substantial expansion of domestic aquaculture.

For additional details on this body of evidence, visit: UN FAO report on *The State of World Fisheries and Agriculture, 2012.* http://www.fao.org/fishery/sofia/en

Overview Figure and Tables

Figure 1. Comparison of EPA and DHA in Seafood from USDA-ARS National Nutrient Database, Release 27 and from updated 2014 survey (Cladis *et al.*, 2014)

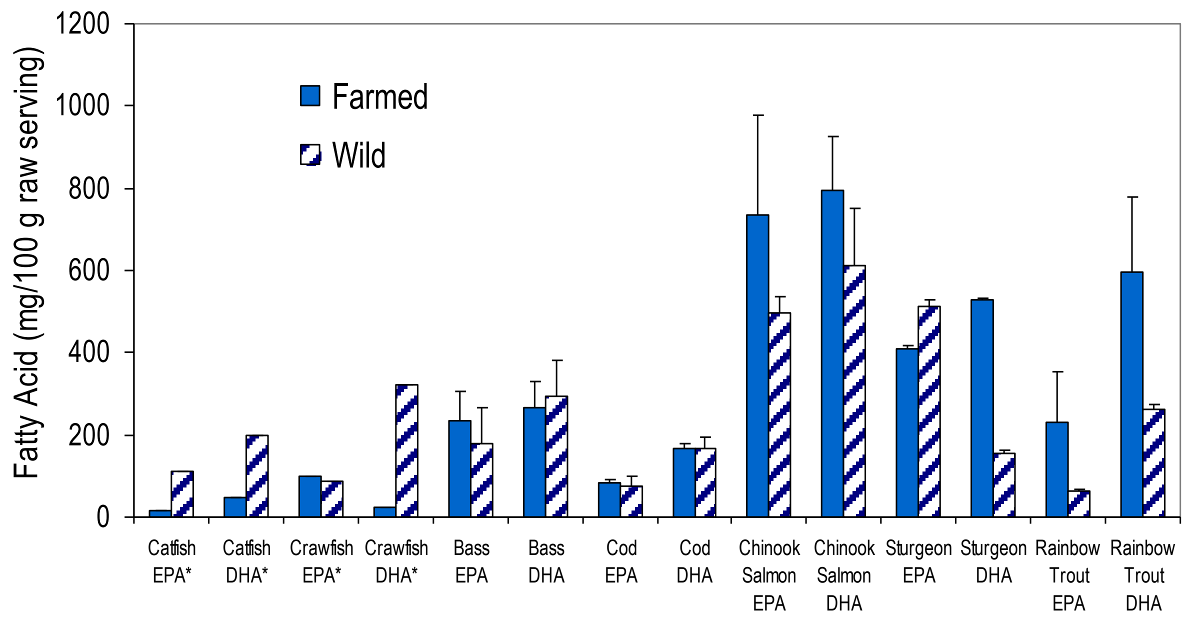

Table 1. Summary of Contaminants in Farm-raised and Wild-Caught Seafood

Topic	Evidence	Mercury [*Mean concentration per gram fresh weight*]	Dioxins [*Mean concentration per gram fresh weight*]	Report Statement/ Other
Contaminants in fish: Mercury and Dioxins	4 seafood composition databases were available from France, Japan, Norway and the US, together with one published international database	Halibut Wild (Greenland): [Hg] = 0.23 μg/g Halibut Farmed (Atlantic): [Hg] = 0.14 μg/g Salmon Wild (Atlantic): [Hg] = 0.07 μg/g Salmon Farmed (Atlantic): [Hg] = 0.05 μg/g Salmon Wild (Pacific): [Hg] = 0.04 μg/g Rainbow Trout Farmed: [Hg] = 0.05 μg/g	Halibut Wild (Greenland): [Dioxin] = 3.70 pg TEQ/g Halibut Farmed (Atlantic): [Dioxin] = 2.65 pg TEQ/g Salmon Wild (Atlantic): [Dioxin] = 1.36 pg TEQ/g Salmon Farmed (Atlantic): [Dioxin] = 1.63 pg TEQ/g Salmon Wild (Pacific): [Dioxin] = 0.25 pg TEQ/g Rainbow Trout Farmed: [Dioxin] = 1.02 pg TEQ/g	Levels of mercury and dioxins are in the same range for farmed and wild fish
Risk/Benefit: Mercury and Dioxins by EPA+DHA levels	Analyzed composition of fish by comparing levels of LCn3PUFA as DHA+EPA with levels of total mercury and dioxins The matrix categorized fish species by one of four levels of each of these substances Databases provided information on the content of total fat, EPA plus DHA, total mercury and dioxins (defined to include PCDDs, PCDFs and dioxin-like PCBs)	**Mercury:** ≤ 0.1 μg/g **+** **EPA + DHA:** 8 -15 mg/g Salmon, Atlantic (Wild) Salmon, Pacific (Wild) ≥15 mg/g: Salmon, Atlantic (Farmed) Rainbow Trout (Farmed) **Mercury:** 0.1 - ≤0.5 μg/g **+** **EPA + DHA:** 8 -15 mg/g Halibut (Wild) Halibut (Farmed	**Dioxins:** ≤ 0.5 pg TEQ/g **+** **EPA + DHA:** 8 -15 mg/g Salmon, Pacific (Wild) **Dioxins:** 0.5 - ≤4 pg TEQ/g **+** **EPA + DHA:** 8 -15 mg/g Salmon, Atlantic (Wild) Halibut (Farmed) ≥15 mg/g: Salmon, Atlantic (Farmed) Rainbow Trout (Farmed)	At the same level of mercury content (lowest and 2nd lowest levels), farmed fish have the same or higher levels of EPA + DHA as wild-caught At the same level of dioxin content (2nd lowest level), farmed fish have the same or higher levels of EPA + DHA as wild-caught Only wild-caught Pacific salmon has lowest level of dioxins

Mortality Risk	Estimated mortality per million people from consuming fish (2 serv/wk) with different dioxin and EPA + DHA levels		**Dioxins:** ≤ 1.0 pg/g **+** **EPA + DHA:** 8 -15 mg/g Salmon, Pacific (Wild) **+100 Est lives lost*** **-39,800 Est lives saved**[‡] **Dioxins:** 1.0 - ≤4 pg/g **+** **EPA + DHA:** 8 -15 mg/g Salmon, Atlantic (Wild) Halibut (Farmed) **+1,200 Est lives lost*** **-39,800 Est lives saved**[‡] ≥15 mg/g: Salmon, Atlantic (Farmed) Rainbow Trout (Farmed) **+1,200 Est lives lost*** **-39,800 Est lives saved**[‡]	There are CHD mortality benefits from eating fish and CHD risks from not eating fish, except for fish in the highest dioxin category and lowest EPA+DHA category

Table 2. Summary – The FAO Agricultural Outlook: Fish

Topic	Evidence	Projections 2012-2021 Aquaculture	Projections 2012-2021 Capture Fisheries
The Outlook Model	To analyze the outlook of the fisheries and aquaculture sector in terms of future production potential, projected demand for fisheries products, consumption, prices and key factors that might influence future supply and demand Developed and integrated model with overall structure of an already existing and valid agricultural model, the OECD-FAO- AGLINK-COSIMO projection system The fish model is a dynamic, policy-specific, partial-equilibrium model w/ 2 types of supply functions: capture and aquaculture	Stimulated by higher demand for fish, world fisheries and aquaculture production is projected to reach about 172 million tonnes in 2021, a growth of 15 percent above the average level for 2009–11 Increase should be driven by aquaculture, projected to reach ~79 million, rising by 33% over 2012-2021, compared with 3% growth for capture fisheries A slowing in aquaculture growth is anticipated, from an average annual rate of 5.8 percent in the last decade to 2.4 percent during the period under review Notwithstanding the slower growth rate, aquaculture will remain one of the fastest growing animal food-producing sectors. Thanks to its contribution, total fisheries production (capture and aquaculture) will exceed that of beef, pork or poultry Aquaculture production is expected to continue to expand on all continents, with variations across countries and regions in terms of the product range of species and product forms. Asian countries will continue to dominate world aquaculture production, with a share of 89 percent in 2021, with China alone representing 61 percent of total production	Portion of capture fisheries used to produce fishmeal will be about 17% by 2021, down ~6% from 2009-2011 due to growing demand for fish for human consumption

Research Recommendations

1. Conduct research on methods to ensure the maintenance of nutrient profiles of high-trophic level farmed seafood and improve nutrient profiles of low-trophic farmed seafood concurrently with research to improve production efficacy.
2. Conduct research to develop methods to ensure contaminant levels in all seafood remain at levels similar to or lower than at present. Maintain monitoring of contaminant levels for capture fisheries to ensure that levels caused by pollution do not rise appreciably. This research should include developing effective rapid response approaches if the quality of seafood supply is acutely affected.

References

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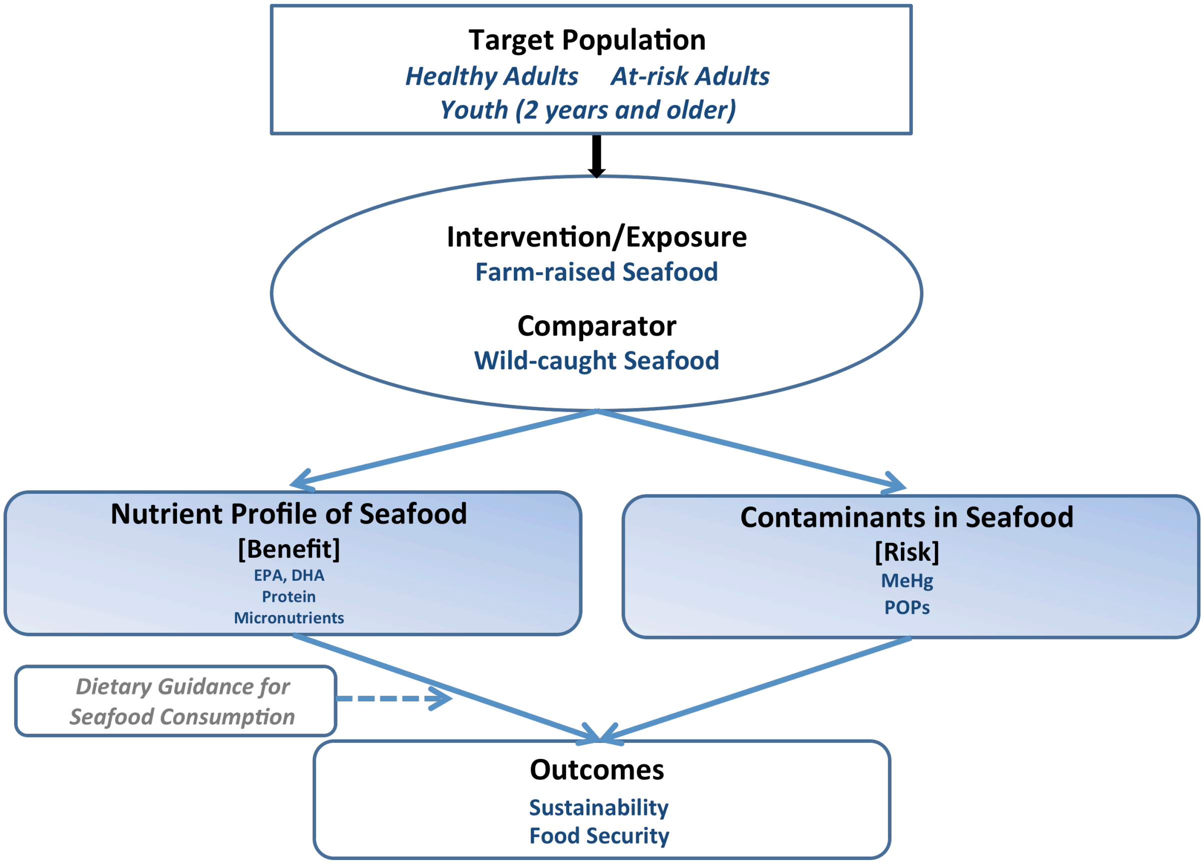
2. Cladis DP, Kleiner AC, Freiser HH, Santerre CR. Fatty Acid Profiles of Commercially Available Finfish Fillets in the United States. Lipids. 2014. PMID: 25108414. http://www.ncbi.nlm.nih.gov/pubmed/25108414

3. Food and Agriculture Organization of the United Nations; Geneva WHO. Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption. Rome. 2011.

4. FAO Fisheries and Aquaculture Department Food and Agriculture Organization of the United Nations. The State of World Fisheries and Aquaculture Rome,2012. Available from: http://www.fao.org/docrep/016/i2727e/i2727e.pdf.

ANALYTICAL FRAMEWORK FOR SEAFOOD AND SUSTAINABILITY



Appendix E-2.39a: Evidence Portfolio

Part D. Chapter 5: Food Sustainability and Safety

Usual Caffeine Consumption and Health

Systematic Review Question: Total Mortality
What is the relationship between usual caffeine consumption and total mortality?

Conclusion Statement: Strong and consistent evidence shows that consumption of coffee within the moderate range (3 to 5 cups/d or up to 400 mg/d caffeine) is not associated with increased risk of major chronic diseases, such as cardiovascular disease (CVD) and cancer and premature death in healthy adults.

DGAC Grade: Strong

Key Findings

- Coffee consumption was associated with reduced risk of total mortality (3-4% lower mortality with 1 cup/day), especially cardiovascular mortality
- Decaffeinated coffee consumption was associated with a lower risk of death (5 studies only)
- The limited number of studies on decaffeinated coffee indicates that protective association of coffee consumption may not be due to caffeine alone

Description of the Evidence

Two systematic reviews and/or meta-analyses (SR/MAs) of 20 and 23 prospective cohort studies (Je 2013 and Malerba 2013, respectively). Je *et al* examined total mortality and Malerba *et al* examined total, CVD, and cancer mortality.

Evidence suggests a significant inverse relationship between coffee consumption of 1-4 cups/day with total mortality, especially cardiovascular disease mortality. This evidence is based on three meta-analyses of more than 20 prospective cohort studies (Je, 2013; Malerba, 2013; Crippa, 2014). In general, results were similar for men and women. The risk reduction associated with each cup of coffee per day was between 3-4 percent. In addition, Je (2013) found a significant inverse association between coffee consumption and cardiovascular disease mortality. This association was stronger in women (16% lower risk) than in men (8% lower risk). However, no association was found for cancer mortality. Crippa et al. found that the lowest risk was observed for 4 cups/d for all-cause mortality (16%, 95% CI = 13-18) and 3 cups/d for CVD mortality (21%, 95% CI = 16-26),

Systematic Review Question: Cardiovascular Disease
What is the relationship between usual caffeine consumption and cardiovascular disease?

Conclusion Statement: Consistent observational evidence indicates that moderate coffee consumption is associated with reduced risk of type 2 diabetes and cardiovascular disease in healthy adults. In addition, consistent observational evidence indicates that regular consumption of coffee is associated with reduced risk of cancer of the liver and endometrium, and slightly inverse or null associations are observed for other cancer sites.
DGAC Grade: Moderate

Key Findings

CVD

- Non-linear association between coffee intake and risk of CVD
- Moderate coffee consumption was inversely associated with CVD risk
    - Lowest risk at 3-5 cups/d
- Heavy consumption was not associated with higher CVD risk

Stroke

- Non-linear association between coffee intake and risk of stroke
- Moderate coffee consumption was inversely associated with stroke
    - Lowest risk at 3-4 cups/d
- Higher intakes were not associated with higher stroke risk

CHD

- Moderate coffee consumption was associated with lower CHD risk
- Higher intakes were not associated with higher CHD risk

Heart Failure

- Moderate (1-5 cups/d) coffee consumption was inversely associated with risk of heart failure
- The largest inverse association observed for 4 cups/d

Blood Pressure & Hypertension

- No effect of coffee on long-term BP or risk of HTN
- For habitual coffee consumption, consumption of >3 cups/d was not associated with increased risk of HTN compared with <1 cup/d
    - There was a slightly elevated risk of HTN for light to moderate consumption (1-3 cups/d)

- In hypertensive individuals, caffeine intake produces an acute increase in BP for ≥3 h, but there is no evidence of an association between long-term coffee consumption and increased BP
- Regular caffeine intake (median 410 mg/d) increases BP in short-term RCTs, although when ingested through coffee, BP effect of caffeine was smaller but significant

Atrial Fibrillation

- Caffeine was not associated with increased risk of atrial fibrillation
- Low-dose caffeine exposure (<350 mg) may have a protective effect

Blood Lipids

- Caffeinated, but not decaffeinated coffee, had significant effect on serum lipids. The effects were mostly found in unfiltered coffee.
  - Coffee consumption increased TC, LDL-C, and TG
  - Positive dose-response relation between coffee intake and TC, LDL-C, and TG

Description of the Evidence

Twelve SR/MAs examined CVD (Ding 2014, Caldiera 2013, Cai 2013, Kim 2012, Mostofsky 2012, Steffen 2012, Zhang 2011, Mesas 2011, Larrson 2011, Wu 2009, Soffi 2007, Noordjiz 2005). Some SR/MAs covered only RCTs (Cai 2013). Others included only prospective cohort studies (Larsson 2011, Zhang 2011, Kim2012, Mostofsky 2012, Wu 2009). Other SR/MAs covered RCTs and cohort studies (Steffen 2012); controlled trials (randomized and non-randomized) and cohort studies (Mesas 2011); prospective studies and case-control (Soffi 2007); prospective cohort studies, case-cohort, and nested case-control studies (Ding 2014); and RCT, prospective or retrospective cohorts and case-control studies (Caldiera 2013). The number of studies included in the SR/MAs ranged from 5-36.

A large and current body of evidence directly addressed the relationship between normal coffee consumption and risk of cardiovascular disease (CVD). The evidence included 12 systematic reviews with meta-analyses, all of which had high quality ratings (AMSTAR scores 8/11 – 11/11). CVD incidence and mortality, as well as coronary heart disease (CHD), stroke, heart failure, and hypertension were assessed by meta-analyses that consisted primarily of prospective cohort studies; intermediate outcomes such as blood pressure, blood lipids, and blood glucose were assessed by meta-analyses of randomized controlled trials.

CVD risk was assessed by a current meta-analysis of 36 prospective cohort studies on long-term coffee consumption (Ding, 2014). This analysis showed a non-linear association, such that the lowest risk of CVD was seen with moderate coffee consumption (3-5 cups/day), but higher intakes (>5 cups/day) were neither protective nor harmful. Overall, moderate consumption of caffeinated, but not decaffeinated, coffee was associated with a 12 percent lower risk of CVD.

Results from the assessment of CHD risk in three meta-analyses (Ding, 2014; Wu, 2009; Sofi, 2007) were inconsistent. Ding (2014) found 10 percent lower CHD risk with moderate coffee consumption (3-5 cups/day) in a meta-analysis of 30 prospective cohort studies, whereas Wu (2009) and Sofi (2007) in meta-analyses of 21 and 10 prospective cohort studies, respectively, found no association between coffee consumption and CHD risk. However, in sub-group analysis, Wu (2009) found that habitual moderate coffee consumption (1-4 cups/day) was associated with an 18 percent lower risk among women. Overall, the meta-analyses of Sofi (2007) and Wu (2009) were conducted with smaller bodies of evidence and Ding (2014) assessed several more recent studies. One reason for the inconsistent associations may be that coffee brewing methods have changed over time and the filter method has become more widely used, replacing unfiltered forms of coffee such as boiled coffee that were more widely consumed by participants in earlier studies.

Risk of stroke was assessed in two systematic reviews with meta-analyses of prospective cohort studies (Larsson, 2011; Kim, 2012) with consistent findings. Kim (2012) found that coffee intake of 4 or more cups/day had a protective effect on risk of stroke. Larsson (2011) documented a non-linear association such that coffee consumption ranging from 1 to 6 cups/day was associated with an 8 percent-13 percent lower risk of stroke, and higher intakes were not associated with decreased or increased risk. The inverse associations were limited to ischemic stroke and no association was seen with hemorrhagic stroke.

Regarding blood pressure, three meta-analyses evaluated the effect of coffee and caffeine on systolic and diastolic blood pressure using controlled trials (Steffen, 2012; Mesas, 2011; Noordzij, 2005). The most recent meta-analysis of 10 randomized controlled trials by Steffen et al. (2012) showed no effect of coffee on either systolic or diastolic blood pressure. Similarly, in another meta-analysis of 11 coffee trials and 5 caffeine trials, caffeine doses of <410 mg/day had no effect on systolic and diastolic blood pressure while doses of 410 or more mg/day resulted in a net increase (Noordzij, 2005). A third meta-analysis showed that among individuals with hypertension, 200-300 mg of caffeine (equivalent to ~2-3 cups filtered coffee) resulted in an acute increase of systolic and diastolic blood pressure (Mesas, 2011). Additionally, two meta-analyses quantified the effect of coffee on incidence of hypertension (Steffen, 2012; Zhang, 2011) and found no association between habitual coffee consumption and risk of hypertension. However, Zhang et al. (2011) documented a slightly elevated risk for light to moderate consumption (1-3 cups/day) of coffee compared to less than 1 cup/day. Regarding blood lipids, in a quantitative analysis of short-term randomized controlled trials, Cai et al. (2012) revealed that coffee consumption contributed significantly to an increase in total cholesterol, LDL-cholesterol, and triglycerides, and that unfiltered coffee had a greater effect than filtered coffee. Interestingly, caffeinated, but not decaffeinated (more likely to be filtered), coffee had this effect on serum lipids.

In a meta-analysis of observational study data, including prospective, retrospective, and case-control studies, higher amounts of coffee or caffeine had no association with risk of atrial fibrillation, but low doses of caffeine (<350 mg/day) appeared to have a protective effect (Caldeira, 2013). In contrast, coffee consumption of 1-5 cups/day was found to be inversely associated with risk of heart failure in a meta-analysis of 5 prospective studies (Mostofsky, 2012). A non-linear association was documented and the lowest risk was observed for 4 cups/day (Mostofsky, 2012).

Systematic Review Question: Type 2 Diabetes
What is the relationship between usual caffeine consumption and type 2 diabetes?

Conclusion Statement: Consistent observational evidence indicates that moderate coffee consumption is associated with reduced risk of type 2 diabetes and cardiovascular disease in healthy adults. In addition, consistent observational evidence indicates that regular consumption of coffee is associated with reduced risk of cancer of the liver and endometrium, and slightly inverse or null associations are observed for other cancer sites.

DGAC Grade: Moderate

Key Findings

- Coffee consumption was inversely associated with T2D risk in a dose-response manner
- Both caffeinated and decaffeinated coffee were associated with lower T2D risk
- Increased coffee consumption by 1 cup/d was associated with 7% lower T2D risk
- Similar associations were seen in men and women
- A smaller number of studies on decaffeinated coffee indicate that protective association of coffee consumption is unlikely to be due to caffeine alone
- In T2D individuals, ingestion of caffeine (~200-500 mg) significantly increased blood glucose, serum insulin, and lowered insulin sensitivity in those with T2D in short-term RCTs.

Description of the Evidence

Five SR/MAs examined T2D (Ding 2014, Jiang 2014, Whitehead 2013, Huxley 2009, Van Dam 2005). One SR/MA covered controlled trials (Whitehead 2013) and two others covered only prospective cohort studies (Jiang 2014, Huxley 2009). Other SR/MAs covered both prospective cohort and nested case-control studies (Ding 2014) or prospective cohort and cross-sectional studies (van Dam 2005). The number of studies included in the SR/MAs ranged from 9-31.

Coffee consumption has consistently been associated with a reduced risk of type 2 diabetes. In four meta-analyses of prospective cohort studies (Ding, 2014; Jiang, 2014; Huxley, 2009; van Dam, 2005) and cross-sectional studies (van Dam, 2005), coffee consumption was inversely associated with risk of type 2 diabetes in a dose-response manner. Risk for type 2 diabetes was 33 percent lower for those consuming 6 cups/day in the analysis by Ding et al. (2014) while the risk was 37 percent lower for those consuming 10 cups/day in the analysis by Jiang et al. (2014). Using a sub-set of the prospective cohorts in the Ding et al. (2014) and Jiang et al. (2014) meta-analyses, Huxley (2009) documented that each cup of coffee was associated with a 7 percent lower risk of type 2 diabetes. Similarly, van Dam (2005) noted that consumption of ≥6 or ≥7 cups/day was associated with a 35 percent lower risk of type 2 diabetes. Three meta-analyses (Ding, 2014; Jiang, 2014; Huxley, 2009) found protective associations for decaffeinated coffee. Moderate decaffeinated coffee consumption (3-4 cups/day) was associated with a 36 percent lower risk of type 2 diabetes (Huxley, 2009). Each cup of decaffeinated coffee was associated with a 6 percent lower risk (Ding, 2014) while every 2 cups were associated with a 11 percent lower risk (Jiang, 2014). Both reports also documented a dose-response association between caffeine and type 2 diabetes risk such that every 140 mg/day was associated with an 8 percent lower risk in the Ding et al (2014) meta-analysis while every 200 mg/day was associated with a 14 percent lower risk in the analysis by Jiang et al (2014). However, it remains unclear if this inverse association is independent of coffee consumption as Ding et al (2014) indicated that none of the studies included in the caffeine dose-response analysis adjusted for total coffee.

Only one systematic review of 9 randomized controlled trials examined the effects of caffeine on blood glucose and insulin concentrations among those with type 2 diabetes (Whitehead & White 2013). Ingestion of 200-500 mg of caffeine acutely increased blood glucose concentrations by 16-28 percent of the area under the curve and insulin secretions by 19-48 percent of the area under the curve when taken prior to a glucose load. At the same time, these trials also noted a decrease in insulin sensitivity by 14-37 percent. Although it is not clear if the acute effects of caffeine on blood glucose and insulin persist in the long term, evidence from prospective cohorts indicate that caffeine may have no adverse effect on the risk of type 2 diabetes.

Systematic Review Question: Cancer
What is the relationship between usual caffeine consumption and cancer?

Conclusion Statement: Consistent observational evidence indicates that moderate coffee consumption is associated with reduced risk of type 2 diabetes and cardiovascular disease in healthy adults. In addition, consistent observational evidence indicates that regular consumption of coffee is associated with reduced risk of cancer of the liver and endometrium, and slightly inverse or null associations are observed for other cancer sites.

DGAC Grade: Moderate

Key Findings

Total Cancer

- Total Cancer Coffee drinkers had a modestly lower total cancer incidence compared to nondrinkers or those with the lowest intakes

Lung Cancer

- Coffee consumption was associated with higher risk of lung cancer, but the association was mainly explained by smoking. An association was not founder among nonsmokers

Liver Cancer

- Significant inverse association between coffee consumption and liver cancer risk seen in both case-control and cohort studies (after adjustment for existing liver disease)
- Risk of hepatocelluar carcinoma was reduced by 40% for any coffee consumption versus no coffee consumption

Breast Cancer

- No association between caffeine, coffee, or decaffeinated coffee and breast cancer risk.
    - An inverse association was seen in postmenopausal women and a strong inverse association seen in BRCA1 mutation carriers
- Borderline lower risk for highest versus lowest coffee consumption
    - For all studies together, an increase of 2 cups of coffee per day was associated with a 2% marginally lower breast cancer risk

Prostate Cancer

- Regular coffee consumption associated with modestly lower risk of prostate cancer
- Significant inverse association documented for cohort studies. For case-control studies, a 2 cup increment was associated with a higher risk of prostate cancer
- Dose-response meta-analysis of coffee consumption showed inverse association with prostate cancer mortality, but not incidence

Ovarian Cancer

- No association between coffee consumption and ovarian cancer risk in high versus low or dose-response meta-analysis

Endometrial Cancer

- Increased coffee intake was associated with a reduced risk of endometrial cancer in both cohort and case-control studies
- A reduction of ~20% in endometrial cancer risk among coffee drinkers; >20% and >30% reduction in risk among low to mod and heavy drinkers, respectively

Bladder Cancer

- Data from case-control studies suggest that consumption of coffee is associated with an increased risk for bladder cancer, but no significant association was seen in prospective cohort studies

Pancreatic Cancer

- Meta-analysis of prospective cohort studies showed that coffee drinking was inversely associated with pancreatic cancer risk (in sub-group analyses, there was a reduced risk in men but not women)

- A positive association was found between coffee intake and pancreatic cancer in case-control studies that did not adjust for smoking. An inverse association was found in prospective cohort studies.

Upper Digestive & Respiratory Cancer

- Coffee drinking was inversely related to oral/pharyngeal cancer risk while there was no relation with laryngeal cancer, ESCC, and EAC

Gastro-esophageal Cancer

- Coffee consumption was inversely, but non-significantly, associated with risk of esophageal cancer
- No association between coffee consumption and gastric cancer risk in cohort or case-control studies

Colorectal Cancer

- Case-control studies suggest coffee consumption decreases risk of colorectal and colon cancer, especially in women; the association was inverse, but marginally non-significant, for cohort studies for colorectal and colon cancer
- Prospective cohort studies showed no association between coffee consumption on colorectal cancer risk (a suggestive inverse association was slightly stronger in studies that adjusted for smoking and alcohol)

Description of the Evidence

A large number of SR/MAs addressed cancer, including total cancer (Yu 2011), lung cancer (Tang 2010), liver cancer (Sang 2013, Bravi 2013), breast cancer (Jiang 2013, Li 2013, Tang 2009), prostate cancer (Cao 2014, Zhong 2013, Discacciati 2013, Park 2010), ovarian cancer (Braem 2012), endometrial cancer (Je 2012, Bravi 2009), bladder cancer (Zhou 2012), pancreatic cancer (Turati 2011, Dong 2011), upper digestive and respiratory tract cancer (Turati 2011), esophageal cancer (Zheng 2013), gastric cancer (Botelho 2006), and colorectal cancer (Li 2012, Galeone 2010, Je 2009). The majority of the studies included cohort and cross-sectional studies, although some covered only prospective cohort studies or case-control studies. The number of studies included in the SR/MAs ranged from 3-54.

Several systematic reviews and meta-analyses examined the association between coffee consumption and risk of cancer. Types of cancer examined by the Committee included total cancer, cancers of the lung, liver, breast, prostate, ovaries, endometrium, bladder, pancreas, upper digestive and respiratory tract, esophagus, stomach, colon, and rectum.

In a quantitative summary of 40 prospective cohort studies with an average follow-up of 14.3 years, Yu (2011) found a 13 percent lower risk of total cancer among coffee drinkers compared to non-drinkers or those with lowest intakes. Risk estimates were similar for men and women. In sub-group analyses, the authors noted that coffee drinking was associated with a reduced risk of bladder, breast, buccal and pharyngeal, colorectal, endometrial, esophageal, hepatocellular, leukemic, pancreatic, and prostate cancers.

Tang et al (2010) evaluated 5 prospective cohorts and 8 case-control studies and found that overall those with the highest levels of coffee consumption had a 27 percent higher risk for lung cancer compared to never drinkers or those with least consumption. An increase in coffee consumption of 2 cups/day was associated with a 14 percent higher risk of developing lung cancer. However, because smoking is an important confounder, when analyses were stratified by smoking status, coffee consumption was marginally protective in non-smokers and was not associated with lung cancer among smokers. When estimates from 2 studies that examined decaffeinated coffee were summarized, there was a protective association with lung cancer. No association was seen with lung cancer when only case-control studies were considered.

Results from two meta-analyses indicate the coffee consumption is associated with a 50 percent lower risk of liver cancer (Sang, 2013) and a 40 percent lower risk of hepatocellular carcinoma (Bravi, 2013) when considering both cohort and case-control studies. Associations were significant in men but not in women (Sang, 2013).

Three meta-analyses of observational studies found no association between coffee consumption (Jiang, 2013; Li, 2013; Tang, 2013), caffeine consumption (Jiang, 2013), or decaffeinated coffee consumption (Jiang, 2013) and risk of breast cancer. In all 3 reports, each 2 cup/day of coffee was marginally associated with a 2 percent lower risk of breast cancer. However, in sub-group analyses, coffee consumption was protective against breast cancer risk in postmenopausal women (Jiang, 2013), BRCA1 mutation carriers (Jiang, 2013), and women with estrogen receptor negative status (Li, 2013).

The association between coffee consumption and risk of prostate cancer was mixed. Cao (2014) and Zhong (2013) found that regular or high coffee consumption, compared to non- or lowest levels of consumption, was associated with a 12 percent-17 percent lower risk of prostate cancer in prospective cohort studies. Further, each 2 cups of coffee per day was associated with a 7% lower risk of prostate cancer. However, no associations were seen with case-control data alone or when these studies were examined together with prospective cohort studies. Using a combination of both prospective cohort and case-control data, Discacciati (2013) found that each 3 cups/day of coffee was associated with a 3% lower risk of localized prostate cancer and an 11% lower risk of mortality from prostate cancer. On the other hand, after summarizing data from 12 prospective cohort and case-control studies, Park (2010) found a 16% higher risk of prostate cancer. However, in sub-group analyses by study design, the higher risk was observed in case-control but not in cohort studies.

Consumption of coffee was not associated with risk of ovarian cancer in a meta-analysis of 7 prospective cohort studies with over 640,000 participants (Braem, 2012).

Two meta-analyses confirmed an inverse association between coffee consumption and risk of endometrial cancer (Je, 2012; Bravi, 2009). In the most recent and updated meta-analysis of prospective cohort and case-control studies, compared to those in the lowest category of coffee consumption, those with the highest intakes of coffee had a 29%

lower risk of endometrial cancer (Je, 2012). Each cup of coffee per day was associated with an 8% lower risk of endometrial cancer. Similar results were found in the meta-analysis by Bravi (2009) that included a sub-set of the studies in Je (2012) and documented a 20% lower risk of endometrial cancer overall, and a 7% decrease for each cup of coffee per day. However, the association was significant only in case-control studies but not in cohort studies, most likely due to lower statistical power.

A recent meta-analysis of 23 case-control studies by Zhou (2012) found coffee was a risk factor for bladder cancer. There was a smoking-adjusted increased risk of bladder cancer for those in the highest (45%), second highest, (21%), and third highest (8%) groups of coffee consumption, compared to those in the lowest group. No association was, however, seen in cohort studies.

Two meta-analyses of coffee consumption and pancreatic cancer risk provided mixed results (Turati, 2011; Dong, 2011). Using both prospective cohort and case-control studies, Turati (2011) found that coffee consumption was not associated with risk of pancreatic cancer. However, an increased risk was seen in case-control studies that did not adjust for smoking. Using a sub-set of prospective cohorts included in the Turati (2011) meta-analysis, Dong (2011) found that coffee drinking was inversely associated with pancreatic cancer risk but did not separate studies based on their adjustment for smoking status. Sub-group analyses revealed a protective association in men, but not in women.

Turati (2011) quantified the association between coffee consumption and various upper digestive and respiratory tract cancers using data from observational studies. Coffee consumption was associated with a 36% lower risk of oral and pharyngeal cancer but not with risk of laryngeal cancer, esophageal squamous cell carcinoma, or esophageal adenocarcinoma. In a meta-analysis of prospective cohort and case-control studies, Zheng (2013) noted that coffee was inversely, but non-significantly, associated with risk of esophageal cancer. Regarding gastric cancer, no association between coffee consumption and risk was seen in a meta-analysis of observational studies by Botelho (2006).

Three meta-analyses on the association between coffee consumption and colorectal cancer risk (Li, 2012; Galeone, 2012; Je, 2009) have yielded mixed findings. Results from case-control studies suggested coffee consumption was associated with lower risk of colorectal (15% lower) and colon cancer (21% lower), especially in women. However, this inverse association was non-significant for cohort studies. Using all but one of the case-control studies, Galeone (2012) arrived at similar conclusions as the Li (2012) analysis although associations were in general stronger. Galeone (2012) also provided suggestive evidence for a dose-response relationship between coffee and colorectal cancer such that each cup of coffee was associated with a 6% lower risk of colorectal cancer, 5% lower risk of colon cancer, and 3% lower risk of rectal cancer. Using several prospective cohort studies as in the Li (2012) meta-analysis, Je (2009) found no significant association of coffee consumption with risk of colorectal cancer. Interestingly, no differences were seen by sex but the suggestive inverse associations were slightly stronger in studies that adjusted for smoking and alcohol.

Systematic Review Question: Cognitive Function
What is the relationship between usual caffeine consumption and cognitive function?

Conclusion Statement: Limited evidence indicates that caffeine consumption is associated with a modestly lower risk of cognitive decline or impairment and lower risk of Alzheimer's disease.

DGAC Grade: Limited

Key Findings:

- There was a trend toward a protective effect of caffeine from different sources and cognitive impairment/dementia.

Description of the Evidence

Two systematic reviews (Arab, 2013; Santos, 2010) and one meta-analysis (Santos, 2010) examined the effects of caffeine from various sources, including coffee, tea, chocolate, on cognitive outcomes. Arab (2013) systematically reviewed six longitudinal cohort studies evaluating the effect of caffeine or caffeine-rich beverages on cognitive decline. Most studies in this review used the Mini Mental State Examination Score as a global measure of cognitive decline. The review concluded that estimates of cognitive decline were lower among consumers, although there was no clear dose-response relationship. Studies also showed stronger effects among women than men. In a meta-analysis of nine cohort and two case-control studies, caffeine intake from various sources was associated with a 16% lower risk of various measures of cognitive impairment/decline. Specifically, data from four studies indicate that caffeine is associated with a 38% lower risk of Alzheimer's disease.

Systematic Review Question: Parkinson's Disease
What is the relationship between usual caffeine consumption and Parkinson's disease?

Conclusion Statement: Consistent evidence indicates an inverse association between caffeine intake and risk of Parkinson's disease.
DGAC Grade: Moderate

Key Findings

- There was a non-linear inverse association between coffee and Parkinson's disease risk with maximum protection at ~3 cups/d (adjusted for smoking)

- For caffeine consumption, a linear inverse association was found (adjusted for smoking); every 300 mg/day was associated with a 24% lower risk of Parkinson's disease.

Description of the Evidence

Evidence from two systematic reviews (Ishihara, 2005; Costa, 2010) and one quantitative meta-analysis (Qi, 2013) confirmed an inverse association between coffee, caffeine, and risk of Parkinson's disease. Qi (2013) evaluated six case-control studies and seven prospective articles and documented a non-linear relationship between coffee and risk of Parkinson's disease, overall. The lowest risk was observed at ~3 cups/day (smoking-adjusted risk reduction was 28%). For caffeine, a linear dose-response was found and every 200 mg/day increment in caffeine intake was associated with a 17% lower risk of Parkinson's disease. Using a combination of cohort, case-control, and cross-sectional data, Costa (2010) summarized that the risk of Parkinson's disease was 25% lower among those consuming the highest versus lowest amounts of caffeine. Like Qi (2013), Costa documented a linear dose-response with caffeine intake such that every 300 mg/day was associated with a 24% lower risk of Parkinson's disease. In both reports, associations were weaker among women than in men.

Systematic Review Question: Pregnancy outcomes

What is the relationship between usual caffeine consumption and pregnancy outcomes?

Conclusion

Consistent evidence from observational studies indicates that caffeine intake in pregnant women is not associated with risk of preterm delivery. Higher caffeine intake (especially >=300 mg/day) is associated with a small increased risk of miscarriage, stillbirth, low birth weight, and small for gestational age (SGA) births. However, these data should be interpreted cautiously due to potential recall bias in the case-control studies and confounding by smoking and pregnancy signal symptoms.

DGAC Grade Moderate

Key Findings

- No important association between caffeine intake during pregnancy and risk of pre-term birth were observed in either cohort or case-control studies.
- Consumption of caffeine from various sources was associated with a significantly increased risk of spontaneous abortion and low birth weight. Control for confounders such as maternal age, smoking, and ethanol use was not possible.

Description of the Evidence

Two SR/MAs assessed observational studies on the association of caffeine intake with adverse pregnancy outcomes (Greenwood 2014, Maslova 2010). The pregnancy outcomes included miscarriage, pre-term birth, stillbirth, small for gestational age (SGA), and low birth-weight. The most recent SR/MA by Greenwood *et al* quantified the association between caffeine intake and adverse pregnancy outcomes from 60 publications from 53 separate cohort (26) and case-control (27) studies. The evidence covered a variety of countries with caffeine intake categories that ranged from non-consumers to those consuming >1,000mg/day. They found that an increment of 100 mg caffeine was associated with a 14% increased risk of miscarriage, 19% increased risk of stillbirth, 10% increased risk of SGA, and 7% increased risk of low birth weight. There was no significant increase in risk of preterm delivery. The magnitude of these associations was relatively small within the range of caffeine intakes of the majority women in the study populations, and the associations became more pronounced at higher range (>=300 mg/day). The authors also note the substantial heterogeneity observed in the meta-analyses shows that interpretation of the results should be cautious. In addition, the results from prospective cohort studies and case-control studies were mixed together. Since coffee consumption is positively correlated with smoking, residual confounding by smoking may have biased the results toward a positive direction.

The other SR/MAs did not cover all of the above pregnancy outcomes, but for those adverse outcomes covered, the results were in agreement with Greenwood *et al*. Maslova (2010) reviewed 22 studies (15 cohort and 7 case-control studies) and found no significant association between caffeine intake and risk of pre-term birth in either case-control or cohort studies. For all of the observational studies assessed across the three SR/MAs, most studies did not adequately adjust for the pregnancy signal phenomenon, i.e. that nausea, vomiting, and other adverse symptoms are associated with a healthy pregnancy that results in a live birth, whereas pregnancy signal symptoms occur less frequently when the result is miscarriage. Coffee consumption decreases with increasing pregnancy signal symptoms, typically during the early weeks of pregnancy, and this confounds the association (Peck et al 2010). Greenwood *et al* state that this potential bias is the most prominent argument against a causal role for caffeine in adverse pregnancy outcomes. Only one randomized controlled trial of caffeine/coffee reduction during pregnancy has been conducted to date (Bech 2007). The study found that a reduction of 200 mg of caffeine intake per day did not significantly influence birth weight or length of gestation. The trial did not examine other outcomes.

Research Recommendations

1. Evaluate the effects of coffee on health outcomes in vulnerable populations, such as women who are pregnant (premature birth, low birth weight, spontaneous abortion).
2. Examine the effects of coffee on sleep patterns, quality of life, and dependency and addiction.
3. Evaluate the prospective association between coffee/caffeine consumption and

cancer at different sites.

4. Examine prospectively the effects of coffee/caffeine on cognitive decline, neurodegenerative diseases, and depression.
5. Understand the mechanisms underlying the protective effects of coffee on diabetes and CVD.
6. Understand the association between coffee and health outcomes in individuals with existing CVD, diabetes, cancer, neurodegenerative diseases, or depressive symptoms.

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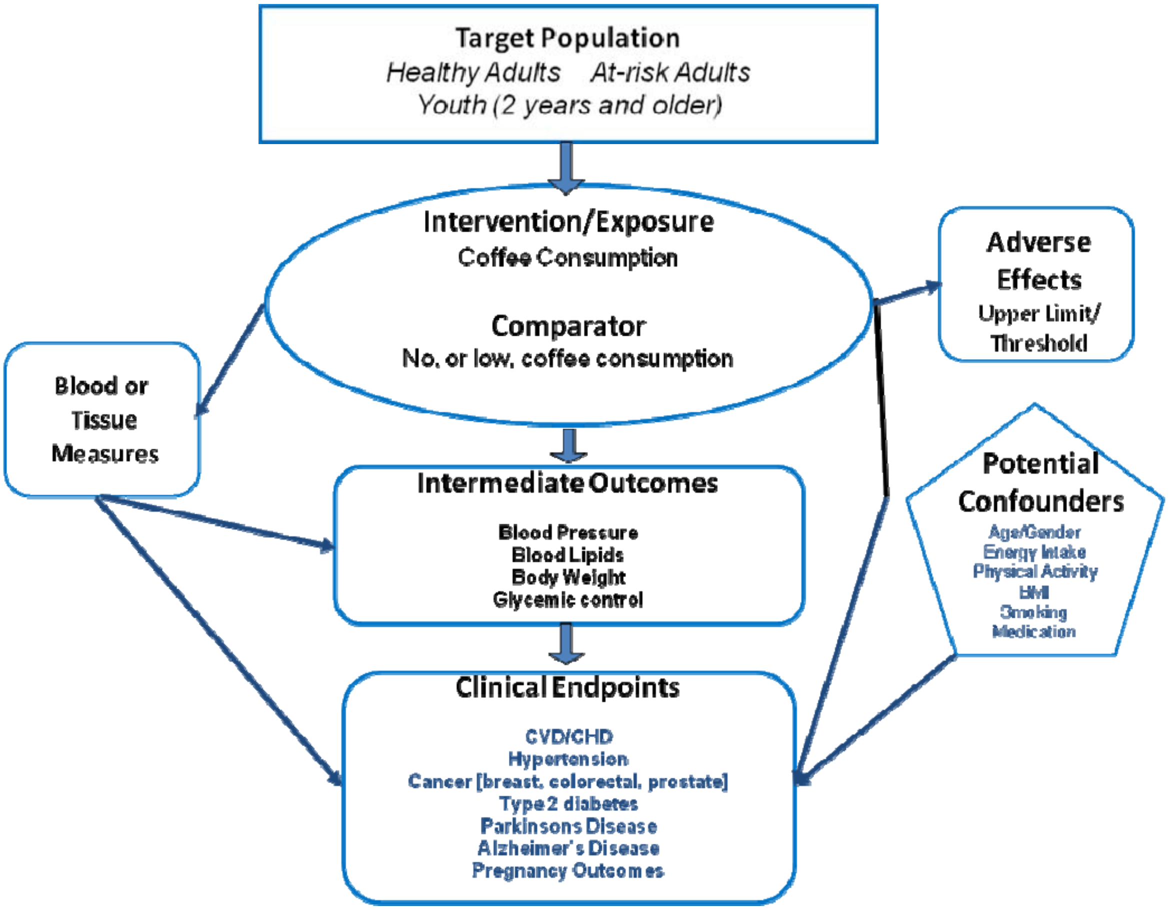
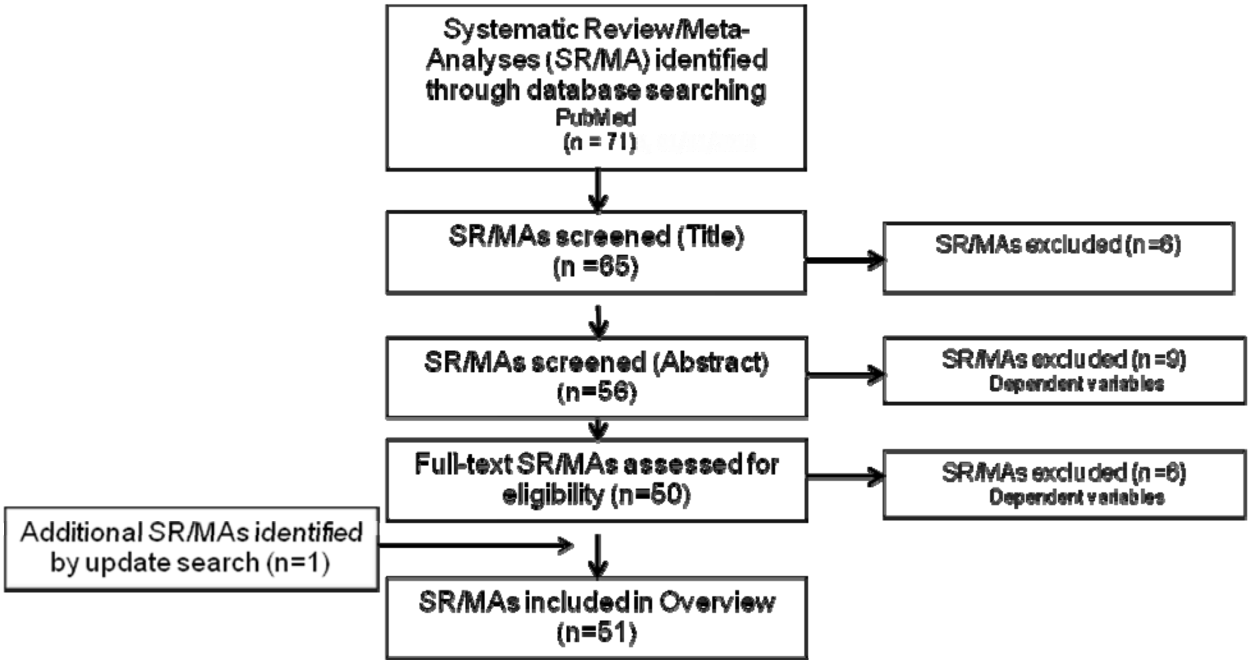
Analytical Framework



Inclusion Criteria

PubMed was searched for original research articles published in English in peer-reviewed journals. Studies published since January 2000 with subjects who were healthy or at elevated chronic disease risk from countries with high or very high human development were considered. Study design was limited to systematic reviews or systematic reviews with meta-analyses. All other study designs were excluded. Studies were required to specify level of caffeine and included caffeine from any source. Both short- and long-term health outcomes were included. Studies that examined low-calorie diets and other treatment diets were excluded. Finally, studies were required to include a description of the dietary pattern along with sustainability or food security outcomes.

Search Results



Appendix E-2.39a: Systematic Review/Meta-Analysis Data Table

Part D. Chapter 5: Food Sustainability and Safety

Usual Caffeine Consumption and Health

For this data table, please see the web link:

Systematic Review/Meta-Analysis Data Table [Excel - 56KB]

Appendix E-2.40: Evidence Portfolio

Part D. Chapter 5: Food Sustainability and Safety

What is the relationship between high-dose caffeine consumption and health?

Conclusion Statement: Evidence on the effects of excessive caffeine intake on the health of adults or children (>400 mg/day for adults; undetermined for children and adolescents) is limited. Some evidence links high caffeine intake in the form of energy drinks to certain adverse outcomes, such as caffeine toxicity and cardiovascular events. Randomized controlled trials (RCTs) on the relationship between high-caffeine energy drinks and cardiovascular risk factors and other health outcomes report mixed results. Evidence also is limited on the health effects of mixing alcohol with energy drinks, but some evidence suggests that energy drinks may mask the effects of alcohol intoxication, so an individual may drink more and increase their risk of alcohol-related adverse events.

DGAC Grade: Limited

Key Findings

- Early safety signals consisting of case reports of adverse events associated with high-caffeine drink consumption, including increased emergency room visits, indicate a potential public health problem.
- The DGAC agrees with the American Academy of Pediatrics and the American Medical Association that until safety has been demonstrated, limited or no consumption of high-caffeine drinks, or other products with high amounts of caffeine, is advised for vulnerable populations, including children and adolescents.
- High-caffeine energy drinks and alcoholic beverages should not be consumed together, either mixed together or consumed at the same sitting. This is especially true for children and adolescents.

Background

According to the FDA, the upper limit of moderate caffeine intake in healthy adult populations (barring pregnant women) is 400 mg/day, with intakes higher than this being considered excessive caffeine consumption. The FDA has not defined moderate and excessive intake levels for children and adolescents. However, according to Health Canada, children should not consume more than 2.5 mg of caffeine per kg bodyweight per day (http://www.hc-sc.gc.ca/fn-an/securit/addit/caf/food-caf-aliments-eng.php). While this guideline only pertains to children up to the age of 12 years, in the literature it is usually applied to children and adolescents of all ages. A caffeine threshold of 2.5 mg/kg/day would translate into around 37.5 mg/day for 2-5 year olds with an average weight of 15 kg, 75 mg/day for 6-12 year olds with an average weight of 30 kg, and 137.5 mg/day for 13-17 year olds with an average weight of 55 kg.

The main sources of caffeine among both adults and children are coffee, tea, and carbonated soft drinks. Another product, which has received a lot of attention recently as a potential source of excessive caffeine intake, especially among younger populations, is energy drinks (Pomeranz et al, 2013). An energy drink is a beverage that contains caffeine as its active ingredient, along with other ingredients such as taurine, herbal supplements, vitamins, and sugar. It is usually marketed as a product that can improve energy, stamina, athletic performance, or concentration (Seifert et al, 2011). Energy drinks have recently evaded oversight and regulation due to their variable, sometimes excessively high caffeine content (from 50 to 505 mg per can/bottle, with caffeine concentrations anywhere between 2.5 to 171 mg per fluid ounce) (Reissig et al, 2009), which is not regulated by the FDA due to the classification of energy drinks as dietary supplements (Seifert et al, 2011).

Health organizations including the American Academy of Pediatrics, the International Society of Sports Nutrition, and the American Medical Association have issued position statements on energy drinks, advising limited/no consumption among children and adolescents. Given the increasing evidence pointing towards harmful effects of excessive caffeine consumption, the FDA requested the Institute of Medicine (IOM) convene a workshop examining the science behind safe levels of caffeine intake. A report summarizing this workshop was recently published (Institute of Medicine, 2014). Its main conclusions were: 1) Children and adolescents are a potential vulnerable group, in whom caffeine intake could have detrimental health consequences. This is particularly important given insufficient data on caffeine consumption in this demographic, which is increasingly getting exposed to new modes of caffeine intake such as energy drinks; 2) Not enough is understood about potential interactions between caffeine and other ingredients commonly found in caffeine containing foods and beverages; and 3) More research is needed on identifying individual differences in reactions to caffeine, and vulnerable populations, including children with underlying heart conditions, and individuals with genetic predispositions to heart conditions.

The Center for Disease Control (CDC) recently reported on trends in caffeine intake over the past decade (1999-2010) among US children, adolescents, and young adults (Branum 2014). The CDC found that although energy drinks were not widely available prior to 1999, energy drinks made up nearly 6% of caffeine intake in 2009–2010, indicating fast growth in US consumption over a short period of time. When energy drink consumption was assessed in a nationally-representative sample of US secondary school students (Terry-McElrath 2014), 35% of 8th graders, 30% of 10th graders, and 31% of 12th graders consumed energy drinks or shots, and consumption was higher for adolescent boys than girls. Furthermore, energy drink use was associated with higher prevalence of substance use, as assessed for all grades of US secondary students.

Furthermore, a serious issue of public health concern has been the popular trend of combining energy drinks with alcoholic beverages. In 2010, the FDA determined that caffeine added to alcoholic beverages was not generally recognize as safe (GRAS), leading to withdrawal of premixed, caffeinated alcoholic beverages from the market (Arria and O’Brian 2011). Currently, Health Canada caps caffeine levels for energy drinks at 100 mg/250 ml (~1 cup) and has determined that an energy drink container that cannot be resealed be treated as a single-serving container. They have also mandated that manufacturers add a warning to labels that energy drinks should not be combined with alcohol. Recently, the CDC has made public statements on the dangers of mixing alcohol and energy drinks. They indicate that high amounts of caffeine in energy drinks can mask the intoxicating effects of alcohol, while at the same time they have no effect on the metabolism of alcohol by the liver. Therefore, high amounts of caffeine in energy drinks may result in an “awake” state of intoxication, thus increasing the risk of alcohol-related harm and injury (http://www.cdc.gov/alcohol/fact-sheets/cab.htm, March 2014).

Description of the Evidence

Several case reports of adverse events related to energy drink use have been published. A recent systematic review of case reports of adverse cardiovascular events related to consumption of energy drinks documented 17 such published case reports (Goldfarb et al, 2014). The cardiovascular events so documented included atrial fibrillation, ventricular fibrillation, supraventricular tachycardia, prolonged QT, and ST elevation. In 41% of the cases, there had been heavy consumption of energy drinks, and 29% of the cases were associated with consumption of energy drinks together with alcohol or other drugs. In 88% of the cases, no underlying cardiac condition was found which could potentially explain the cardiovascular event, although there was co-occurrence of other cardiovascular risk factors along with energy drink consumption prior to onset of the event in most cases. Of the cases that presented with serious adverse events, including cardiac arrest, the majority occurred with either acute heavy consumption of energy drinks or in combination with alcohol or other drugs. Overall, the authors concluded that causality cannot be inferred from this case series, but physicians should routinely inquire about energy drink consumption in relevant cases and vulnerable consumers should be cautioned against heavy consumption of energy drinks or concomitant alcohol (or drug) ingestion. This systematic review is consistent with a recent report from the Drug Abuse Warning Network (DAWN) on energy drink-related emergency room visits that showed US emergency room visits temporally related to energy drink consumption doubled from 2007 – 2011 (http://www.samhsa.gov/data/2k13/DAWN126/sr126-energy-drinks-use.pdf). These visits were attributed mainly to adverse reactions to energy drinks, but also to combination with alcohol or drugs. It is generally agreed that adverse events associated with energy drink consumption are underreported.

Several short-term randomized controlled trials (RCTs) have examined the health effects of energy drink consumption. All of these have been carried out in adult populations, probably due to ethical constraints in providing energy drinks to children. Burrows et al (2013) recently published a systematic review of RCTs examining this question. They found 15 such RCTS, examining the effect of variable doses of energy drinks (mean dose: one and a half 250ml cans per study session) with differing ingredient combinations and concentrations on a number of different health outcomes. The high variability in exposure and outcome definitions made a meta-analysis infeasible. Overall, they found no consistent effects of energy drinks on cardiorespiratory outcomes (heart rate, arrhythmias, blood pressure), pathological outcomes (blood glucose, blood lactate, free fatty acids, clinical safety markers), and body composition, with some studies showing positive, some inverse, and some no associations. For many of these outcomes, consistent results could not be stated due to only one study reporting on them. There was a slight indication of a potential positive effect of energy drinks on physiological outcomes (run time to exhaustion, peak oxygen uptake, resting energy expenditure); however the authors concluded that more studies were needed before arriving at a definitive conclusion. Two of the studies assessed the simultaneous ingestion of alcohol and energy drinks (Ferreira 2006; Wiklund 2009). One found that when compared with the ingestion of alcohol alone, the addition of an energy drink reduced individuals' perception of impairment from alcohol, while at the same time, objective measures indicated ongoing deficits in motor coordination and visual acuity (Ferreira 2006). Nor did energy drinks reduce breath alcohol concentration, indicating no change or increase in alcohol metabolism by the liver. Another study on energy drinks in combination with alcohol and exercise showed that during post-exercise recovery there was no effect on arrhythmias within 6 hours of energy drink ingestion in healthy young adults (Wiklund 2009).

There are several issues with many of the above studies, such as lack of a true control group (water or no drink), a very short follow-up duration of only a few hours, and small sample sizes, which could explain the inconsistent findings. In addition, many of these studies did not report whether they were commercially funded. Several of those that did report funding sources had financial conflicts of interest. Lastly, the doses of energy drinks used in these studies were not too high, resulting in caffeine intake levels that fell within the normal range. It is possible that excessive caffeine intake due to heavy energy drink consumption adversely impacts several health outcomes, but this hypothesis was not clearly addressed by these studies. Hence it is difficult to ascertain the impact of excessive caffeine intake on health outcomes on the basis of these RCTs. There is also very little data on the health effects of excessive caffeine consumption in pediatric populations.

Table1. Summary of Studies on High-dose Caffeine Consumption and Health

Author, Year Risk of Bias Study Design	Location Duration	Sample	Intervention/ Exposure	Results
Burrows et al., 2013 AMSTAR: 7/11 Systematic Review: 15 intervention trials 5 RCTs; 10 Pseudo-RCTs (*alternate allocation or other method*) No overlap w/ Goldfarb 2014 (case reports)	5 in US; 4 UK, 2 Germany, 1 in Canada, Brazil, Sweden, and Australia Trial duration: Short-term: 30 min-3 h Long-term: 4-10 wk	Range N = 10 - 69 (mostly crossover) Mean N = 25 32-70% Women; 3 trials all Men Mean Age = 25y; Range = 18-45y	10 studies used standard Cal EDs; 6 studies used low-Cal or sugar-free EDs (1 study tested both standard and sugar-free EDs) Mean dose = 389 ml (~1.5 cans)/ session Range = 250-750 ml 2 studies investigated ED + alcohol Most common EDs: Red Bull = 10 studies Celsius = 2 studies	**Heart Rate:** 2/10 studies reported increase in heart rate at 30-60 min post-consumption; 1 study found decreased heart rate at 45 sec-3 min; 6/10 studies found no change in heart rate post-consumption of ED; 1 study found a decrease in heart rate variability **Blood Pressure (BP):** 4/4 studies found no change in BP with ED doses of 250-500 mL **ECG:** 1/1 study reported no arrhythmias in ECG with 750 mL ED or alcoholic ED w/ 0.4% ethanol/kg BW **Aerobic endurance:** 3/5 studies reported improved aerobic endurance; 1/1 study reported improved stroke volume; 1/1 study reported improved resting energy expenditure after 4 wk daily consumption **Blood glucose and free FAs**: 2/6 studies reported increased blood glucose, no changes in remaining studies; 3/3 studies reported no change in blood lactate but inconsistent on free FAs **Body Composition:** 2/4 studies reported a decrease in fat mass and % body fat in long-term follow-up of ED consumption
Goldfarb et al., 2014	Systematic review of	13 male cases; 15 cases <30 y,	Acute ingestion of >480 mg	4 cases atrial fibrillation: 13y male: 85mg caf/NR

AMSTAR: 7/11 Systematic Review: 17 case reports: 14 studies involving 15 cases + 2 cases from authors' institution No overlap w/ Burrows 2013 (RCTs)	PubMed and Embase for articles published from Jan 1980 - Feb 2013 (English, French, or Spanish) Included all cases of acute CV events potentially associated with ED w/ sufficient clinical information	range 13-58 y 13 Men 4 Women No predisposing cardiac abnormality or previous cardiac disease (1 minor)	caffeine within 8 h considered “acute heavy consumption” this corresponds to >3 cans (16 oz) of several EDs in short time period Chronic heavy consumption >200 mg/ day of caffeine from EDs over >1 wk ED & Co-ingestions: Red Bull + vodka (2) GNC Speed Shot Race Energy Blast Monster + marijuana NOS Red Bull + Monster XL + MDMA 4 studies did not report ED brand (1 +vodka) Range caffeine intake: 80-1,600 mg	14y male: NR mg/Red Bull 16y male: NR mg/Red Bull + vodka 58y male: 575mg/NR 1 case supraventricular tachycardia: 23y woman: 250mg/GNC Speed Shot 1 case electrophysiological changes w/out arrhythmia: 13y female: 160mg/NR 7 cases ventricular arrhythmia or cardiac arrest: Caf rang = 80-1300mg incl: Red Bull + vodka, Monster + marijuana, NOS, Race Energy Blast, and NR 4 cases ST elevation: 17-24y males 560-800 mg/Red Bull+vodka 1,600 mg XL+MDMA 160-240mg Red Bull NR mg/ NR+vodka

Research Recommendations

1. Define excessive caffeine intake and safe levels of consumption for children, adolescents, and young adults.
2. Determine the prevalence of excessive caffeine intake in children and adults beyond intake of energy drinks.
3. Examine the effect of excessive consumption of caffeine and energy drinks on health outcomes in both children and adults.
4. Conduct observational studies to examine the health effects of alcohol mixed with energy drinks.

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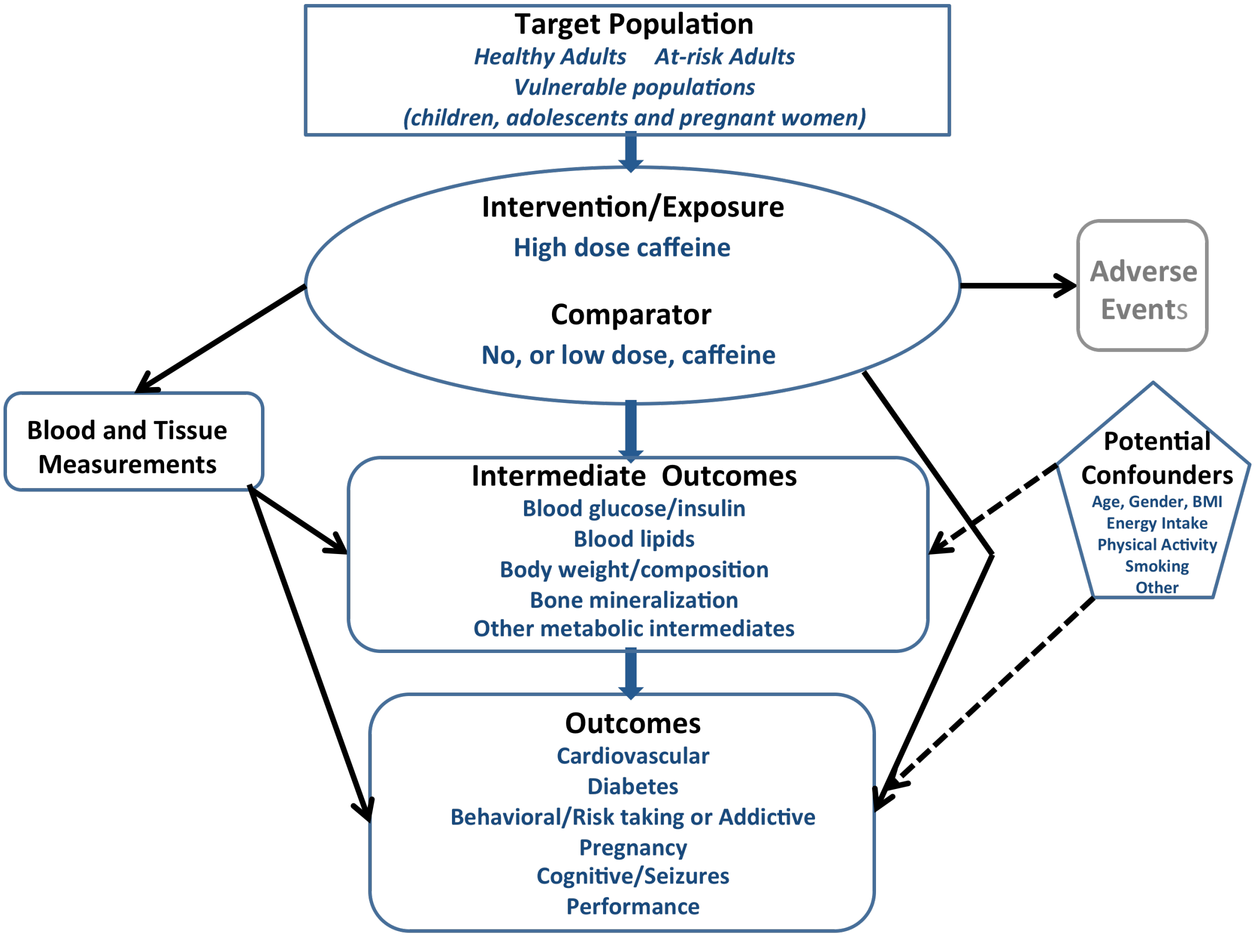
ANALYTICAL FRAMEWORK



Appendix E-2.41: Evidence Portfolio

Part D. Chapter 5: Food Sustainability and Safety

What is the relationship between aspartame consumption and health?

Conclusion Statement: The DGAC generally concurs with the European Food Safety Authority (EFSA) Panel on Food Additives that aspartame in amounts commonly consumed is safe and poses minimal health risk for healthy individuals without phenylketonuria (PKU).
DGAC Grade: Moderate

Limited and inconsistent evidence suggests a possible association between aspartame and risk of some hematopoietic cancers (non-Hodgkin lymphoma and multiple myeloma) in men, indicating the need for more long-term human studies. In addition, limited and inconsistent evidence indicates a potential for risk of preterm delivery. Due to very limited evidence it is not possible to draw any conclusions on the relationship between aspartame consumption and headaches.
DGAC Grade: Limited

Key Findings

- Overall, intakes of aspartame are not associated with an increased risk of adverse outcomes in populations who do not have PKU.
- Some concern requiring further investigation exist for some cancers, especially hematopeitic ones, but the data do not clearly identify a relationship.
- The possibility that intakes amongst the higher exposure groups during pregnancy could be associated with preterm delivery requires further evaluation and research.
- Overall exposures up to 40 mg/kg/day do not pose safety concerns based on modeling of evidence-based safe blood levels in a dose-response model.
- Intakes exceeding this amount are uncommon in the US population (need to quantify if possible).
- It must be emphasized that these findings do not apply to individuals with the disease PKU.

Description of the Evidence

European Food Safety Authority (EFSA) Report on the Scientific Opinion on the Re-evaluation of Aspartame as a Food Additive; EFSA Panel of Food Additives and Nutrient Sources added to Food (ANS), January 2013

Background

Aspartame is the most common low-calorie sweeteners used in the United States. It is found in numerous dietary sources. Although most commonly associated with low-calorie/low-sugar versions of carbonated and non-carbonated beverages, it also is found in low-calorie/low-sugar versions of canned fruits and juices; instant cereals; baked goods; ice cream and frozen ices; candy and chocolate products; jams, jellies, syrups, and condiments; yogurt; and beer. Nonnutritive sweeteners are regulated by the FDA. The FDA has concluded that aspartame is safe as a general purpose sweetener in food. Given the high interest of the public in the safety of aspartame, the DGAC reviewed the EFSA report on the sweetener and health outcomes.

Evidence Synthesis

The most recent European Food Safety Authority (EFSA) report on the re-evaluation of aspartame as a food additive was used to address this question. The EFSA report based its evaluation on original study reports and information submitted following public calls for data, previous evaluations, and additional literature that became available up until the end of public consultation on Nov 15, 2013. The DGAC focused on results from human studies, not animal studies or studies conducted *in vitro*. The Mode of Action (MoA) analysis on reproductive and developmental toxicity of aspartame was also included. Although the EFSA report considered both published and unpublished studies, the DGAC only considered published studies.

Cancer

A relatively limited body of evidence on human studies has directly addressed the relationship between aspartame consumption and cancer risk. The most consistent finding in six U.S. and European case-control studies (Andreatta 2008; Bosetti 2009; Bunin 2005; Cabaniols 2011; Gallus 2006; Hardell 2001) was the absence of an adverse relationship between consumption of low-calorie sweeteners, including aspartame, and risk of common cancers. An exception was one study in Argentina that found a positive association between long-term use (≥10 y) of artificial sweeteners and risk of urinary tract tumors (UTT), compared to non-users; although for short-term users, no association was observed (Andreatta 2008).

The findings of two prospective cohort studies (Lim 2006; Schernhammer 2012) were not consistent. Lim et al. examined a large cohort of men and women from the NIH-AARP Diet and Health study and found no association between consumption of aspartame-containing beverages and risk of overall hematopoietic cancer, brain cancer, or their subtypes. A second large prospective cohort study involved the Nurses' Health Study (NHS) and Health Professionals Follow-up Study (HPFS) cohorts followed over 22 years with dietary intake measured every 4 years (Shernhammer 2013). In this study, the highest category of aspartame intake (≥143 mg/day from diet soda and packets) was associated with significantly elevated risk of non-Hodgkin lymphoma (NHL) and of multiple myeloma in men. Both of the prospective cohort studies that addressed cancer risk had limitations regarding generalizability. The NIH-AARP cohort had an age range of 50-71 years and was, therefore, not generalizable to the overall adult population. Additionally, the Panel did not consider the positive findings in Shernhammer et al. to be significant because the positive association between aspartame consumption and NHL was limited to men and lacked a clear dose-response relationship. Note: non-Hodgkin's lymphomas are ~49% of hematological malignancies in the US; myelomas are ~14%.

Further investigation should be considered to assure there is no association between aspartame consumption and specific cancer risk.

Preterm Delivery

Two European cohort studies were used in this evaluation. A large prospective cohort study (Halldorsson et al., 2010) from the Danish National Birth Cohort investigated associations between consumption of artificially sweetened and sugar sweetened soft drinks during pregnancy and subsequent pre-term delivery. Also, a large prospective cohort study of Norwegian women (Englund-Ögge et al., 2012) investigated the relationship between consumption of artificially sweetened and sugar sweetened soft drinks during the first 4-5 months of pregnancy and subsequent pre-term delivery. In addition, La Vecchia (2013) combined these two studies in a meta-analysis that was considered.

Regarding the Haldorsson study, significant trends in risk of pre-term delivery with increasing consumption of artificially sweetened drinks (carbonated and non-carbonated) were found, but not for sugar-sweetened drinks. In the highest exposure groups (≥ 4 serv/d) the odds ratios relative to non-consumption were 1.78 (95 % CI 1.19-2.66) and 1.29 (95 % CI 1.05-1.59) respectively for carbonated and noncarbonated artificially sweetened drinks. Associations with consumption of artificially sweetened carbonated drinks did not differ according to whether delivery was very early (< 32 weeks) or only moderately or late pre-term. The EFSA Panel noted that the prospective design and large size of the study sample were major strengths, and there were no important flaws in the methods used. The Panel agreed with the authors who concluded that replication of their findings in another setting was warranted.

Regarding the Englund-Ögge study, no significant trends were found in risk of pre-term delivery with increasing consumption of artificially sweetened drinks or sugar-sweetened drinks. Small elevations of risk were observed with higher consumption of artificially sweetened soft drinks, but after adjustment for covariates, these reached significance only when categories of consumption were aggregated to four levels, and then the odds ratio for the highest category (≥ 1 serving/day) was 1.11 (95 % CI 1.00-1.24) compared with non-consumption. This was driven by an increase in spontaneous but not medically induced pre-term delivery. Associations with sugar-sweetened soft drinks tended to be stronger, with an adjusted odds ratio of 1.25 (95 % CI 1.08-1.45) for consumption of at least 1 serv/d. The Panel noted that effects may have been underestimated because of inaccuracies in the assessment of dietary exposures, but the method was similar to that used by Halldorsson et al., and the same for sugar-sweetened as for artificially sweetened soft drinks.

Behavior and Cognition

Children

Two randomized controlled trials (RCTs) (Shaywitz 1994; Wolraich 1994) and two non-randomized controlled trials (Kruesi 1987; Roshon & Hagen 1989) conducted in the US were included in the evidence on effects of aspartame on behavior and cognition in children. Wolraich et al. compared diets high in sucrose to diets high in aspartame in 25 preschool and 23 primary school-age children and found that even when intake exceeded typical dietary levels, neither dietary sucrose nor aspartame affected children's behavior or cognitive function. Shaywitz et al. examined the effect of large doses of aspartame (10 times usual consumption) on behavioral/cognitive function in children with attention deficit disorder (5-13 year of age) and found no effect of aspartame on cognitive, attentive, or behavioral testing. Roshon and Hagan examined 12 preschool children on alternate experimental days with a challenge of sucrose- or aspartame-containing drinks and found no significant differences in locomotion, task orientation or learning. Lastly, Kruesi et al. investigated the effect of sugar, aspartame, saccharin, and glucose on disruptive behavior in 30 preschool boys on four separate experimental days. There was no significant difference in scores of aggression or observer's ratings of behavior in response to any of the treatments. The limitations of this evidence were that all of the trials were approximately 20-30 years old, all had small sample sizes, and all were conducted over the short-term (1 day to 3 weeks). Overall, the Panel noted that no effects of aspartame on behavior and cognition were observed in children in these studies.

Adults

Seven studies on the effect of aspartame on adult behavior and cognition were included in this body of evidence. Five RCTs, one non-randomized controlled trial, and one case-control study were conducted in the US. Two of these trials examined a single experimental dose of aspartame on one day (Lapierre 1990; Ryan-Harshman 1987). Lapierre et al. examined 15 mg aspartame/kg body weight in 10 healthy adults and found no significant differences between aspartame and placebo in cognition or memory during the study. Ryan-Harshman et al. tested 13 healthy adult men and found no change in any behavioral effects measured. A third randomized crossover trial examined 48 adults over 20 days; half of the participants were given high dose aspartame (45 mg/kg/d) and half were given low dose aspartame (15 mg/kg/d) (Spiers 1998). This study found no neuropsychologic, neurophysiologic or behavioral effects linked to aspartame consumption. Two trials were conducted with pilots or college students to test cognitive abilities related to aviation tasks (Stokes 1991; Stokes 1993). In the first study, 12 pilots were given aspartame (50 mg/kg) or placebo and tested for aviation-related information processing after a single treatment on one day. There was no detection of performance decrements associated with exposure to aspartame. In the follow-up study, college students were given repeated dosing of aspartame (50 mg/kg for 9 days) and tested for aviation-related cognitive tasks. No impaired performance was observed. One non-randomized crossover trial examined the effects of aspartame on mood and well-being in 120 young college women and found no difference in changes in mood after consuming a 12 oz water or aspartame-sweetened beverage on a single day (Pivonka & Grunewald 1990). Lastly, a case-control study was conducted with 40 adults with unipolar depression and a similar number of subjects without a psychiatric history (Walton 1993). Participants were given aspartame (30 mg/kg) or placebo for 7 days and individuals with depression reported a difference in severity of self-scored symptoms between aspartame and placebo; whereas the non-depressed matched subjects reported no difference. This suggested that individuals with mood disorders may be sensitive to aspartame. Overall, the Panel noted the limited number of participants, the short duration of the studies, and the inconsistency of the reporting of the results in all adult studies. However, despite these limitations, the Panel concluded that there was no evidence that aspartame affects behavior or cognitive function in adults.

Other (Headaches, Seizures)

Several studies examined headaches and seizures. A number of RCTs were conducted to assess the incidence of headache after consumption of aspartame. One RCT tested the effects of aspartame within 24 hours of consumption (30 mg/kg) on 40 subjects with a history of headache and found no difference in the incidence rate of headaches (Schiffman 1987). Another RCT looked at the effect of aspartame on frequency and intensity of migraine headaches in 10 subjects with medical diagnosis of migraine headaches over 4 weeks (Koehler and Glaros, 1988). The authors found an increase in the frequency of migraine headaches with the aspartame treatment. In an RCT of 18 subjects with self-described sensitivity to aspartame, the participants reported headaches on 33% of the days, compared with 24% with placebo (Van den Eeden 1994). The authors concluded that a subset of the population may be susceptible to headaches induced by aspartame. Lastly, in a survey study of 171 patients at a headache unit, 8% reported that aspartame was a trigger of headaches compared to 2.3% for carbohydrates and 50% for alcohol (Lipton 1989). Overall, the Panel concluded the possible effect of aspartame on headaches had been investigated in various studies which reported conflicting results, ranging from no effect to the suggestion that a small subset of the population may be susceptible to aspartame-induced headaches. The number of existing studies was small and dated, and several studies had high dropout rates. The Panel noted that because of the limitations of the studies it was not possible to draw a conclusion on the relationship between aspartame consumption and headaches.

Several small studies assessed seizures. One RCT in children investigated whether aspartame would induce the occurrence of petit mal seizures (Camfield 1992). Ten children were given one treatment of aspartame at the ADI of 40 mg/kg and that treatment exacerbated the number of EEG spike waves per hour for these children without a history of seizures. In a second RCT, aspartame (34 mg/kg) was administered to 10 epileptic children over 2 weeks to examine the induction of seizures (Shaywitz 1994). No difference was found in the occurrence of seizures between aspartame and placebo exposure. Another RCT studied 18 subjects who claimed to have experienced epileptic seizures due to aspartame (Rowan 1995). One treatment (50 mg/kg) was administered on a single day and the authors reported no seizures or other adverse effect from aspartame treatment in this group. Overall, the Panel concluded that the available data do not provide evidence for a relationship between aspartame consumption and seizures.

Pregnancy Outcomes: Mode of Action (MoA) analysis

The EFSA Panel considered that adverse effects on reproduction and development reported for aspartame in animal studies could be attributed to the metabolite phenylalanine. They undertook a formal Mode of Action (MoA) analysis of the putative role of phenylalanine in developmental toxicity (as seen in animal studies).

Risk characterization was based on comparison of plasma phenylalanine levels following aspartame administration with plasma phenylalanine levels associated with developmental effects in children born from mothers with PKU. Current clinical practice guidelines recommend PKU patients restrict dietary intake of phenylalanine to keep plasma levels below 360μM. The

EFSA Panel noted that intakes of aspartame as a food additive could occur at the same time as other dietary phenylalanine sources. Therefore, they considered the threshold utilized for comparisons should be lowered to allow for simultaneous intake of aspartame with meals. So plasma phenylalanine from the diet (120µM) was subtracted from 360µM to determine the maximum safe plasma concentration of phenylalanine that can be derived from aspartame (240µM).

The Panel considered that given these conservative assumptions, realistic dietary intake of aspartame and the confidence intervals provided by the modeling, the peak plasma phenylalanine levels would not exceed the clinical target threshold of 240µM when a normal individual consumed aspartame at or below the current ADI of 40 mg/kg body weight/day. Therefore, the Panel concluded there would not be a risk of adverse effects on pregnancy in the general population at the current ADI.

For additional details on this body of evidence, visit: www.efsa.europa.eu/efsajournal

Table 1. Summary of Relevant Human Studies from the European Food Safety Authority (EFSA) Report: Scientific Opinion on the Re-evaluation of Aspartame as a Food Additive

Topic	Evidence	Outcomes	Strengths/ Limitations	Author Statements/ Other
Aspartame: Preterm Delivery	Large prospective cohort study (Halldorsson et al.) from the Danish National Birth Cohort investigated associations between consumption of artificially sweetened and sugar sweetened soft drinks during pregnancy and subsequent pre-term delivery.	Significant trends in risk of pre-term delivery with increasing consumption of artificially sweetened drinks (carbonated and non-carbonated), but not for sugar-sweetened drinks. For highest exposure groups (≥ 4 serv/d) vs non-consumption OR = 1.78 (95% CI 1.19-2.66) and 1.29 (95% CI 1.05-1.59) for carbonated and noncarbonated artificially sweetened drinks. Associations with consumption of artificially sweetened carbonated drinks did not differ according to whether delivery was very early (<32 weeks) or only moderately or late pre-term.	The Panel noted the prospective design and large size of study sample were major strengths, and there were no important flaws in the methods used. Panel agreed with the authors who concluded that replication of their findings in another setting was warranted.	Both Halldorsson and Englund-Ögge were well designed and conducted. Noting this, the Panel concluded that even at high levels of exposure to artificially sweetened soft drinks the risk of pre-term delivery is likely to be small, if any. The observed associations could be a consequence of uncontrolled residual confounding.
	Large prospective cohort study of Norwegian women (Englund-Ögge et al.) investigated the relationship between consumption of artificially sweetened and sugar-sweetened soft drinks during the first 4-5 months of pregnancy and subsequent pre-term delivery.	No significant trends were found in risk of pre-term delivery with increasing consumption of artificially sweetened drinks or sugar-sweetened drinks. Small elevations of risk were observed with higher consumption of artificially sweetened soft drinks, but after adjustment for covariates, these reached significance only when categories of consumption were aggregated to four levels, then OR = 1.11 (95% CI 1.00-1.24) for the highest category (≥ 1 serving/day) in comparison to non-consumption. This was driven by	The Panel noted that effects may have been underestimated because of non-differential inaccuracies in the assessment of dietary exposures, but the method was similar to that used by Halldorsson et al. and the same for sugar-sweetened as for artificially sweetened soft	

		an increase in spontaneous but not medically induced pre-term delivery. Associations with sugar-sweetened soft drinks tended to be stronger, with an adjusted OR = 1.25 (95% CI 1.08-1.45) for consumption of at least 1 serv/d.	drinks.	
	La Vecchia (2013) performed a meta-analysis of findings from Halldorsson et al. (2010) and Englund-Ögge et al.[20-22]	The analysis indicated similarly elevated risks of pre-term delivery with higher consumption both of sugar-sweetened and of artificially sweetened drinks.	The lack of specificity in the associations points to possible residual confounding.	
	Overall, currently available epidemiological data do not suggest that consumption of artificially sweetened soft drinks is a cause of pre-term delivery.			
Aspartame: Cancer	Case-control study (Hardell et.) in Sweden of 209 patients with brain tumors compared with 425 controls, selected from the Swedish Population Register and matched for sex, age and region of residence. The focus of study was exposure to ionizing radiation/cell phones, but information was also collected on consumption of low-calorie drinks, most of which contained aspartame.	Non-significant elevations of risk for consumption of low-calorie drinks in relation to brain tumors overall (OR = 1.24, 95% CI 0.72-2.14) and malignant brain tumors specifically (OR = 1.70, 95% CI 0.84-3.44).	The study had a high response rate, but was limited by its relatively small size, the basic assessment of exposure (low-calorie drinks), and the potential for recall bias (because cases knew that they had a brain tumor) all of which could have led to inflation of risk estimates.	
	Case-control study (Bunin et al.) of 315 US children with medulloblastoma/primitive neuroectodermal tumor diagnosed before the age of 6 y, and 315 control children (selected from the general population by random digit dialing).[24]	In an unadjusted analysis, a significant trend of increasing risk was observed with more frequent consumption of low-calorie carbonated drinks in the pre-conception period. This was attenuated after adjustment for potential confounders, with an adjusted OR = 1.3 (95% CI 0.7-2.5) for ≥2/day versus < 1/month. There were no significant associations with reported frequency of consuming diet soda during midpregnancy.	Assessment of exposure to diet soda required recall after an interval of several years and therefore may not have been reliable. It served only as a proxy for exposure to aspartame (at the time was the most widely used sweetener in soft drinks), and other possible sources of aspartame were	The authors concluded that their results generally did not support an association with aspartame, but the limitations, and also the low statistical power, restrict the conclusions that can be drawn from this study.

			not evaluated.	
	Linked set of case-control studies (Gallus et al.) in Italy assessed the association of artificial sweeteners with 9 types of cancer. Patients with incident, histologically confirmed cancers of the oral cavity and pharynx (598), esophagus (304), colon (1225), rectum (728), larynx (460), breast (2569), ovary (1031), prostate (1294) and kidney (767) were compared with 7028 controls admitted to the same hospitals for acute, non neoplastic disorders.	The ORs for consumption of other sweeteners, mainly aspartame, were 0.77 (95% CI 0.39–1.53) for cancers of the oral cavity and pharynx, 0.77 (95% CI 0.34–1.75) for esophageal, 0.90 (95% CI 0.70–1.16) for colon, 0.71 (95% CI 0.50–1.02) for rectal, 1.62 (95% CI 0.84–3.14) for laryngeal, 0.80 (95% CI 0.65–0.97) for breast, 0.75 (95% CI 0.56–1.00) for ovarian, 1.23 (95% CI 0.86–1.76) for prostate and 1.03 (95% CI 0.73–1.46) for kidney cancer. A significant inverse trend in risk for increasing categories of total sweeteners (incl saccharin) was found for breast and ovarian cancer, and a direct one for laryngeal cancer.	Misclassification of exposures will have been non-differential (i.e. similar for cases and controls), in which case the effect will have been to bias risk estimates towards the null. Thus, while the results do not suggest a hazard for the cancers studied, on their own they provide only limited reassurance of safety.	The authors state this study provides no evidence that saccharin or other sweeteners (mainly aspartame) increase the risk of cancer at several common sites in humans.
	Case-control update of Gallus et al. in Italy (Bosetti et al.) to test possible associations of artificial sweeteners with 3 types of cancer. Cases were 230 patients with stomach cancer, 326 patients with pancreatic cancer and 454 patients with endometrial cancer. These were compared with 547, 652 and 908 controls, frequency matched by age, sex and study center.	ORs for use of low-calorie sweeteners versus non-use were 0.80 (95% CI, 0.45-1.43) for gastric cancer, 0.62 (95% CI, 0.37-1.04) for pancreatic cancer, and 0.96 (95%CI, 0.67-1.40) for endometrial cancer. Corresponding ORs for saccharin were 0.65 (95% CI, 0.25-1.68), 0.19 (95 % CI, 0.08-0.46), and 0.71 (95% CI, 0.36-1.38), and for other sweeteners were 0.86 (95% CI, 0.45-1.67), 1.16 (95%CI, 0.66-2.04), and 1.07 (95% CI, 0.71-1.61).	The findings do not suggest a hazard, but because exposures to aspartame specifically were not distinguished, and because of possible non-differential misclassification of exposures, on their own they provide only limited evidence of safety.	Authors state that this study adds further evidence on the absence of an adverse effect of low-calorie sweeteners, including aspartame, on risk of common neoplasms.

	Case-control study (Andreatta et al.) in Argentina to investigate the relation between consumption of artificial sweeteners and urinary tract tumours (UTT). A study of 197 patients with incident confirmed transitional-cell UTTs along with 397 controls from the same area who had no history of cancer, and had been admitted to hospital with acute non-neoplastic, non-urinary tract diseases.	For long-term use (≥10 y) a positive association was found between use of artificial sweeteners and risk of UTT compared to non-users (OR = 2.18, 95% CI 1.22–3.89, adjusted for age, sex, BMI, social status, and years of tobacco use). For short-term consumers, no association with UTT was observed.	The Panel noted that ~80% of cases and controls who consumed artificial sweeteners, used saccharin or cyclamate. The study provided little information about possible risks from aspartame.	The authors concluded that use of artificial sweeteners for 10 years or more was positively associated with UTT.
	Prospective cohort study by Lim et al. from the NIH-AARP Diet and Health Study included 285,079 men and 188,905 women aged 50-71 y at entry, which was drawn from 8 areas in the US.[28] In this cohort, risk of hematopoietic cancer (1888 cases) and malignant glioma (315 cases) during 5 y follow-up (1995-2000) was examined in relation to daily intake of aspartame assessed at baseline.	During > 5 y follow-up, 1,888 hematopoietic cancers and 315 malignant gliomas. Higher levels of aspartame intake were not associated with the risk of overall hematopoietic cancer (RR for ≥600 mg/d = 0.98; 95% CI, 0.76-1.27), glioma (RR for ≥400 mg/d = 0.73; 95% CI, 0.46-1.15; P for inverse linear trend = 0.05), or their subtypes in men and women.	The Panel noted that major strengths of this investigation were its prospective longitudinal design, large number of cases, and that exposures were assessed at baseline and therefore unbiased by knowledge of disease outcome. Ascertainment of cancers was reliable. Confounding was unlikely to have been a major problem, although there was no adjustment for socio-economic status (which has shown some relation with brain cancer). Assessment of exposure to aspartame covered aspartame containing drinks as well as addition of aspartame to coffee and tea, but it was limited to one point in time, and usage in	The authors concluded that their prospective study suggested that aspartame consumption derived from its main source, aspartame-containing beverages, does not raise the risk of hematopoietic or brain malignancies.

			the years before the study may have been lower.	
	Pilot case-control study (Cabaniols et al.) conducted in France to investigate lifestyle factors and brain cancer risk with 122 incident adult cases of malignant primitive brain tumors (MPBT) and 122 controls with other neurological diagnoses.	There was no association between aspartame consumption during the past five years of at least once per week and risk of MPBT (OR = 1.02, 95% CI 0.57-1.85).	Information on the method of dietary assessment was limited, and there was no attempt to control for potential confounding other than sex and age. In view of this, and the low statistical power of the study (reflected in the CI), the nonpositive finding provides little reassurance of an absence of hazard.	The authors stated that additional large clinical studies are needed to confirm these findings.

	Prospective cohort study with Nurses' Health Study and Health Professionals Follow-Up Study cohorts (Schernhammer et al.).[30] The risk of lymphatic and hematopoietic cancers in relation to consumption of diet soda and aspartame sweeteners added at the table was examined; 77,218 female registered nurses and 47,810 male health professionals were followed for 22 y.	1,324 subjects developed non-Hodgkin lymphoma (NHL), 285 multiple myeloma, and 339 leukemia (mostly myeloid leukemia). The highest category of aspartame intake (≥143 mg/day) was associated with elevated relative risk of NHL (RR = 1.64, 95% CI 1.17-2.29) and of multiple myeloma (RR = 3.36, 95% CI 1.38-8.19) in men. There was no consistent trend in risk with increasing exposure, and there were no corresponding elevations in risk in women. No clear association with leukemia was apparent in either men or women.	Major strengths of this study were its prospective design, the substantial number of cancer cases, the repeated assessment of dietary intake every 4 y, aspartame intake assessed from time of entry in US diet, and many potential confounders assessed. The Panel stated that the positive findings can be given little weight, given their limitation to men, the small relative risks observed, and the lack of clear dose-response relationships.	Schernhammer et al speculated that the differential findings for men and women might reflect differences in the activity of alcohol dehydrogenase type 1, which converts methanol (a metabolite of aspartame) to formaldehyde, and is higher in men than in women.
	The Panel considered that the results of these epidemiological studies do not suggest an increased risk associated with aspartame consumption for the types of cancer examined.			
Aspartame: Metabolic Outcomes	Randomized controlled trial (Leon et al. 1989) on the effects of aspartame on metabolic outcomes.[31] Participants included 57 women and 51 men randomly assigned to either the aspartame (n = 53, 75 mg/kg/d) or placebo (n = 55) for 24 wks.	No treatment-related hematological changes, alterations in clinical chemistry, urinary abnormalities, or differences in vital signs or body weight. No differences in blood formate or methanol; urinary Ca2+ or formate; serum folate; or serum lipids. No significant changes in amino acid profiles and no evidence of accumulation of phenylalanine or tyrosine.		
	Controlled diet study (Porikos and Van Italie) with 21 men (24-45 y) given a baseline diet (25-30 % calories from sucrose) alternating with a calorie restricted diet (sweetness replaced with aspartame).	There were small increases in blood urea nitrogen (BUN) in subjects on aspartame containing diet, but renal function remained within normal parameters. Serum triglycerides decreased by 33 % on the aspartame diet.	The Panel noted that the dose of aspartame was not specified and that there were other changes in the diet, including changes in its caloric content.	
	Overall, the Panel concluded that no significant adverse effects were observed following repeated administration of aspartame for different durations and at different dose levels of aspartame in healthy subjects.			

Aspartame: Behavior and Cognition Children	Cross-over study (Kruesi et al.) investigated the effect of sugar and aspartame consumption on behavior in 30 preschool boys (2 - 6 y).[33] Double blind cross-over challenge with aspartame (30 mg/kg bw), sucrose (1.75 g/kg bw), saccharin (amount not specified) and glucose (1.75 g/kg bw).	There was no significant difference in scores of aggression or observers'' ratings of behavior between the sugar responsive and age-matched control boys following any of the four treatments.		
	Randomized cross-over trial (Wolraich et al.) with 25 normal preschool children (3 - 5 y) and 23 primary school-age children (6 - 10 y). Over three consecutive 3-wk periods, double blind randomized distribution to a diet high in aspartame (32-38 mg/kg/d), sucrose (4500-5600 mg/kg/d), or saccharin (10-12 mg/kg/d).	For the children described as sugar-sensitive, there were no significant differences among the 3 diets in any of the 39 behavioral and cognitive variables. For the preschool children significant differences were measured in 4 of the 31 measures (Parents'' ratings of cognition, grooved pegboard, dominant hand, non-dominant hand); however, no consistent pattern in behavioral and cognitive differences was observed amongst the 3 diets.		The authors concluded that 'even when intake exceeded typical dietary levels, neither dietary sucrose nor aspartame affects children's behavior or cognitive function'.
	Randomized crossover trial (Shaywitz et al.) of the effect of large doses of aspartame on behavior, cognitive function and monoamine metabolism in 15 children with attention deficit disorder (11 boys and 4 girls, 5-13 y). The trial consisted of two 2-week periods that were identical except for the administration of either aspartame (34 mg/kg/d) or placebo (microcrystalline cellulose).	No significant effect of aspartame on cognitive, attentive or behavioral testing. The biochemical and hematological parameters were not altered by aspartame except that plasma phenylalanine levels increased by approximately 40 % two hours following aspartame administration (within in normal postprandial range).		The authors state that the findings indicate that aspartame at greater than 10 times usual consumption had no effect on the cognitive and behavioral status of children with attention deficit disorder. In addition, aspartame did not appear to affect urinary excretion rates of monoamines and metabolites.
	Non-randomized, controlled study of Roshon and Hagen (1989) examined the effect of sucrose consumption on the behavior of 12 preschool children (6 boys and 6 girls, 3-5 y).	No significant difference in locomotion, task orientation and learning in participants exposed to either sucrose or placebo (9 mg aspartame/kg).		
	The Panel noted that no effects of aspartame on behavior and cognition were observed in children in these studies.			
Aspartame: Behavior and Cognition Adults	Randomized, crossover trial (Lapierre et al.) with 10 healthy adults (6 men, 4 women, 21—36 y) who received a single dose of aspartame (15 mg/kg) or placebo capsules.	No significant differences between aspartame and placebo were found in measures of sedation, hunger, headache, reaction-time, cognition or memory during the study. Plasma phenylalanine levels rose within thirty minutes of administration of aspartame.		

	Randomized crossover trial (Ryan-Harshman et al.) with healthy males age 20 - 35 y (n = 13/group) given phenylalanine capsules (0.8, 2.5, 5 and 10 g) or aspartame (5 or 10 g) as a single dose to investigate neurobehavioral effects on energy and macronutrient selection and on subjective feelings of hunger, mood and arousal.	Neither phenylalanine nor aspartame altered mean energy intakes or macronutrient selection nor caused any behavioral effects.		
	Non-randomized, controlled crossover study (Pivonka and Grunewald 1990) examined the effect on mood and well-being in 120 women (18 - 30 y) receiving water, aspartame-sweetened or sugar-sweetened beverages.	Mood tests employed were the Stanford Sleepiness Scale (SSS), the Visual Analogue Mood Scale (VAMS), and the Profile of Mood States (POMS). Changes in mood were similar following consumption of water or the aspartame-sweetened beverage. However, the ingestion of the sugar-sweetened beverage was followed by increased sleepiness during the last half of the one-hour observation period (p less than .002).		
	Double-blind study (Stokes et al.), 12 healthy pilots (4 females and 8 males) were given placebo, aspartame (50 mg/kg bw) or ethanol (positive control, dose not reported but estimated to raise plasma alcohol to 0.1 %).[40] Each subject performed the SPARTANS cognitive test battery of aviation-relevant information-processing tasks on 5 sessions after a single treatment.	No detectable performance decrements were associated with the exposure to aspartame, but decrements in psychomotor and spatial abilities were detected following ethanol administration.		
	Follow up study (Stokes et al.) was undertaken in 12 subjects (college students, sex not reported) in order to examine the effects of double-blind repeated dosing of aspartame on performance in aviation-relevant cognitive tasks. The subjects received placebo capsules or aspartame capsules (50 mg/kg bw/day) for 9 days, or an acute dose of ethanol to achieve 0.1 % blood ethanol levels.	Forty-seven task variables were measured using the SPARTANS 2.0 cognitive test battery and no significantly impaired performance on flight-relevant cognitive tasks was observed.		

	Study by Walton et al. was designed to test whether subjects with mood disorders were sensitive to adverse effects caused by aspartame; 40 adult patients with unipolar depression and a similar number of adult subjects without a psychiatric history were recruited. The participants were given aspartame (30 mg/kg bw/day) or placebo (sucrose) in capsules for a period of 7 days with two 3-day washout periods using a double-blind cross-over study design.	Despite the small number of subjects, there was a significant difference in the number and severity of self-scored symptoms between aspartame and placebo in the patient group while there was no difference in the non-depressed volunteer group.		
	Randomized double-blind placebo-controlled 3-way crossover, 48 adults (24 men, 24 women, 18—34 y) were exposed after an initial one-month aspartame-free period, to aspartame, sucrose or placebo administered for 20 days each (Spiers et al.).[43] Twenty-four participants were given a high dose of aspartame (45 mg/kg/d) and the remaining received a low dose of aspartame (15 mg/kg/d). The dose of sucrose was 90 g/day for all subjects. Administration of aspartame or placebo (microcrystalline cellulose) was in the form of capsules and for sucrose, a beverage.	Plasma phenylalanine levels increased dose-dependently with aspartame consumption from 56 µM (placebo) to 79 µM (high dose), but no neuropsychologic, neurophysiologic and behavioral effects linked to aspartame consumption were observed.		
	The Panel noted the limited number of participants, the short duration and the inconsistency of the reporting of the results in all these adult human studies. These limitations apply to both positive and negative studies. Overall, the Panel concluded that there was no evidence that aspartame affects behavior or cognitive function in children or adults.			
Aspartame: Seizures	Double-blind study in 8 girls and 2 boys (5.1 - 14.6 y) diagnosed with generalized absence seizures (petit mal seizures) to investigate whether aspartame exacerbates occurrence of seizures (Camfield et al.).[44] Following 1-hr baseline recordings of the number and length of spike-wave bursts (determined using an ambulatory cassette EEG recorder), the children were given 250 ml orange juice sweetened with either aspartame (40 mg/kg) or sucrose (1 g sucrose for every 25 mg aspartame to achieve	Following the consumption of aspartame but not of sucrose, the total duration of spike-wave discharge per hr was significantly increased and aspartame appeared to exacerbate the amount of EEG spike waves in children with absence seizures.	The Panel noted that the combination of the two parameters (number and length of spike-wave bursts) into a single measure was not adequately explained, and lack of control of food and drink intake before and after dosing may have affected the results. The Panel further noted that aspartame was	

	similar sweetness) (assigned randomly) and the EEG recordings were continued for 6 h. Each child was tested once with each substance.		given in a single dose at the ADI.	
	Randomized double-blind placebo-controlled, crossover study (Shaywitz et al.) aspartame (34 mg/kg) was administered to epileptic children (5 boys, 5 girls, 5-13 y) for 2 wks to investigate the induction of seizures following aspartame consumption.	Nine children completed the study and it was reported that there was no difference in the occurrence of seizures between aspartame and placebo exposure. The plasma levels of phenylalanine increased from 60 μM to 82 μM by one hour post aspartame administration.		
	Randomized double-blind placebo-controlled crossover study by Rowan et al.[46] In this trial, subjects (sixteen adults and two children) who claimed to have experienced epileptic seizures reportedly due to aspartame were given capsules either containing microcrystalline cellulose (placebo) or aspartame (total dose of 50 mg/kg bw). This dose was divided into three portions and administered in the morning at two-hour intervals	The authors reported no seizures or other adverse effects from aspartame ingestion. Mean plasma phenylalanine levels increased from 52 μM (after placebo) to 84 μM two hours after the first two doses aspartame.		
	Overall the Panel concluded that the available data do not provide evidence for a relationship between aspartame consumption and seizures.			
Aspartame: Headaches	Schiffman et al. reported a randomized double-blind crossover trial with aspartame on 40 subjects with a history of headache and related neurologic symptoms within 24h of aspartame consumption.[47] The subjects (12 males and 28 females, 19—69 y) were given aspartame (30 mg/kg bw) or placebo (microcrystalline cellulose) in capsules; the dose was divided into 3 doses administered in the morning at 2 h intervals.	The incidence rate of headache after consumption of aspartame (35%) was not significantly different from that after placebo (45%).		

	Randomized cross-over trial by Koehler and Glaros comparing the effect of aspartame to matched placebo on frequency and intensity of migraine headache.[48] The subjects (2 males, 8 females; 18 - 47 y) who had medical diagnosis of migraine, consumed aspartame (1200 mg/person) or placebo (microcrystalline cellulose) in capsules and during two 4 wk phases.	Statistical analysis indicated a significant increase in the frequency of migraine headaches from the placebo to the aspartame treatment (mean number of migraines per subject: 1.72 (baseline phase), 1.55 (placebo phase), and 3.55 (aspartame phase)). No differences were reported in the intensity or duration of migraine headaches.	The high drop-out rate, from 25 to 11 participants in this study was not due to increased frequency or intensity of migraines. The Panel noted that the high inter individual variability in the response of the remaining volunteers makes interpretation unreliable.	
	In the study by Lipton et al. 171 patients at a headache unit completed a survey in which alcohol, aspartame, or carbohydrates intake were felt to be triggers of their headaches.	Study showed that 8% reported aspartame as a trigger of headaches compared to 2.3% for carbohydrates, and to about 50% for alcohol.	The Panel considered that having only listed possible triggers of headaches was a major limitation of this study.	
	Van den Eeden et al. conducted a double-blind randomized cross-over trial with subjects self-diagnosed as sensitive to aspartame.[50] Of the 32 subjects recruited and randomized to receive aspartame (in capsules given 3X/d to give a daily dose of 30 mg/kg bw/day for 7 d) and placebo (microcrystalline cellulose in capsules given 3X/d), only 18 participants completed the full study.	Participants reported headaches on 33 % of days during aspartame intake, compared with 24 % on placebo treatment (p = 0.04). However, no significant difference in the length or intensity of headaches or in the occurrence of side effects associated with the headaches was observed between treatments.		The authors concluded that a small subset of the population may be susceptible to headaches induced by aspartame.
	The possible effect of aspartame on headaches has been investigated in various studies, which reported conflicting results, ranging from no effect to the suggestion that a small subset of the population may be susceptible to aspartame-induced headaches. The number of existing studies was small, and several had high participant drop-out rates, both under placebo and aspartame treatment. Overall, the Panel noted that because of the limitations of the studies it is not possible to conclude on a relationship between aspartame consumption and headaches.			
Aspartame: Eating Behavior	The Panel is aware that a number of studies have focused on the effects of aspartame on appetite, hunger and food intake. The Panel considered that these studies of the effect of aspartame (or other low calorie sweeteners) on eating behavior were not relevant for the assessment of the safety of aspartame and that risk benefit assessment of aspartame are not within the term of reference and the remit of the Panel.			

Aspartame: Allergenicity	Study by Szucs et al. on aspartame effects on mast cells in vitro.	Aspartame did not affect IgE-mediated histamine release from mast cells in vitro. Mast cells cultured in the presence of aspartame for up to 9 days showed enhanced proliferation and decreased responsiveness to releasing stimuli.	The authors concluded that the effect of aspartame on proliferation of cells in culture could be ascribed to a nonspecific enhancing effect of its constituent amino acids. Aspartame did not stimulate mast cell or basophil in vivo as assessed by skin testing.	
	Kulczycki reported a cases of aspartame induced urticaria.	Reported a case of aspartame induced urticaria confirmed by double blind challenge in a 23 year old woman with no history of allergic disease. A second case in a 42 year old woman was also reported.		
	Garriga et al. (1991) attempted to identify subjects with hypersensitivity reactions to aspartame with blinded challenge procedures.[53] A total of 61 self-referrals and physician referrals were screened, with 20 referrals evaluated in the clinic. Twelve patients underwent single- and double-blind challenge with up to 2000 mg of aspartame.	No subject with a clearly reproducible adverse reaction to aspartame was identified.	The authors concluded that subjects who believed themselves to be allergic to aspartame did not have reproducible reactions.	
	Geha et al. conducted a multi-centre placebo-controlled clinical study to evaluate individuals who had experienced urticaria and/or angioedema associated with ingestion of food containing aspartame.[54] In a double-blind crossover study, 21 recruited subjects with a self-reported history of hypersensitivity to aspartame were exposed to aspartame and placebo. Conversion products of aspartame, aspartyl-phenylalanine diketopiperazine and beta-aspartame, were also included in the study. Patients received, on different days, increasing doses of aspartame (50, 300, 600 mg) and	Four urticaria reactions were observed, two followed aspartame ingestion and two followed placebo ingestion.	The authors concluded that aspartame and its conversion products were no more likely than placebo to cause allergic symptoms in subjects with a history consistent with hypersensitivity to aspartame.	

	placebo.			
	Butchko et al. reviewed all published papers from 1980 onwards reporting allergic-type reactions and attributed to aspartame exposure.	In an evaluation of consumer complaints related to aspartame by the Centers for Disease Control and Prevention (CDC, 1984) approximately 15 % of the anecdotal complaints were assigned to allergic-dermatologic reactions attributed to aspartame ingestion, such as rashes, sore throat/mouth, swelling and itching. Cases of urticaria and granulomatous panniculitis thought to be related to aspartame were reported.		
	The Panel noted that the studies available were performed on a limited number of participants. Overall, taking into account the limited data currently available, the Panel considered that the weight of evidence does not suggest that aspartame is associated with allergic-type reactions in experimental models or in humans. However, the Panel cannot exclude the possibility that in rare instances individuals could be susceptible to allergic reactions following aspartame ingestion.			
Aspartame: Allergies in Children	Prospective cohort study by Maslova et al. explored how intake of artificially sweetened beverages during pregnancy related to asthma and allergic rhinitis in children at 18 months and 7 years of age.[56] Analysis was based on 60,466 pregnant women who enrolled in the prospective longitudinal Danish National Birth Cohort between 1996 and 2002.	In comparison with no consumption of artificially sweetened non-carbonated soft drinks during pregnancy, consumption of at least one serving per day was associated with an increased risk of asthma by three of the four case definitions (odds ratios up to 1.23, 95% CI 1.13-1.33 for asthma at 18 months), but there was no consistent exposure-response relationship across lower frequencies of consumption. In a corresponding analysis for artificially sweetened carbonated soft drinks, elevated odds ratios were observed for all four case definitions with the highest odds ratios of 1.30, 95% CI 1.01 — 1.66 for asthma at 7 years of age identified through the Danish National Patient Registry, but again without clear exposure-response relationships. Allergic rhinitis was non-significantly associated with daily consumption of artificially sweetened carbonated soft drinks (OR 1.31, 95% CI 0.98-1.74); no association was observed with daily consumption of artificially sweetened non-carbonated drinks (odds ratios of 1.03, 95% CI 0.86-1.24).	Because in epidemiological terms, the elevations of risk were only small and inconsistent, the findings from this study can only be considered weakly suggestive of hazard i.e. an association between the consumption of artificially sweetened beverages during pregnancy and the diagnosis of asthma or allergic rhinitis in children. Before a final conclusion can be reached with regard to aspartame, the findings need to be explored further with more detailed assessment of exposure to specific artificial sweeteners.	
Mode of Action (MoA)	The Panel considered that adverse effects on reproduction and development reported for aspartame in animal studies could be attributed to the metabolite phenylalanine. They undertook a formal Mode of Action (MoA) analysis of the putative role of phenylalanine in developmental toxicity (as seen in animal studies).[19]			

	Risk characterization was based on comparison of plasma phenylalanine levels following aspartame administration with plasma phenylalanine levels associated with developmental effects in children born from mothers with PKU. Data on the concentrations of phenylalanine in plasma after different doses of aspartame were extracted from various studies, mainly unpublished studies submitted in response to EFSA's call for data.	Current clinical practice guidelines recommend PKU patients restrict dietary intake of phenylalanine to keep plasma levels below 360 µM. The Panel noted that intakes of aspartame as a food additive could occur at the same time as other dietary phenylalanine sources. Therefore, they considered the threshold utilized for comparisons should be lowered to allow for simultaneous intake of the food additive with meals. The highest mean dietary phenylalanine exposure per meal is 34.2 mg/kg bw and this corresponds to a phenylalanine plasma concentration of 120 µM. So plasma phenylalanine from the diet (120 µM) was subtracted from 360 µM to determine the maximum safe plasma concentration of phenylalanine that can be derived from aspartame (240 µM).	The Panel considered that given the conservative assumptions, realistic dietary intake of aspartame and the confidence intervals provided by the modeling, the peak plasma phenylalanine levels would not exceed the clinical target threshold when a normal individual consumed aspartame at levels below the current ADI of 40 mg/kg bw/day.	The Panel therefore concluded that there would not be a risk of adverse effects on pregnancy in the general population including heterozygous individuals at the current ADI.

Overall Conclusions

The Panel concluded that chronic toxicity and reproductive and developmental toxicity were the critical endpoints in the animal database. The Panel considered that the evaluation of long-term effects of aspartame should continue to be based on the animal data. Based on a Mode of Action analysis and the weight-of-evidence, the Panel considered that the reproductive and developmental toxicity in animals was due to phenylalanine released from aspartame and concluded that the basis for evaluation of the reproductive and developmental endpoint should be the available data in humans.

Conservative estimates of exposure to aspartame made by the Panel for the general population were ≤36 mg/kg bw/day at the 95th percentile.

Due to the conservatism of both the exposure assessment and the aspartame dose-phenylalanine concentration response modeling, the Panel considered that it was highly unlikely that any individual in the normal and PKU heterozygous population would have plasma levels of phenylalanine above 240 uM following oral aspartame exposure up to the ADI of 40mg/kg bw/day. The Panel further considered that even in combination with diet, these aspartame intakes would not lead to peak plasma phenylalanine concentrations above 360 uM, the current clinical guideline for prevention of adverse effects on the fetuses of PKU mothers.

The Panel concluded from the present assessment of aspartame that there were no safety concerns at the current ADI of 40 mg/kg bw/day. Therefore, there was no reason to revise the ADI for aspartame.

The Panel emphasized that its evaluation of phenylalanine plasma levels from a dose of aspartame at the ensuing ADI is not applicable to PKU patients. These individuals require total control of dietary phenylalanine intake to manage the risk from elevated phenylalanine plasma levels.

Research Recommendations

1. Examine the risks of aspartame related to some cancers, especially hematopoietic ones, and pregnancy outcomes.

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Appendix E2.42: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between dietary sodium intake and blood pressure in adults?

Conclusion Statements: The DGAC concurs with the three conclusions from the 2013 AHA/ACC Lifestyle Guideline that apply to adults who would benefit from blood pressure lowering:

The DGAC concurs that adults who would benefit from blood pressure lowering should "lower sodium intake." AHA/ACC Grade: Strong

DGAC Grade: Strong

The DGAC concurs that adults who would benefit from blood pressure lowering should "Consume no more than 2,400 mg of sodium/day." The report also indicates that "Further reduction of sodium intake to 1,500 mg/d can result in even greater reduction in blood pressure"; and concludes that "Even without achieving these goals, reducing sodium intake by at least 1,000 mg/d lowers blood pressure." AHA/ACC Grade: Moderate

DGAC Grade: Moderate

The DGAC concurs that adults who would benefit from blood pressure lowering should "Combine the DASH dietary pattern with lower sodium intake." AHA/ACC Grade: Strong

DGAC Grade: Strong

Methodology

To answer this question, the Committee used the 2013 National Heart, Lung, and Blood Institute (NHLBI) *Lifestyle Interventions to Reduce Cardiovascular Risk: Systematic Evidence Review from the Lifestyle Work Group* and the associated American Heart Association (AHA)/ American College of Cardiology (ACC) *Guideline on Lifestyle Management to Reduce Cardiovascular Risk*.[1] The Committee also reviewed the 2013 Institute of Medicine (IOM) report, *Sodium Intake in Populations*[2] and the recommendations of the IOM Panel on Dietary Reference Intakes for Electrolytes and Water[3] for consistency. Although new studies examining the relationship between sodium and blood pressure have been published since the completion of the NHLBI review, including findings from the Prospective Urban Rural Epidemiology (PURE) study,[4] the Committee determined the evidence presented in the SR conducted by NHLBI, linking sodium and blood pressure, was strong and that consideration of more recent findings would not change the conclusions. Thus, the Committee did not update the review.

Review of Evidence

The 2013 AHA/ACC Lifestyle Guideline and associated NHLBI Lifestyle Report summarized strong and consistent evidence that supports dietary sodium reduction as a means to prevent and treat high blood pressure. The studies used to inform the conclusion to lower sodium intake were conducted in older and younger adults, individuals with prehypertension and hypertension, men and women, and African American and non-African American adults. The trials also documented positive effects of sodium reduction that were independent of weight change; and include behavioral interventions where individuals were counseled to reduce sodium, as well as feeding studies.

The recommendation to combine the DASH dietary pattern with lower sodium is based heavily on the results of the DASH sodium trial, which showed clinically significant lowering of blood pressure with sodium intake of 2,400 mg/day and even lower blood pressure with sodium intake of 1,500 mg/day. The goal of 2,400 or less mg/day was selected because it is the estimated average urinary sodium excretion in the DASH sodium trial.

The recommendation to reduce sodium intake by 1,000 mg/day even if goals for 2,400 mg/day or 1,500 mg/day cannot be reached comes from studies where this level of sodium reduction was beneficial for blood pressure lowering.

The differences in the evidence grade for the three conclusions related to sodium and blood pressure in adults results from the differences in the number and power of clinical trials supporting each recommendation. For example, a grade of “moderate” was assigned to the second conclusion because fewer clinical trials informed the goals of 2,400 and 1,500 mg/day than for the overall goal of sodium reduction.

Table 1. Summary of existing reports examining the relationship between dietary sodium intake and blood pressure in adults

Question/ Purpose	Outcomes and Population of Interest	Included Studies	Evidence Statements/Conclusions from Existing Reports
Lifestyle Interventions to Reduce Cardiovascular Risk-Systematic Evidence Review from the Lifestyle Work Group, (NHLBI 2013) **ACC/AHA Guideline on Lifestyle Management to Reduce Cardiovascular Risk (Eckel, 2013)**			
Critical Question 2 (CQ2): Among adults, what is the effect of dietary intake of sodium and potassium on CVD risk factors and outcomes, when compared to no treatment or to other types	**Sodium and Blood Pressure**: Part a: Overall effect of dietary intake of sodium on blood pressure	Three RCTs.	Evidence Summary 1 (ES1): In adults, 25–80 years of age with BP 120–159/80–95 mmHg, reducing sodium intake lowers BP. (Strength of evidence: High)
	Part b: Comparison of different levels of dietary intake of sodium on blood pressure	One RCT	Evidence Summary 2 (ES2): In adults, 25–75 years of age with BP 120–159/80–95 mmHg, reducing sodium intake that achieves a mean 24-hour urinary sodium excretion of approximately 2,400 mg/day, relative to approximately 3,300 mg/day, lowers BP by 2/1 mmHg, and reducing sodium intake that achieves a mean 24-hour urinary sodium excretion of approximately 1,500 mg/day, lowers BP by 7/3

of interventions?			mmHg. (Strength of evidence: Moderate)
	Counseling to reduce dietary sodium and BP reduction	Two RCTs	Evidence Summary 3 (ES3): In adults, 30–80 years of age with or without hypertension, counseling to reduce sodium intake by an average of 1,150 mg/day reduces BP by 3–4/1–2 mmHg. (Strength of evidence: High)
	Part c: Sodium and blood pressure in subpopulations: subgroups included men and women, African Americans and non-African Americans, and older and younger adults.	Three RCTs (3–6 months' duration)	Evidence Summary 4 (ES4): In adults with prehypertension or hypertension, reducing sodium intake lowers BP in women and men, African American and non-African American adults, and older and younger adults. (Strength of evidence: High)
	Sodium and blood pressure in subpopulations: adults with either prehypertension or hypertension.	Three studies	Evidence Summary 5 (ES 5): Reducing sodium intake lowers BP in adults with either prehypertension or hypertension when eating either the typical American diet or the DASH dietary pattern. The effect is greater in those with hypertension. (Strength of evidence: High)
	Part d: Sodium and blood pressure in the context of dietary pattern changes	DASH-Sodium trial.	Evidence Summary 6 (ES6): In adults, 25–80 years of age with BP 120–159/80–95 mmHg, the combination of reducing sodium intake and eating the DASH dietary pattern lowers BP more than reducing sodium intake alone. (Strength of evidence: Moderate)
	Part e. Sodium and blood pressure in the context of other minerals	No RCTs or meta-analyses met inclusion criteria that examined whether reducing sodium intake plus changing dietary intake of any other single mineral lowers BP more than reducing sodium intake alone.	Evidence Summary 7 (ES7): Evidence from RCTs is not sufficient to determine whether reducing sodium intake and changing dietary intake of any other single mineral (e.g., increasing potassium, calcium, or magnesium) lowers BP more than reducing sodium intake alone
IOM, Sodium intake in populations: Assessment of evidence, 2013			
What is the effect of reducing dietary sodium intake in all individuals compared to habitual intake on health outcomes?	Cardiovascular disease (CVD), including stroke CVD mortality and all-cause mortality, congestive heart failure (CHF), chronic kidney disease (CKD), diabetes, cancer, and "other" outcomes, such as asthma and depression.	4 RCTs; 35 observational (cohort or case-control) studies • CVD, Stroke and Mortality (4 RCTS, 22 obs. studies) • Kidney disease (2 obs. studies) • Metabolic syndrome (2 obs. studies)	Conclusion 1: Although the reviewed evidence on associations between sodium intake and direct health outcomes has methodological flaws and limitations, the committee concluded that, when considered collectively, it indicates a positive relationship between higher levels of sodium intake and risk of CVD. This evidence is consistent with existing evidence on blood pressure as a surrogate indicator of CVD risk. Conclusion 2: The committee determined that evidence from studies on direct health outcomes is inconsistent and insufficient to conclude that lowering sodium intakes below 2,300 mg per day either increases or decreases risk of CVD outcomes (including stroke and CVD mortality) or all-cause mortality in the general U.S. population.

		• Diabetes (2 obs. studies) • Gastrointestinal cancer (8 obs. studies)	
What is the effect of reducing dietary sodium intake in individuals with hypertension, pre-hypertension, those aged 51 years and older, African Americans, and individuals with diabetes, chronic kidney disease, or congestive heart failure, compared to habitual intake on health outcomes?	Cardiovascular disease (CVD), including stroke CVD mortality and all-cause mortality, congestive heart failure (CHF), chronic kidney disease (CKD), diabetes, cancer, and "other" outcomes, such as asthma and depression.	4 RCTs; 35 observational (cohort or case-control) studies • CVD, Stroke and Mortality (4 RCTS, 22 obs. studies) • Kidney disease (2 obs. studies) • Metabolic syndrome (2 obs. studies) • Diabetes (2 obs. studies) • Gastrointestinal cancer (8 obs. studies)	Conclusion 1: The committee concluded that the available evidence suggests that low sodium intakes may lead to higher risk of adverse events in mid- to late-stage CHF patients with reduced ejection fraction and who are receiving aggressive therapeutic regimens. Because these therapeutic regimens were very different than current standards of care in the United States, the results may not be generalizable. Similar studies in other settings and using regimens more closely resembling those in standard U.S. clinical practice are needed. Conclusion 2: The committee concluded that, with the exception of the CHF patients described above, the current body of evidence addressing the association between low sodium intake and health outcomes in the population subgroups considered is limited. The evidence available is inconsistent and limited in its approaches to measuring sodium intake. The evidence also is limited by small numbers of health outcomes and the methodological constraints of observational study designs, including the potential for reverse causality and confounding. The committee further concluded that, while the current literature provides some evidence for adverse health effects of low sodium intake among individuals with diabetes, CKD, or preexisting CVD, the evidence on both the benefit and harm is not strong enough to indicate that these subgroups should be treated differently from the general U.S. population. Thus, the committee concluded that the evidence on direct health outcomes does not support recommendations to lower sodium intake within these subgroups to, or even below, 1,500 mg per day.
IOM, Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate, 2005			
What is the AI for sodium intake? *(Because insufficient data from dose-response trials, an Estimated Average Requirement (EAR) could not be established, and thus a Recommended*	To ensure that the overall diet provides an adequate intake of other important nutrients and to cover sodium sweat losses	>400 citations	Adults (19-50 yrs): The AI for sodium is set for young adults at 1.5 g (65 mmol)/day (3.8 g of sodium chloride) to ensure that the overall diet provides an adequate intake of other important nutrients and to cover sodium sweat losses in unacclimatized individuals who are exposed to high temperatures or who become physically active as recommended in other DRI reports. Older adults: The AI for sodium for older adults and the elderly is somewhat less, based on lower energy intakes, and is set at 1.3 g (55 mmol)/day for men and women 50 through 70 years of age, and at 1.2 g (50 mmol)/day for those 71 years of age and older Children 1– 18 : Given that little data are available indicating that in normal children, inadequate sodium intakes result in specific identifiable markers, and that, as with adults, normal kidney function can maintain sodium balance at extremes of sodium intake, the AI is set based on meeting

Dietary Allowance could not be derived)			nutrient needs for other essential nutrients. The AI is thus extrapolated down from the adult AI of 1.5 g/day (65 mmol/day) using relative energy intake, that is, the average of median energy intake levels of the age groups for adults and for children as the basis for extrapolation.
What is the recommended UL for sodium intake?	Blood pressure, stroke and CHD; left ventricular mass; calcium excretion, bone mineral density, and kidney stones; pulmonary function; gastric cancer	>400 citations	Adults (19- 50 yrs): Because the relationship between sodium intake and blood pressure is progressive and continuous without an apparent threshold, it is difficult to precisely set a UL, especially because other environmental factors (weight, exercise, potassium intake, dietary pattern, and alcohol intake) and genetic factors also affect blood pressure. For adults, a UL for sodium of 2.3 g (100 mmol)/day is set, equivalent to a total of 5.8 g/day of sodium chloride. In dose-response trials, this level was commonly the next level above the AI that was tested. The equivalent UL for chloride is 3.5 g. It should be noted that the UL is not a recommended intake and, as with other ULs, there is no demonstrated benefit to consuming levels above the AI. Individuals who are most sensitive to the blood pressure effects of increased sodium intake (e.g., older persons, African Americans, and individuals with hypertension, diabetes, or chronic kidney disease): Their UL for sodium may well be lower. These groups also experience an especially high incidence of blood pressure-related cardiovascular disease. Individuals who are unacclimatized to prolonged physical activity in a hot environment: Their needs may exceed the UL because of sodium sweat losses Children and adolescents (1- 18 yrs) The ULs for children are extrapolated from the adult UL of 2.3g (100 mmol)/day based on these estimated energy intakes, after rounding. Since the estimated energy intake for adolescents is in the same range as adults, the ULs for this age group are the same as those for adults.

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   Associated Lifestyle Guideline:

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Appendix E2.43: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between intake of saturated fat and risk of cardiovascular disease?

Conclusion Statements: Strong and consistent evidence from RCTs shows that replacing SFA with unsaturated fats, especially PUFA, significantly reduces total and LDL cholesterol. Replacing SFA with carbohydrates (sources not defined) also reduces total and LDL cholesterol, but significantly increases triglycerides and reduces HDL cholesterol.

Strong and consistent evidence from RCTs and statistical modeling in prospective cohort studies shows that replacing SFA with PUFA reduces the risk of CVD events and coronary mortality. For every 1 percent of energy intake from SFA replaced with PUFA, incidence of CHD is reduced by 2 to 3 percent. However, reducing total fat (replacing total fat with overall carbohydrates) does not lower CVD risk. Consistent evidence from prospective cohort studies shows that higher SFA intake as compared to total carbohydrates is not associated with CVD risk.

DGAC Grade: Strong

Evidence is limited regarding whether replacing SFA with MUFA confers overall CVD (or CVD endpoint) benefits. One reason is that the main sources of MUFA in a typical American diet are animal fat, and because of the co-occurrence of SFA and MUFA in foods makes it difficult to tease out the independent association of MUFA with CVD. However, evidence from RCTs and prospective studies has demonstrated benefits of plant sources of monounsaturated fats, such as olive oil and nuts on CVD risk.

DGAC Grade: Limited

Review of Evidence

The Committee drew evidence from SRs or MA published between January 2009 and August 2014 in English in a peer-reviewed journal, which included RCTs and/or prospective cohort studies. Participants included healthy volunteers as well as individuals at elevated chronic disease risk. The main exposure was SFA, and the main outcomes included LDL-cholesterol (LDL-C), HDL-cholesterol (HDL-C), triglycerides (TG), blood pressure (BP), and incidence of CVD, CVD-related death, myocardial infarction, or stroke. All reviews were high-quality, with ratings ranging from 8 to 11 on AMSTAR. The Committee drew evidence on blood lipids and blood pressure outcomes from the *2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk* and the *NHLBI Evidence Report on Lifestyle Interventions to Reduce Cardiovascular Disease Risk*[1], which included primarily RCTs on intermediate CVD risk factors. The Committee drew evidence on CVD endpoints and effect size estimates from seven published MA that included one or more studies not covered in these reports.[2-8] Little evidence on the contribution of SFA to cardiovascular risk factors in the pediatric populations was available, and that which was published has not been systematically reviewed.

Effects of Replacing SFA on LDL-C, HDL-C, and TG

Macronutrients may affect plasma lipids and lipoproteins, which are strong predictors of CVD risk. The NHLBI Lifestyle Report summarized evidence from three feeding trials examining effects on LDL-C of dietary patterns with varying SFA levels: DASH (Dietary Approaches to Stop Hypertension), DASH-Sodium, and DELTA (Dietary Effects on Lipoproteins and Thrombogenic Activity). The results from these trials indicate that reducing total and saturated fat led to a significant reduction in LDL cholesterol in the context of the DASH dietary pattern and the National Cholesterol Education Program (NCEP) Step 1 diet. To estimate the effects of replacing SFA by specific macronutrients such as carbohydrates, MUFA, or PUFA, the NHLBI Lifestyle Report also included two MA from Mensink and Katan (n=1,672), covering the period from 1970 to 1998 (27 controlled trials in the first MA and 60 controlled trials in the second MA) and using the same inclusion/exclusion criteria to estimate changes in plasma lipids when substituting dietary SFA with carbohydrates or other fat types and holding dietary cholesterol constant.[9, 10] Mensink and Katan found that replacing 1 percent of SFA with an equal amount of carbohydrates, MUFA, or PUFA led to comparable LDL-C reductions: 1.2, 1.3, and 1.8 mg/dL, respectively. Replacing 1 percent of SFA with carbohydrates, MUFA, or PUFA also lowered HDL-C by 0.4, 1.2, and 0.2 mg/dL, respectively. Replacing 1 percent of carbohydrates by an equal amount of MUFA or PUFA raised LDL-C by 0.3 and 0.7 mg/dL, raised HDL-C by 0.3 and 0.2 mg/dL, and lowered TG by 1.7 and 2.3 mg/dL, respectively. The 2003 MA by Mensink and Katan[10] indicated that the ratio of total to HDL-C, a stronger predictor of CVD risk than total or LDL cholesterol alone, did not change when SFA was replaced by carbohydrates, but the ratio significantly decreased when SFA was replaced by unsaturated fats, especially PUFA.

In summary, strong and consistent evidence from RCTs shows that replacing SFA with unsaturated fats, especially PUFA, significantly reduces total and LDL cholesterol. Replacing SFA with carbohydrates also reduces total and LDL cholesterol, but significantly increases TG and reduces HDL cholesterol. However, the evidence of beneficial effects on one risk factor does not rule out neutral or opposite effects on unstudied risk factors. To better assess the overall effects of intervention to reduce or modify SFA intake, studies of clinical endpoints are summarized below.

The Relationship between Consumption of Total Fat and SFA and Risk of CVD

A MA by Skeaff et al. in 2009 included 28 U.S. and European cohorts (6,600 CHD deaths among 280,000 participants) and found no clear relationship between total or SFA intake and CHD events or deaths.[8] Similarly, Siri-Tarino et al., 2010 found that SFA intake was not associated with risk of CHD, stroke or cardiovascular disease.[7] The Siri-Tarino et al., 2010 meta-analysis included data from 347,747 participants (11,006 developed CVD) in 21 unique studies, with 16 studies providing risk estimates for CHD and 8 studies providing data for stroke as an endpoint. In the 2012 MA of trials to reduce or modify intake of SFA, Hooper et al. also found no significant associations of total fat reduction with cardiovascular events or mortality. Consistent with these prior studies, Chowdhury et al.'s 2014 MA of total SFA also did not specify what macronutrient substituted SFA and again found no association of dietary SFA intake, nor of circulating SFA, with coronary disease.[2] Chowdhury et al. included data from 32 observational studies (530,525 participants) of fatty acids from dietary intake, 17 observational studies (25,721 participants) of fatty acid biomarkers, and 27 RCTs (103,052 participants) of fatty acid supplementation.

The results described above do not explicitly specify the comparison or replacement nutrient, but typically it consists largely of carbohydrates (sources not defined). These results suggest that replacing SFA with carbohydrates is not associated with CVD risk. Taken together, these results suggest that simply reducing SFA or total fat in the diet by replacing it with any type of carbohydrates is not effective in reducing risk of CVD.

Effects of Replacing SFA with Polyunsaturated Fat or Carbohydrates on CVD Events

Hooper et al.'s 2012 Cochrane MA of trials of SFA reduction/modification found that reducing SFA by reducing and/or modifying dietary fat reduced the risk of cardiovascular events by 14 percent (pooled RR = 0.86; 95% CI = 0.77 to 0.96, with 24 comparisons and 65,508 participants of whom 7 percent had a cardiovascular event, I= 50%).[4] Subgroup analyses revealed this protective effect was driven by dietary fat *modification* rather than reduction and was only apparent in longer trials (2 years or more). Despite the reduction in total cardiovascular events, there was no clear evidence of reductions in any individual outcome (total or non-fatal myocardial infarction, stroke, cancer deaths or diagnoses, diabetes diagnoses), nor was there any evidence that trials of reduced or modified SFA reduced cardiovascular mortality. These results suggest that modifying dietary fat by replacing some saturated (animal) fats with plant oils and unsaturated spreads may reduce risk of heart and vascular disease.

Emphasizing the benefits of replacement of saturated with polyunsaturated fats, Mozaffarian et al., 2010 found in a MA of 8 trials (13,614 participants with 1,042 CHD events) that modifying fat reduced the risk of myocardial infarction or coronary heart disease death (combined) by 19 percent (RR = 0.81; 95% CI = 0.70 to 0.95; p = 0.008), corresponding to 10 percent reduced CHD risk (RR = 0.90; 95% CI = 0.83 to 0.97) for each 5 percent energy of increased PUFA.[6] This magnitude of effect is similar to that observed in the Cochrane MA. In secondary analyses restricted to CHD mortality events, the pooled RR was 0.80 (95% CI = 0.65 to 0.98). In subgroup analyses, the RR was greater in magnitude in the four trials in primary prevention populations but non-significant (24 percent reduction in CHD events) compared to a significant reduction of 16 percent in the four trials of secondary prevention populations. Mozaffarian et al. argue that the slightly greater risk reduction in studies of CHD events, compared with predicted effects based on lipid changes alone, is consistent with potential additional benefits of PUFA on other non-lipid pathways of risk, such as insulin resistance. Many of the included trials used vegetable oils containing small amounts of plant-derived n-3 PUFA in addition to omega-6 PUFA.

Consistent with the benefits of replacing SFA with PUFA for prevention of CHD shown in other studies, Farvid et al., 2014 conducted an SR and MA of prospective cohort studies of dietary linoleic acid (LA), which included 13 studies with 310,602 individuals and 12,479 total CHD events (5,882 CHD deaths).[3] Farvid et al. found dietary LA intake is inversely associated with CHD risk in a dose-response manner: when comparing the highest to the lowest category of intake, LA was associated with a 15 percent lower risk of CHD events (pooled RR = 0.85; 95% CI = 0.78 to 0.92; I^2=35.5%) and a 21% lower risk of CHD deaths (pooled RR = 0.79; 95% CI = 0.71 to 0.89; I^2=0.0%). A 5 percent of energy increment in LA intake replacing energy from SFA intake was associated with a 9 percent lower risk of CHD events (RR = 0.91; 95% CI = 0.86 to 0.96) and a 13 percent lower risk of CHD deaths (RR = 0.87; 95% CI = 0.82 to 0.94). In the meta-analysis conducted by Chowdhury et al., there was no significant association between LA intake and CHD risk, but the analysis was based on a limited number of prospective cohort studies.

In Jakobsen et al.'s 2009 pooled analysis of 11 cohorts (344,696 persons with 5,249 coronary events and 2,155 coronary deaths), a 5 percent lower energy intake from SFAs and a concomitant higher energy intake from PUFAs reduced risk of coronary events by 13 percent (hazard ratio [HR] = 0.87; 95% CI = 0.77 to 0.97) and coronary deaths by 16 percent (hazard ratio = 0.74; 95% CI = 0.61 to 0.89).[5] By contrast, a 5 percent lower energy intake from SFAs and a concomitant higher energy intake from carbohydrates, there was a modest significant direct association between carbohydrates and coronary events (hazard ratio = 1.07; 95% CI = 1.01 to 1.14) and no association with coronary deaths (hazard ratio = 0.96; 95% CI = 0.82 to 1.13). Notably, the estimated HRs for carbohydrate intake in this study could reflect high glycemic carbohydrate intake rather than total carbohydrate, as fiber was controlled for in the analyses. MUFA intake was not associated with CHD incidence or death.

Taken together, strong and consistent evidence from RCTs and statistical modeling in prospective cohort studies shows that replacing SFA with PUFA reduces the risk of CVD events and coronary mortality. For every 1 percent of energy intake from SFA replaced with PUFA, incidence of CHD is reduced by 2 to 3 percent. The evidence is not as clear for replacement by MUFA or replacement with carbohydrate, and likely depends on the type and source.

Methodological Issues

When individuals in natural settings reduce calories from SFA, they typically replaced them with other macronutrients, and the type and source of the macronutrients substituting SFA determine effects on CVD. For this reason, studies specifying the macronutrient type replacing SFA are more informative than those examining only total SFA intake, and the strongest and most consistent evidence for CVD reduction is with replacement of SFA with PUFA in both RCTs and observational studies.

The differing effects of the type and source of macronutrient substituted may be one reason for the limited evidence regarding whether replacing SFA with MUFA confers CVD benefits and the lack of benefit from carbohydrate substitution. The main sources of MUFA in a typical American diet are animal fats, which could confound potential benefits of SFA-replacement with plant-source MUFA, such as nuts and olive oil, which have demonstrated benefits on CVD risk. To date, evidence testing replacement of SFA by MUFA from different sources is insufficient to reach a firm conclusion. Similarly, most analyses did not distinguish between substitution of saturated fat by different types of carbohydrates (e.g., refined carbohydrate vs. whole grains).

Of the RCTs included in this evidence summary, the intervention methods used varied from long-term dietary counseling with good generalizability but variable compliance, to providing a whole diet for weeks (e.g., controlled feeding studies) with maximal compliance but limited generalizability. Though the content of the recommended or provided diet is known with greater precision in the RCTs than in observational studies, adherence to the diet is likely variable and could result in lack of compliance and high rates of dropout in long-term trials. Additionally, bias may arise from the lack of blinding in non-supplement dietary intervention trials.

In prospective observational studies, misclassification of dietary fatty acid intake could bias associations towards the null. In addition, residual confounding by other dietary and lifestyle factors cannot be ruled out through statistical adjustment. Despite these methodological issues, there is high consistency of the evidence from prospective cohort studies and RCTs in supporting the benefits of replacing saturated fat with unsaturated fats especially PUFA in reducing CVD risk.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of saturated fat and risk of cardiovascular disease

Author, Year **Publication Type** **AMSTAR Rating***	**Independent Variable** **Outcomes Considered**	**Date Range Searched** **Criteria Used**	**Included Studies** (Number and Design)**	**Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA**
NHLBI, 2013; Eckel, 2014 Systematic Review AMSTAR: 9/11	Examined "dietary patterns"; focused on studies that assessed macronutrients (types and amount), including SFAs (discussed replacement) Plasma LDL-C, HDL-C, and TG	1998-2009 for trials; 1990-2009 for SR/MA Trials with minimum of 1 mo of exposure; any geographic location and clinical or research setting; adults (≥18 years of age) with or without established CVD; with or without CVD risk factors; with or without tobacco use; and who were of normal weight, overweight, or obese; studies were excluded if they focused on the use of	5 trials (6 papers); four systematic reviews/meta-analyses (2 were used to inform evidence statements; one had 27 RCTs; one had 60 trials)	**Recommendations (AHA/ACC):** Advise adults who would benefit from LDL–C lowering to: • Aim for a dietary pattern that achieves 5% to 6% of calories from saturated fat. (Class of Recommendation: I, Level of Evidence: A) • Reduce percent of calories from saturated fat.(Class of Recommendation: I, Level of Evidence: A) **Evidence Statements (NHLBI):** **ES11.** When food was supplied to adults in a dietary pattern that achieved a macronutrient composition of 5–6 % saturated fat, 26–27 % total fat, 15–18 % protein, and 55–59 % carbohydrates, compared with a

		dietary supplements or non-oral routes of nutrient delivery or the primary outcome of the nutritional intervention was weight change or when the weight change was greater than 3%		control diet (14–15% saturated fat, 34–38% total fat, 13–15% protein, and 48–51% carbohydrate), LDL-C was lowered 11–13mg/dL in two studies and 11 % in one study. Strength of evidence: High **ES12.** In controlled feeding trials among adults, for every 1% of energy from SFA that is replaced by 1% of energy from carbohydrate, MUFA, or PUFA: • LDL-C decreases by an estimated 1.2, 1.3, and 1.8 mg/dL, respectively; and • HDL-C decreases by an estimated 0.4, 1.2, and 0.2 mg/dL, respectively. For every 1% of energy from SFA that is replaced by 1% of energy from: • Carbohydrate and MUFA, TG increases by an estimated 1.9 and 0.2 mg/dL, respectively; and • PUFA, TG decreases by an estimated 0.4 mg/dL. Strength of evidence: Moderate **ES13.** In controlled feeding trials among adults, for every 1% of energy from carbohydrates that is replaced by 1% of energy from: • MUFA, LDL-C decreases by 0.3 mg/dL, HDL-C increases by 0.3 mg/dL, and TG decreases by1.7 mg/dL; and • PUFA, LDL-C decreases by 0.7 mg/dL, HDL-C increases by 0.2 mg/dL, and TG decreases by 2.3 mg/dL. Strength of evidence: Moderate
Hooper, 2012 Systematic Review AMSTAR: 11/11	Examined reduction and/or modification of dietary fats, including SFAs (discussed replacement) Cardiovascular mortality and events (MI, stroke, angina, heart failure, peripheral vascular disease, angioplasty, and coronary artery bypass grafting)	Up to June 2010 RCTs of at least 6 mo duration; intention to reduce or modify fat intake (excluding exclusively omega-3 fat interventions); not multi-factorial; adult humans with or without CVD, but excluding those who were acutely ill, pregnant, or lactating	48 RCTs (some trials included multiple papers)	**Conclusions:** Findings are suggestive of a small but potentially important reduction in cardiovascular risk on modification of dietary fat, but not reduction of total fat, in longer trials. Lifestyle advice to all those at risk of CVD and to lower risk population groups, should continue to include permanent reduction of dietary saturated fat and partial replacement by unsaturates. The ideal type of unsaturated fat is unclear. **Main results:** This updated review suggested that reducing saturated fat by reducing and/or modifying dietary fat reduced the risk of cardiovascular events by 14%. Subgrouping suggested that this reduction in cardiovascular events was seen in studies of fat modification (not reduction-which related directly to the

				degree of effect on serum total and LDL cholesterol and triglycerides), of at least two years duration and in studies of men (not of women). There were no clear effects of dietary fat changes on cardiovascular mortality.
Mozaffarian, 2010 Meta-Analysis AMSTAR: 11/11	Examined PUFA consumption, as a replacement for SFA Incidence of CHD (MI and/or cardiac death)	Up to June 2009 RCTs of at least 1 yr duration; without concomitant interventions; appropriate control group	8 RCTs	**Conclusions:** These findings provide evidence that consuming PUFA in place of SFA reduces CHD events in RCTs. This suggests that rather than trying to lower PUFA consumption, a shift toward greater population PUFA consumption in place of SFA would significantly reduce rates of CHD. **Main results:** Average weighted PUFA consumption was 14.9% energy in intervention groups versus 5.0% energy in controls. The overall pooled risk reduction was 19%, corresponding to 10% reduced CHD risk for each 5% energy of increased PUFA, without evidence for statistical heterogeneity.
Siri-Tarino, 2010 Meta-Analysis AMSTAR: 9/11	Examined SFA (insufficient power to assess effects of replacing SFAs with PUFAs or CHO) Nonfatal or fatal CVD (but not CVD risk factors)	Up to September 2009 PCSs that specifically evaluated SFAs and CVD among generally healthy adults at baseline	21 PCSs	**Conclusions:** A meta-analysis of prospective epidemiologic studies showed that there is no significant evidence for concluding that dietary saturated fat is associated with an increased risk of CHD or CVD. More data are needed to elucidate whether CVD risks are likely to be influenced by the specific nutrients used to replace saturated fat. **Main results:** Intake of saturated fat was not associated with an increased risk of CHD, stroke, or CVD. The pooled relative risk estimates that compared extreme quantiles of saturated fat intake were 1.07 for CHD, 0.81 for stroke, and 1.00 for CVD. Consideration of age, sex, and study quality did not change the results.
Chowdhury, 2014 Systematic Review and Meta-Analysis AMSTAR: 11/11	Examined SFA, MUFAs, and PUFAs, but did not assess replacement Coronary events	Up to July 2013 PCSs with at least 1 yr with participants from the general population or with stable CVD at study entry	20 PCSs (25 papers) with SFA	**Conclusions:** Current evidence does not clearly support cardiovascular guidelines that encourage high consumption of polyunsaturated fatty acids and low consumption of total saturated fats. **Main results:** Relative risks for coronary disease were 1.02 for saturated, 0.99 for monounsaturated, 0.93 for long-chain n-3 polyunsaturated, 1.01 for n-6 polyunsaturated, and 1.16 for trans fatty acids when the top and bottom thirds of baseline dietary fatty acid intake were compared.

Farvid, 2014 Meta-Analysis AMSTAR: 9/11	Examined dietary linoleic acid, including replacing SFAs with linoleic acid (LA) CHD outcomes (MI, ischemic heart disease, coronary artery bypass graft, sudden cardiac arrest, acute coronary syndrome and CHD deaths)	Up to June 2013 PCSs in adults that provided multivariate-adjusted risk estimates or hazard ratios for dietary LA and CHD endpoints; excluded retrospective, cross-sectional, ecological studies; excluded meeting abstracts and duplicated publications; excluded studies in patients with known CHD at baseline; for papers from the same cohort, used the most recent analyses with the highest number of outcomes	8 PCSs examined substitution of LA for SFA	**Conclusions:** These data provide support for current recommendations to replace saturated fat with polyunsaturated fat for primary prevention of CHD in the general population. **Main results:** A 5% of energy increment in linoleic acid intake replacing energy from saturated fat intake was associated with a 9% lower risk of CHD events and a 13% lower risk of CHD deaths.
Jakobsen, 2009 Meta-Analysis (Pooled analysis) AMSTAR: 8/11	Examined replacement of SFAs with MUFAs, PUFAs, or CHO Fatal CHD (including sudden death) and nonfatal MI	Not specified Studies that included a published follow-up study with at least 150 incident coronary evident; availability of usual dietary intake; validation of diet assessment method; excluded persons who were <35 yrs, had a history of CVD, diabetes, or cancer, or had extreme energy intake	11 cohorts (9 PCSs and 2 randomized primary prevention studies)	**Conclusions:** The findings suggest that replacing SFAs with PUFAs rather than MUFAs or carbohydrates prevents CHD over a wide range of intakes. **Main results:** For a 5% lower energy intake from SFAs and a concomitant higher energy intake from PUFAs, there was a significant inverse association between PUFAs and risk of coronary events (hazard ratio: 0.87; 95% CI: 0.77 to 0.97); the hazard ratio for coronary deaths was 0.74 (95% CI: 0.61 to 0.89). For a 5% lower energy intake from SFAs and a concomitant higher energy intake from carbohydrates, there was a modest significant direct association between carbohydrates and coronary events (hazard ratio: 1.07; 95% CI: 1.01 to 1.14); the hazard ratio for coronary deaths was 0.96 (95% CI: 0.82 to 1.13). MUFA intake was not associated with CHD. No effect modification by sex or age was found.
Skeaff, 2009 Meta-Analysis AMSTAR: 8/11	Examined dietary fat, including total fat, SFAs, TFAs, MUFAs, and PUFAs, but did not assess replacement CHD death, CHD events, and non-fatal	Not specified Cohort studies and controlled trials; English language	11 cohorts (12 papers) in SFA analysis	**Main results:** Intake of SFA was not significantly associated with CHD mortality, with a RR of 1.14 (p =0.431) for those in the highest compared with the lowest category of SFA intake. Similarly, SFA intake was not significantly associated with CHD events (RR 0.93, p = 0.269 for high vs. low categories). Moreover, there was no significant association with CHD death (RR 1.11, p = 0.593) per 5% total energy increment in SFA

	CHD			intake. For the cohort studies included in the meta-analysis, mean or median SFA intake varied from 7 to 11% total energy in the lowest category to 14 to 18% total energy in the highest category. Overall the mean or median SFA intake in all cohort studies varied from 9 to 20% total energy.

* A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

** Reference overlap: In total, 166 articles were considered in these reviews, of which 24 were included in two or more reviews.

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   Associated Lifestyle Guideline:
   Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014 Jun 24;129(25 Suppl 2):S76-99. doi: 10.1161/01.cir.0000437740.48606.d1. Epub 2013 Nov 12. PubMed PMID: 24222015. http://www.ncbi.nlm.nih.gov/pubmed/24222015

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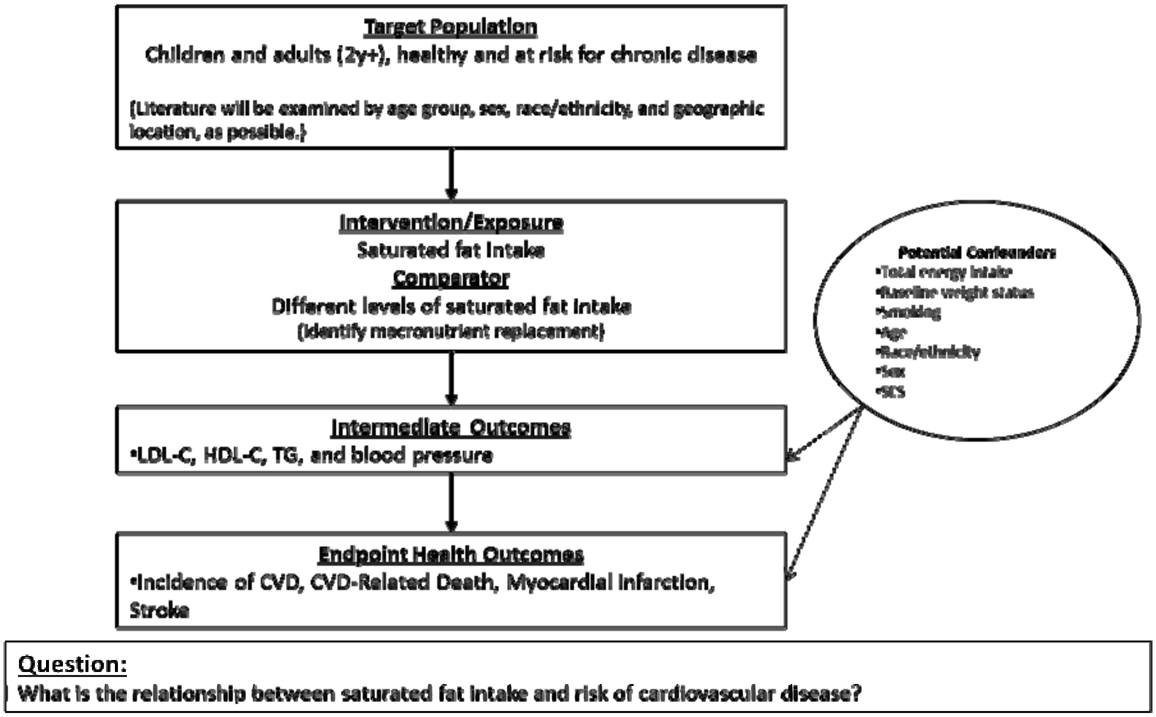
Supplementary Information

Analytical Framework



Methodology

This question was answered using the National Heart, Lung, and Blood Institute *Systematic Evidence Review from the Lifestyle Work Group, 2013* and related AHA/ACC *Guideline on Lifestyle Management to Reduce Cardiovascular Risk*,[1] which focused on randomized controlled trials (RCTs), as well as existing SRs and MA addressing this question published in peer-reviewed literature between January 2009 and August 2014. Particular emphasis was placed on reviews that examined the macronutrient replacement for saturated fat.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

"Mortality"[Mesh] OR mortality[tiab] OR "blood pressure"[tiab] OR "blood pressure"[mesh] OR "cardiovascular diseases"[mh:noexp] OR cardiovascular disease*[tiab] OR cardiovascular event*[tiab] OR hypertension[tiab] OR "Myocardial Infarction"[Mesh] OR "Myocardial Infarction"[tiab] OR "Heart Failure"[Mesh] OR "Heart Arrest"[Mesh] OR "Myocardial Ischemia"[Mesh] OR "heart failure"[tiab] OR "heart arrest"[tiab] OR "Myocardial Ischemia"[tiab] OR hypertension[mh] OR stroke[tiab] OR "stroke"[Mesh] OR mortality[sh] OR (coronary[tiab] AND disease*[tiab])
OR

"cholesterol/blood"[mh] OR "Cholesterol, Dietary"[Mesh] OR "Cholesterol"[Mesh] OR "Cholesterol, HDL"[Mesh] OR "Cholesterol, LDL"[Mesh] OR "Cholesterol, VLDL"[Mesh] OR cholesterol[tiab] OR "Cholesterol, Dietary"[Mesh] OR triglyceride* OR "Lipids/blood"[Mesh] OR hypercholesterolemia[mh] OR hypercholesterol*[tiab] OR hypercholesterolemia[tiab]
AND
(saturated AND ("Fatty Acids"[Mesh] OR "Dietary Fats"[Mesh] OR fat[tiab] OR fats[tiab] OR fatty[tiab])) OR saturated-fat[tiab]
OR
Meat[tiab] OR dairy[tiab] OR milk[tiab] OR butter[tiab] OR yogurt[tiab] OR cheese*[tiab] OR"Dairy Products"[Mesh] OR "Meat"[Mesh] OR meat[tiab] OR margarine*[tiab] OR yoghurt*[tiab] OR egg OR eggs

Embase:

'cardiovascular disease'/de OR ‘cardiovascular disease’:ti,ab OR 'hypertension'/exp OR hypertension:ti,ab OR 'blood pressure'/exp OR 'blood pressure':ti,ab OR 'mortality'/exp OR mortality:ti,ab OR 'triacylglycerol'/exp OR triglyceride*:ab,ti OR (cholesterol NEAR/2 (hdl OR ldl)) OR 'low density lipoprotein'/exp OR 'high density lipoprotein cholesterol'/exp OR 'cholesterol intake'/exp OR cholesterol:ti,ab OR 'stroke'/exp OR 'heart failure'/exp OR 'heart failure':ti,ab OR 'heart infarction'/exp OR 'heart infarction':ti,ab OR 'heart disease'/exp OR 'heart disease':ti,ab OR lipid/exp OR lipid*:ti,ab OR 'cholesterol'/exp OR 'cholesterol':ti,ab OR 'meat'/exp OR hyperlipidemia:ti,ab OR hypercholesterolem*:ti,ab OR hypertriglyeridem*:ti,ab
AND
('saturated fatty acid'/exp OR (saturated NEAR/3 (fat OR fatty OR fats)))
OR
'meat':ti,ab OR 'dairy product'/exp OR milk:ti,ab OR cheese:ti,ab OR butter:ti,ab OR ‘ice cream’:ti,ab OR yogurt:ti,ab OR yoghurt:ti,ab OR margarine:ti,ab
AND 'systematic review'/exp OR 'meta analysis'/exp

Cochrane:

mortality OR "blood pressure" OR (cardiovascular NEXT (event OR disease*)) OR coronary NEXT heart NEXT disease* OR ((cholesterol OR lipid*) NEAR/2 blood) OR (Cholesterol NEAR/2 HDL) OR cholesterol OR (Cholesterol NEAR/2 Dietary) OR triglyceride* OR "Myocardial Infarction" OR "Heart Arrest" OR "Myocardial Ischemia" OR "heart failure" OR hypertension OR “Myocardial Infarction" OR “heart arrest” OR “Myocardial Ischemia" OR stroke OR hypercholesterol* OR hypercholesterolemia*
AND
(saturated NEAR/2 (Fatty OR fats OR fat)) OR saturated-fat OR
Meat OR dairy OR milk OR butter OR yogurt OR cheese OR "Meat" OR margarine*OR yoghurt* OR egg*

Inclusion Criteria

Date Range:

- Published between January 2009 and August 2014 (in English in a peer-reviewed journal)

Study Design:

- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

Study Subjects:

- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:

- Saturated fat

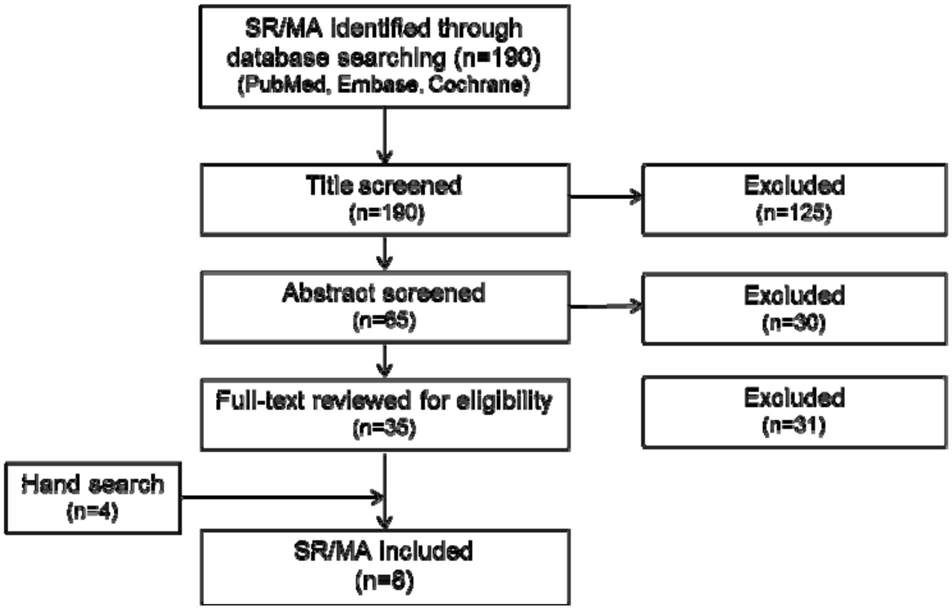
Outcome:

- LDL-cholesterol, HDL-cholesterol, triglycerides, blood pressure, incidence of CVD, CVD-related death, myocardial infarction, or stroke

Quality:

- Reviews rated 8-11 on AMSTAR (A measurement tool for the 'assessment of multiple systematic reviews')

Search Results



Excluded Articles with Reason for Exclusion

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25. Li Y, Zhou C, Zhou X, Li L. Egg consumption and risk of cardiovascular diseases and diabetes: a meta-analysis. Atherosclerosis. 2013;229(2):524-30. PMID: 23643053. http://www.ncbi.nlm.nih.gov/pubmed/23643053. EXCLUDE: Examined food source, not saturated fat specifically

26. Maki KC, Van Elswyk ME, Alexander DD, Rains TM, Sohn EL, McNeill S. A meta-analysis of randomized controlled trials that compare the lipid effects of beef versus poultry and/or fish consumption. J Clin Lipidol. 2012;6(4):352-61. PMID: 22836072. http://www.ncbi.nlm.nih.gov/pubmed/22836072. EXCLUDE: Examined food source, not saturated fat specifically

27. Mente A, de Koning L, Shannon HS, Anand SS. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch Intern Med. 2009;169(7):659-69. PMID: 19364995. http://www.ncbi.nlm.nih.gov/pubmed/19364995. EXCLUDE: Unable to identify which studies were considered for each outcome

28. Micha R, Wallace SK, Mozaffarian D. Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus: a systematic review and meta-analysis. Circulation. 2010;121(21):2271-83. PMID: 20479151. http://www.ncbi.nlm.nih.gov/pubmed/20479151. EXCLUDE: Examined food source, not saturated fat specifically

29. Mozaffarian D. The great fat debate: taking the focus off of saturated fat. J Am Diet Assoc. 2011;111(5):665-6. PMID: 21515109. http://www.ncbi.nlm.nih.gov/pubmed/21515109. EXCLUDE: Commentary

30. O'Sullivan TA, Hafekost K, Mitrou F, Lawrence D. Food sources of saturated fat and the association with mortality: a meta-analysis. Am J Public Health. 2013;103(9):e31-42. PMID: 23865702. http://www.ncbi.nlm.nih.gov/pubmed/23865702. EXCLUDE: Examined food source, not saturated fat specifically

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32. Ramsden CE, Zamora D, Leelarthaepin B, Majchrzak-Hong SF, Faurot KR, Suchindran CM, et al. Use of dietary linoleic acid for secondary prevention of coronary heart disease and death: evaluation of recovered data from the Sydney Diet Heart Study and updated meta-analysis. BMJ. 2013;346:e8707. PMID: 23386268. http://www.ncbi.nlm.nih.gov/pubmed/23386268. EXCLUDE: Articles focuses on secondary prevention of coronary heart disease

33. Ravnskov U, DiNicolantonio JJ, Harcombe Z, Kummerow FA, Okuyama H, Worm N. The questionable benefits of exchanging saturated fat with polyunsaturated fat. Mayo Clin Proc. 2014;89(4):451-3. PMID: 24581756. http://www.ncbi.nlm.nih.gov/pubmed/24581756. EXCLUDE: Commentary

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35. Salter AM. Dietary fatty acids and cardiovascular disease. Animal. 2013;7 Suppl 1:163-71. PMID: 23031737. http://www.ncbi.nlm.nih.gov/pubmed/23031737. EXCLUDE: Narrative review

36. Schwingshackl L, Hoffmann G. Comparison of effects of long-term low-fat vs high-fat diets on blood lipid levels in overweight or obese patients: a systematic review and meta-analysis. J Acad Nutr Diet. 2013;113(12):1640-61. PMID: 24139973. http://www.ncbi.nlm.nih.gov/pubmed/24139973. EXCLUDE: Article focuses on total fat content of the diet; compares low-fat to high-fat diets

37. Schwingshackl L, Hoffmann G. Dietary fatty acids in the secondary prevention of coronary heart disease: a systematic review, meta-analysis and meta-regression. BMJ Open. 2014;4(4):e004487. PMID: 24747790. http://www.ncbi.nlm.nih.gov/pubmed/24747790. EXCLUDE: Article focuses on secondary prevention of coronary heart disease

38. Shin JY, Xun P, Nakamura Y, He K. Egg consumption in relation to risk of cardiovascular disease and diabetes: a systematic review and meta-analysis. Am J Clin Nutr. 2013;98(1):146-59. PMID: 23676423. http://www.ncbi.nlm.nih.gov/pubmed/23676423. EXCLUDE: Examined food source, not saturated fat specifically

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40. Soedamah-Muthu SS, Verberne LD, Ding EL, Engberink MF, Geleijnse JM. Dairy consumption and incidence of hypertension: a dose-response meta-analysis of prospective cohort studies. Hypertension. 2012;60(5):1131-7. PMID: 22987924.

http://www.ncbi.nlm.nih.gov/pubmed/22987924. EXCLUDE: Examined food source, not saturated fat specifically

41. Stettler N, Murphy MM, Barraj LM, Smith KM, Ahima RS. Systematic review of clinical studies related to pork intake and metabolic syndrome or its components. Diabetes Metab Syndr Obes. 2013;6:347-57. PMID: 24106428. http://www.ncbi.nlm.nih.gov/pubmed/24106428. EXCLUDE: Examined food source, not saturated fat specifically

Appendix E2.44: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between the intake of added sugars and body weight/obesity?

Conclusion Statement: Strong and consistent evidence shows that intake of added sugars from food and/or sugar-sweetened beverages are associated with excess body weight in children and adults. The reduction of added sugars and sugar-sweetened beverages in the diet reduces body mass index (BMI) in both children and adults. Comparison groups with the highest versus the lowest intakes of added sugars in cohort studies were compatible with a recommendation to keep added sugars intake below 10 percent of total energy intake.

DGAC Grade: Strong

Review of Evidence

These findings come from three recent reports, all using SRs and MA that examined the relationship between the intake of added sugars and measures of body weight.[1 -3] Te Morenga et al.[1] considered "free sugars[i]," while Malik[2] and Kaiser et al.[3] focused on sugar-sweetened beverages. All reviews reported on body weight. The Te Morenga report also reported on body fatness. In the Te Morenga et al. study, 30 trials and 38 cohort studies were included in the analyses. In the Malik et al. study, 10 trials and 22 cohort studies were included in the analyses. Kaiser et al. provided an updated meta-analysis to a previous publication (Mattes[4]) and included a total of 18 trials. In total, 92 articles were considered in these reviews, of which 21 were included in two or more reviews. Children and adults were included in the analyses as were females and males. Diverse demographics (race/ethnicity and geographic location) also were represented by the participants in the respective research studies. All three reviews were high-quality, with ratings of 11 out of 11 using the AMSTAR tool, and they specifically addressed the Committee's question of interest.

The reviews by Malik et al. and Te Morenga et al. were very consistent. The findings from both reports provide strong evidence that among free-living people consuming ad libitum diets, the intake of added sugars or sugar-sweetened beverages is associated with unfavorable weight status in children and adults. Increased added sugars intake is associated with weight gain; decreased added sugars intake is associated with decreased body weight. Although a dose

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[i] Free sugar is defined by WHO as "all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices." It is used to distinguish between the sugars that are naturally present in fully unrefined carbohydrates such as brown rice, whole wheat pasta, and fruit and those sugars (or carbohydrates) that have been, to some extent, refined (normally by humans but sometimes by animals, such as the free sugars present in honey). They are referred to as "sugars" since they cover multiple chemical forms, including sucrose, glucose, fructose, dextrose, and others.[5]

response cannot be determined at this time, the data analyzed by Te Morenga et al. support limiting added sugars to no more than 10 percent of daily total energy intake based on lowest versus highest intakes from prospective cohort studies. Te Morenga et al. state that, "despite significant heterogeneity in one meta-analysis and potential bias in some trials, sensitivity analyses showed that the trends were consistent and associations remained after these studies were excluded." Despite these limitations the DGAC gave this evidence a grade of **Strong**, as the limitations are those inherent to the primary research on which they are based, notably inadequacy of dietary intake data and variations in the nature and quality of the dietary interventions.

The Kaiser et al. review concluded that the currently available randomized evidence for the effects of reducing sugar-sweetened beverage intake on obesity is equivocal. However, the DGAC noted methodological issues with this review, particularly the inclusion of both efficacy studies (in more controlled settings) and effectiveness studies (in real world). The outcomes from the effectiveness trials vary substantially, depending how effective the interventions are. As a result, the Committee viewed the reviews by Te Morenga et al. and Malik et al. to be stronger than the Kaiser et al. review.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of added sugars and body weight or risk of obesity

Author, Year **Publication Type** **AMSTAR Rating***	**Added Sugars Definition** **Outcomes Considered**	**Date Range Searched** **Criteria Used**	**Included Studies** (Number and Design)**	**Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA**
Te Morenga, 2012 Systematic Review and Meta-Analysis AMSTAR: 11/11	"Free sugars" as defined by the World Health Organization: all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices At least one measure of body fatness	Up to Dec 2011 Examined intake of total sugars, intake of a component of total sugars, or intake of sugar containing foods and beverages; only included RCTs and PCSs in humans; adults and children free from acute illness, but those with diabetes or other non-communicable diseases whom conditions were stable were included; duration of at least 2 wks for RCTs and 1 yr for PCSs; excluded studies with interventions designed to achieve weight loss because the aim of the review was to facilitate the	30 RCTs and 38 PCSs	**Conclusion:** Among free living people involving ad libitum diets, intake of free sugars or sugar sweetened beverages is a determinant of body weight. The change in body fatness that occurs with modifying intakes seems to be mediated via changes in energy intakes, since isoenergetic exchange of sugars with other carbohydrates was not associated with weight change. **Main Results:** In trials of adults with ad libitum diets (that is, with no strict control of food intake), reduced intake of dietary sugars was associated with a decrease in body weight (-0.80 kg, 95% CI: -1.21 to -0.39; P<0.001); increased sugars intake was associated with a comparable weight increase (0.75 kg, 0.30

		development of population-based recommendations rather than recommendations for management of obesity		to 1.19; P=0.001). Isoenergetic exchange of dietary sugars with other carbohydrates showed no change in body weight (0.04 kg, 95% CI: −0.04 to 0.13). Trials in children, which involved recommendations to reduce intake of sugar sweetened foods and beverages, had low participant compliance to dietary advice; these trials showed no overall change in body weight. However, in relation to intakes of sugar sweetened beverages after one year follow-up in prospective studies, the odds ratio for being overweight or obese increased was 1.55 (95% CI: 1.32 to 1.82) among groups with the highest intake compared with those with the lowest intake.
Malik, 2013 Systematic Review and Meta-Analysis AMSTAR: 11/11	Sugar-sweetened beverages (carbonated beverages, sweetened beverages, soda, sports drink, fruit drink) Body weight	Up to March 2013 Original research; PCSs and RCTs in children and adults; reported multivariable-adjusted coefficients for the association between SSBs and BW from PCSs or the difference in changes in BW between intervention and control groups from RCTs; did not combine SSBs with other beverages, foods, or lifestyle factors; had a control group and intervened for at least 2 wks in clinical trials; English language	10 RCTs and 22 PCSs	**Conclusion:** This systematic review and meta-analysis of prospective cohort studies and RCTs provides evidence that SSB consumption promotes weight gain in children and adults. **Main Results:** In cohort studies, one daily serving increment of SSBs was associated with a 0.06 and 0.05-unit increase in BMI in children and 0.22 kg and 0.12 kg weight gain in adults over 1 y in random and fixed effects models, respectively. RCTs in children showed reductions in BMI gain when SSBs were reduced (random and fixed effects: -0.17 and -0.12 kg), whereas RCTs in adults showed increases in body weight when SSBs were added (random and fixed effects: 0.85 kg).
Kaiser, 2013; Mattes, 2011 Systematic Review and Meta-Analysis AMSTAR: 11/11	Nutritively sweetened beverage (NSB) / Sugar-sweetened Beverages (SSB): Something one drinks to which a nutritive sweetener has been added. Regular sodas, fruit punch, and chocolate milk qualified as NSBs. Does not include any studies of	Kaiser, 2013 (Jan 2010 – Oct. 2012); Mattes, 2011 (through January 2009) Note: newly published articles meeting original criteria were combined with the meta-analyzed studies from Mattes, 2011.	18 RCTs	**Conclusion:** The updated meta-analysis shows that the currently available randomized evidence for the effects of reducing SSB intake on obesity is equivocal. **Main Results:** In the three new studies in which SSBs were added to the diets of adults or children, statistically significant weight

	alcoholic beverages or beverages consumed as meal replacements (e.g., Slim-Fast) or growth promoters (e.g., Ensure)	Criteria: RCTS in humans that involved comparison of outcomes between subjects assigned to 2 or more conditions that differed only in the extent to which the subjects were required, asked, or encouraged to consume or not consume NSBs. Study duration had to be at least 3 weeks and included a body weight/composition outcome		gain was observed in both adult trials, ranging from 0.39 to 1.14 kg. No significant difference in weight gain was observed in the study in children. In one new study of adults and the two new studies of children in which participants who drank some amount of SSBs at baseline were asked to eliminate or reduce their SSB consumption, standardized mean differences in percentage weight loss or BMI reduction ranged from 0.13 to 0.33. In new studies in which all participants were overweight or obese at baseline standardized mean differences ranged from 0.13 to 0.73. In combination with earlier studies or subgroup analysis of the effects of reducing SSBs on overweight subjects, the overall standardized mean difference was 0.25 (CI: 0.13 to 0.38 standard deviations), p<0.0001)

* A measurement tool for the ‘assessment of multiple systematic reviews’ (AMSTAR)

**Reference overlap: Of the 92 articles included in total across the reviews, 21 were included in two or more reviews.

References Included in Review

1. Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ. 2013;346:e7492. PMID: 23321486. http://www.ncbi.nlm.nih.gov/pubmed/23321486.

2. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. Am J Clin Nutr. 2013;98(4):1084-102. PMID: 23966427. http://www.ncbi.nlm.nih.gov/pubmed/23966427.

3. Kaiser KA, Shikany JM, Keating KD, Allison DB. Will reducing sugar-sweetened beverage consumption reduce obesity? Evidence supporting conjecture is strong, but evidence when testing effect is weak. Obes Rev. 2013: 14(8):620-633. PMID: 23742715. http://www.ncbi.nlm.nih.gov/pubmed/23742715

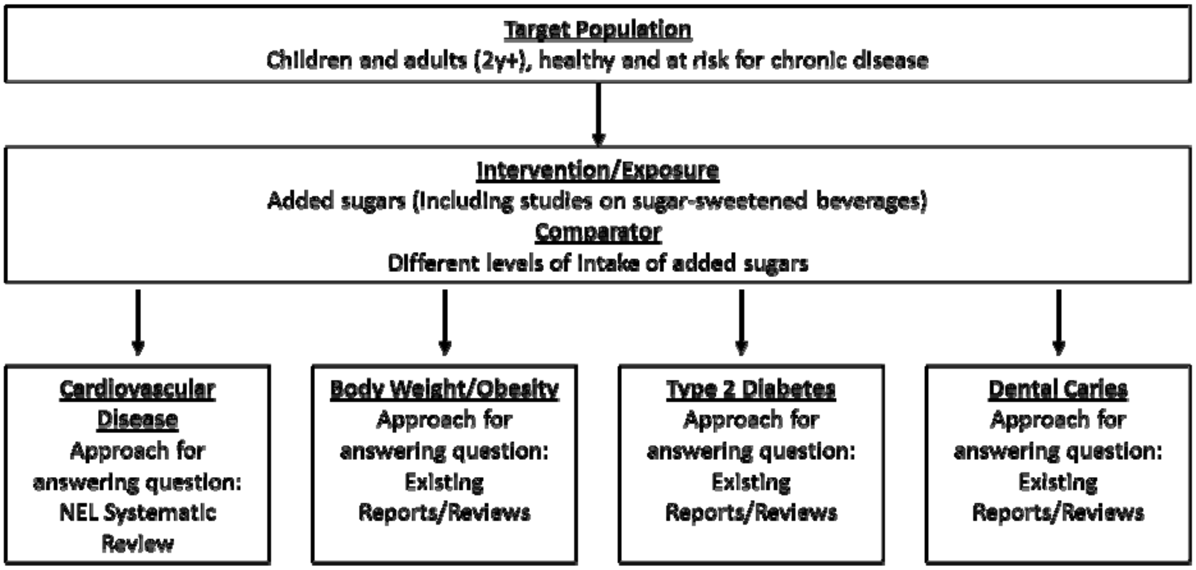
4. Mattes RD, Shikany JM, Kaiser KA, Allison DB. Nutritively Sweetened Beverage Consumption and Body Weight: A Systematic Review and Meta-Analysis of Randomized Experiments. Obes Rev. 2011:12(5):346-365. PMID:20524996 http://www.ncbi.nlm.nih.gov/pubmed/20524996

Additional Reference

5. The science behind the sweetness in our diets. Bull World Health Organ. 2014;92(11):780-1. PMID: 25378738. http://www.ncbi.nlm.nih.gov/pubmed/25378738.

Supplementary Information:

Analytical Framework



Question:
What is the relationship between the intake of added sugars and cardiovascular disease, body weight/obesity, type 2 diabetes, and dental caries?

Methodology

To answer this question, the DGAC relied on a systematic review commissioned by the World Health Organization (WHO).[1] Additionally, to capture new research, the Committee searched for SRs and MA published since January 2012, the completion of the WHO review.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

Added Sugar* OR brown sugar*[tiab] OR white sugar*[tiab] OR raw sugar* OR syrup*[tiab] OR dextrose OR fructose OR fruit juice concentrate* OR glucose OR honey[mh] OR honey[tiab] OR jam[tiab] OR invert sugar* OR malt sugar* OR maltose[tiab] OR maltodextrin OR molasses OR turbinado sugar* OR cane sugar*[tiab] OR cane juice*[tiab] OR “sugar cane”[tiab] OR sugar beet*[tiab] OR trehalose[tiab] OR sucrose[tiab] OR sweetene* OR table sugar*[tiab] OR "Monosaccharides"[Mesh] OR Monosaccharide*[tiab] OR disaccharide*[tiab] OR "Disaccharides"[Mesh] OR "Sweetening Agents"[Mesh:noexp] OR "Nutritive Sweeteners"[Mesh] OR "Dietary Sucrose"[tiab] OR sugar based* OR sugar-based* OR HFCS OR candy[tiab] OR "Candy"[Mesh] OR “Carbonated beverages”[mh] OR Soft drink* OR Liquid sugar* OR Soda pop* OR soda[tiab] OR Carbonated drink*[tiab] OR dessert*[tiab] OR pastries[tiab] OR ice cream*[tiab] OR cookies[tiab] OR cake*[tiab] OR pie[tiab] OR pies[tiab] OR gelatin*[tiab] OR

jello[tiab] OR fruit punch*[tiab] OR fruitade*[tiab] OR sugary[tiab] OR sweets[tiab] OR sugar-sweetene*[tiab] OR caramel OR "malt barley" OR "barley malt" OR "Sweetening Agents" [Pharmacological Action] (done; w/ food/diet terms 30; none selected; 8/7/2014) OR sugar-coated[tiab] OR sugar coated*[tiab] OR sugar*[ti] OR sugar sweeten*[tiab] OR dietary sugar*[tiab] OR confectioner*[tiab] OR fizzy drink*[tiab] OR chewing gum*[tiab]
AND

"body size"[tiab] OR body size[mh] OR obesity[tiab] OR obese[tiab] OR overweight[mh] OR obesity[mh] OR overweight [tiab] OR overnutrition[tiab] OR overnutrition[mh]OR adipos*[tiab] OR adiposity[mh] OR body composition[mh] OR body fat distribution[mh] OR “body fat”[tiab] OR "body weight"[tiab] OR body weight[mh] OR weight gain[mh] OR weight loss[mh] OR “body-weight related”[tiab] OR "weight gain"[tiab] OR weight-gain[tiab] OR weight loss[tiab] OR weight-loss[tiab] OR Body Weights and Measures[mh] OR weight[ti] OR "Anthropometry"[Mesh:noexp] OR body mass index[mh] OR “body mass index”[tiab] OR BMI[tiab] OR “weight status”[tiab] OR adipose tissue [mh] OR "healthy weight"[tiab] OR waist circumference[mh] OR “body mass”[ti] OR “body fat mass”[tiab] OR body weight changes[mh] OR “waist circumference”[tiab] OR ideal body weight[mh] OR waist-hip ratio[mh] OR waist-hip ratio[tiab] OR waist hip ratio[tiab] OR “body height”[tiab] OR "body fat"[tiab] OR waist[ti]

Embase:

(added NEXT/1 sugar*):ti,ab OR (raw NEXT/1 sugar*):ti,ab OR (white NEXT/1 sugar*):ti,ab OR (brown NEXT/1 sugar*):ti,ab OR 'sugar intake'/exp OR 'sucrose'/exp OR 'sweetening agent'/de OR 'fructose'/exp OR 'monosaccharide'/exp OR 'sugarcane'/exp OR 'lactose'/exp OR (milk NEXT/2 sugar*):ti,ab OR 'sugar beet'/exp OR 'sugar'/exp/mj OR (sugar NEXT/1 beet*):ti,ab OR sugarcane:ti,ab OR (sugar NEXT/1 cane):ti,ab OR dextrose:ti,ab OR 'glucose'/exp OR (corn NEXT/1 syrup*):ti,ab OR (maple NEXT/1 syrup*):ti,ab OR 'honey'/exp OR 'invert sugar'/exp OR (invert NEXT/1 sugar*):ti,ab OR 'maltose'/exp OR (malt NEXT/1 sugar*):ti,ab OR 'maltodextrin'/exp OR 'molasses'/exp OR (turbinado NEXT/1 sugar*):ti,ab OR 'disaccharide'/exp OR disaccharide*:ti,ab OR trehalose*:ti,ab OR (sugar NEXT/1 based*):ti,ab OR HFCS*:ti,ab OR candy:ti,ab OR candies:ti,ab OR 'carbonated beverage'/exp OR (carbonated NEXT/1 beverage*):ti,ab OR (Soft NEXT/1 drink*):ti,ab OR (Liquid NEXT/1 sugar*):ti,ab OR (Soda NEXT/1 pop*):ti,ab OR popsicle*:ti,ab OR (soda NEAR/10 (drink* OR beverage*)) OR (Carbonated NEXT/1 drink*):ti,ab OR 'soft drink'/exp OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEXT/1 cream*):ti,ab OR 'ice cream'/exp OR cookies:ti,ab OR cake*:ti OR pie:ti,ab OR pies:ti,ab OR gelatin*:ti,ab OR jello:ti,ab OR (fruit NEXT/1 punch*):ti,ab OR fruitade*:ti,ab OR (('fruit juice'/exp OR (fruit NEXT/1 juice*)) AND concentrate) OR sweets:ti,ab OR caramel:ti,ab OR (malt* NEAR/1 barley) OR ('syrup'/exp OR syrup*:ti,ab) OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab OR 'chewing gum'/exp
('food'/exp OR 'beverage'/exp OR diet/exp OR 'dietetics'/exp OR nutrition/exp OR cane OR rice OR sorghum OR malt OR golden OR 'food additive'/exp)
AND

'body size'/de OR (body NEXT/1 size*):ti,ab OR 'obesity'/exp OR obesity:ti,ab OR obese:ti,ab OR overweight:ab,ti OR adipos*:ab,ti OR 'body weight'/exp OR (body NEXT/1 weight*):ti,ab OR 'weight gain'/de OR (weight NEXT/1 gain):ti,ab OR 'weight reduction'/exp OR 'weight reduction':ab,ti OR (weight NEXT/1 loss):ti,ab OR 'body composition'/exp OR 'body fat':ab,ti OR 'anthropometry'/de OR 'body mass'/de OR bmi:ab,ti OR (body NEXT/1 mass):ti,ab OR weight:ti OR 'waist circumference'/de OR 'waist circumference':ab,ti OR 'waist hip ratio'/de OR (waist NEXT/1 hip):ti,ab OR 'body fat'/de OR 'adipose tissue'/exp OR 'skinfold thickness'/exp OR 'body fat distribution'/exp OR 'overnutrition'/exp OR 'overnutrition':ti,ab OR weight:ti OR “weight status”:ti,ab OR waist:ti

Cochrane:

(Added NEXT Sugar*) OR (brown NEXT sugar*) OR (white NEXT sugar*) OR (raw NEXT sugar*) OR syrup*:ti,kw OR dextrose:ti OR fructose:ti OR (fruit NEXT juice NEXT concentrate*) OR glucose:ti OR honey:ti OR jam:ti OR (invert NEXT sugar*) OR (malt NEXT sugar*) OR maltose:ti OR maltodextrin:ti OR molasses OR (turbinado NEXT sugar*) OR (cane NEXT sugar*) OR (cane NEXT juice*) OR “sugar cane”:ti,ab OR (sugar NEXT beet*):ti,ab OR trehalose:ti OR sucrose:ti OR sweetene* OR (table NEXT sugar*) OR Monosaccharide*:ti OR disaccharide*:ti OR "Dietary Sucrose":ti,ab OR (sugar NEXT based*) OR sugar-based* OR HFCS OR candy:ti,ab OR candies:ti,ab OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEXT drink*) OR (Liquid NEXT sugar*) OR (Soda NEXT pop*) OR popsicle* OR soda:ti OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEAR/1 cream*) OR cookies:ti,ab OR cake*:ti OR pie:ti OR pies:ti OR gelatin*:ti OR jello:ti OR “fruit punch”:ti,ab OR fruitade*:ti,ab OR sugar*:ti OR sweets:ti OR (sugar-sweetene*:ti,kw,ab) OR caramel:ti,ab OR (malt* NEAR/1 barley) OR 'syrup':ti,ab,kw OR (dietary NEXT sugar*):ti,ab OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab (“body weight” OR obesity:ti,kw,ab OR overweight:ti,kw,ab OR “body fat”:ti,kw,ab OR adipos*:ti,kw,ab OR weight:ti,kw,ab OR waist:ti,kw,ab OR “body mass”:ti,kw,ab OR bmi:ti,kw,ab OR “Metabolic syndrome”:ti,kw,ab)

Navigator:

((Added NEXT Sugar*) OR (brown NEAR/1 sugar*) OR (white NEAR/1 sugar*) OR (raw NEAR/1 sugar*) OR title:syrup* OR title:dextrose OR title:fructose OR (fruit NEAR/1 juice NEAR/1 concentrate*) OR title:glucose OR title:honey OR title:jam OR (invert NEAR/1 sugar*) OR (malt NEAR/1 sugar*) OR title:maltose OR title:maltodextrin OR title:molasses OR (turbinado NEAR/1 sugar*) OR (cane NEAR/1 sugar*) OR (cane NEAR/1 juice*) OR “sugar cane” OR (sugar NEAR/1 beet*) OR title:trehalose OR title:sucrose OR title:sweetene* OR (table NEAR/1 sugar*) OR title:Monosaccharide* OR title:disaccharide* OR "Dietary Sucrose" OR (sugar NEAR/1 based*) OR sugar-based* OR HFCS OR title:candy OR title:candie* OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEAR/1 drink*) OR (Liquid NEAR/1 sugar*) OR (Soda NEAR/1 pop*) OR popsicle* OR title:soda OR title:dessert* OR title:pastries OR (ice NEAR/1 cream*) OR title:cookies OR title:cake* OR title:pie OR pies:ti

OR title:gelatin* OR title:jello OR “fruit punch” OR title:fruitade* OR title:sweets OR (sugar-sweetene*) OR title:caramel OR (malt* NEAR/1 barley) OR (dietary NEAR/1 sugar*) OR title:sugar* OR (sugar NEAR/3 sweet*) OR (sugar NEAR/3 coat*) OR (dietary NEAR/1/1 sugar*) OR title:confectioner* OR (fizzy NEAR/1 drink*) OR chewing NEAR/1 gum*)

Inclusion Criteria

Date Range:
- Published between December 2011 and August 2014 (in English in a peer-reviewed journal)

Study Design:
- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

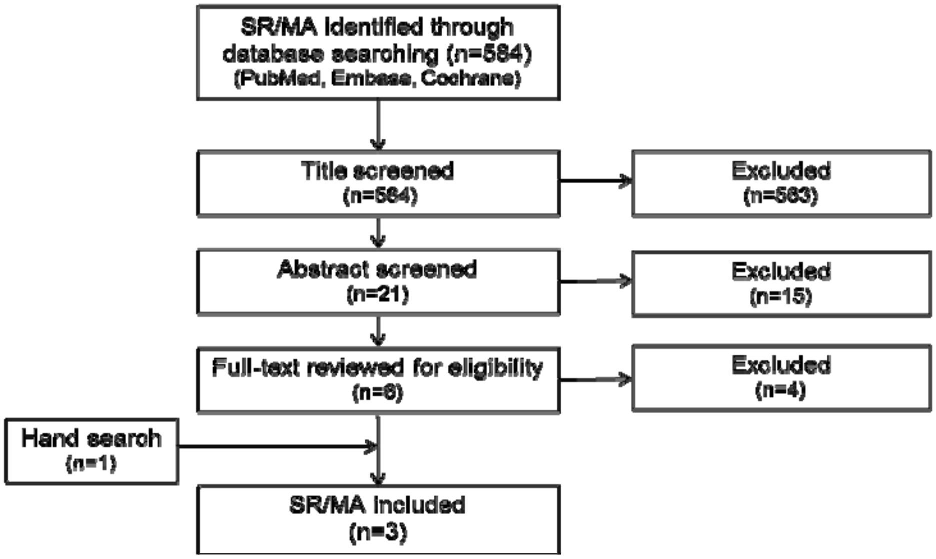
Study Subjects:
- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:
- Added sugars, including sugar-sweetened beverages
- Added sugars are sugars that are either added during the processing of foods, or are packaged as such, and include sugars (free, mono- and disaccharides), syrups, naturally occurring sugars that are isolated from a whole food and concentrated so that sugar is the primary component (e.g., fruit juice concentrates), and other caloric sweeteners.

Outcome:
- Body weight: Body mass index, body weight, percent body fat, waist circumference, incidence of overweight or obesity

Quality:
- Reviews rated 8-11 on AMSTAR (A measurement tool for the ‘assessment of multiple systematic reviews’)

Search Results



<u>Excluded Articles with Reason for Exclusion</u>

6. Dolan LC, Potter SM, Burdock GA. Evidence-based review on the effect of normal dietary consumption of fructose on development of hyperlipidemia and obesity in healthy, normal weight individuals. Crit Rev Food Sci Nutr. 2010;50(1):53-84. PMID: 20047139. http://www.ncbi.nlm.nih.gov/pubmed/20047139. EXCLUDE: Focused on fructose, not added sugars

7. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. Br J Nutr. 2014:1-10. PMID: 24932880. http://www.ncbi.nlm.nih.gov/pubmed/24932880. EXCLUDE: Focused on type 2 diabetes (to be considered for T2D question)

8. Ha V, Jayalath VH, Cozma AI, Mirrahimi A, de Souza RJ, Sievenpiper JL. Fructose-containing sugars, blood pressure, and cardiometabolic risk: a critical review. Curr Hypertens Rep. 2013;15(4):281-97. PMID: 23793849. http://www.ncbi.nlm.nih.gov/pubmed/23793849. EXCLUDE: Narrative review

9. Kelishadi R, Mansourian M, Heidari-Beni M. Association of fructose consumption and components of metabolic syndrome in human studies: a systematic review and meta-analysis. Nutrition. 2014;30(5):503-10. PMID: 24698343. http://www.ncbi.nlm.nih.gov/pubmed/24698343. EXCLUDE: Focused on components of metabolic syndrome; did not consider body weight as an outcome

10. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. Diabetes Care. 2010;33(11):2477-83. PMID: 20693348. http://www.ncbi.nlm.nih.gov/pubmed/20693348. EXCLUDE: Focused on type 2 diabetes (to be considered for T2D question)

11. Massougbodji J, Le Bodo Y, Fratu R, De Wals P. Reviews examining sugar-sweetened beverages and body weight: correlates of their quality and conclusions. Am J Clin Nutr. 2014;99(5):1096-104. PMID: 24572563. http://www.ncbi.nlm.nih.gov/pubmed/24572563. EXLCUDE: Examines quality of existing systematic reviews

12. Miller PE, Perez V. Low-calorie sweeteners and body weight and composition: a meta-analysis of randomized controlled trials and prospective cohort studies. Am J Clin Nutr. 2014. PMID: 24944060. http://www.ncbi.nlm.nih.gov/pubmed/24944060. EXCLUDE: Focuses on low-calorie sweeteners, not added sugars

13. Morgan RE. Does consumption of high-fructose corn syrup beverages cause obesity in children? Pediatr Obes. 2013;8(4):249-54. PMID: 23630060. http://www.ncbi.nlm.nih.gov/pubmed/23630060. EXCLUDE: Examines quality of existing systematic reviews

14. Pereira MA. Diet beverages and the risk of obesity, diabetes, and cardiovascular disease: a review of the evidence. Nutr Rev. 2013;71(7):433-40. PMID: 23815142. http://www.ncbi.nlm.nih.gov/pubmed/23815142. EXCLUDE: Focused on artificial sweeteners, not added sugars

15. Perez-Morales E, Bacardi-Gascon M, Jimenez-Cruz A. Sugar-sweetened beverage intake before 6 years of age and weight or BMI status among older children; systematic review of prospective studies. Nutr Hosp. 2013;28(1):47-51. PMID: 23808429. http://www.ncbi.nlm.nih.gov/pubmed/23808429. EXCLUDE: Scored 7 out of 11 on AMSTAR

16. Ruxton CH, Gardner EJ, McNulty HM. Is sugar consumption detrimental to health? A review of the evidence 1995-2006. Crit Rev Food Sci Nutr. 2010;50(1):1-19. PMID: 20047137. http://www.ncbi.nlm.nih.gov/pubmed/20047137. EXCLUDE: Publication date

17. Rippe JM, Saltzman E. Sweetened beverages and health: current state of scientific understandings. Adv Nutr. 2013;4(5):527-9. PMID: 24038246. http://www.ncbi.nlm.nih.gov/pubmed/24038246. EXCLUDE: Symposium proceedings

18. Sievenpiper JL, de Souza RJ, Mirrahimi A, Yu ME, Carleton AJ, Beyene J, et al. Effect of fructose on body weight in controlled feeding trials: a systematic review and meta-analysis. Ann Intern Med. 2012;156(4):291-304. PMID: 22351714. http://www.ncbi.nlm.nih.gov/pubmed/22351714. EXCLUDE: Focused on fructose, not added sugars

19. Sonestedt E, Overby NC, Laaksonen DE, Birgisdottir BE. Does high sugar consumption exacerbate cardiometabolic risk factors and increase the risk of type 2 diabetes and cardiovascular disease? Food Nutr Res. 2012;56. PMID: 22855643. http://www.ncbi.nlm.nih.gov/pubmed/22855643. EXCLUDE: Focused on type 2 diabetes (to be considered for T2D question)

20. Te Morenga LA, Howatson AJ, Jones RM, Mann J. Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. Am J Clin Nutr. 2014;100(1):65-79. PMID: 24808490. http://www.ncbi.nlm.nih.gov/pubmed/24808490. EXCLUDE: Focused on blood pressure and lipids; did not consider body weight as an outcome

21. Trumbo PR, Rivers CR. Systematic review of the evidence for an association between sugar-sweetened beverage consumption and risk of obesity. Nutr Rev. 2014. PMID: 25091794. http://www.ncbi.nlm.nih.gov/pubmed/25091794. EXCLUDE: Only reviewed studies where energy balance was controlled for (isocaloric); didn't address question of interest

22. Weed DL, Althuis MD, Mink PJ. Quality of reviews on sugar-sweetened beverages and health outcomes: a systematic review. Am J Clin Nutr. 2011;94(5):1340-7. PMID: 21918218. http://www.ncbi.nlm.nih.gov/pubmed/21918218. EXCLUDE: Reviewed quality of existing reviews

23. Wiebe N, Padwal R, Field C, Marks S, Jacobs R, Tonelli M. A systematic review on the effect of sweeteners on glycemic response and clinically relevant outcomes. BMC Med. 2011;9:123. PMID: 22093544. http://www.ncbi.nlm.nih.gov/pubmed/22093544. EXCLUDE: Focused on non-caloric sweeteners, not added sugars

24. Zhang YH, An T, Zhang RC, Zhou Q, Huang Y, Zhang J. Very high fructose intake increases serum LDL-cholesterol and total cholesterol: a meta-analysis of controlled feeding trials. J Nutr. 2013;143(9):1391-8. PMID: 23825185. http://www.ncbi.nlm.nih.gov/pubmed/23825185. EXCLUDE: Focused on total cholesterol and LDL-cholesterol; did not consider body weight as an outcome

Appendix E2.45: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between the intake of added sugars and the risk of type 2 diabetes?

Conclusion Statement: Strong evidence shows that higher consumption of added sugars, especially sugar-sweetened beverages, increases the risk of type 2 diabetes among adults and this relationship is not fully explained by body weight.

DGAC Grade: Strong

Review of Evidence

Evidence for this question and conclusion came from five SRs and MA published between January 2010 and August 2014.[1-5] Four of the reviews focused on sugar-sweetened beverages[1-3, 5] and one review examined sugar intake.[4] Combined, a total of 17 articles were considered in these reviews, of which nine were included in two or more reviews. Increased consumption of sugar-sweetened beverages was consistently associated with increased risk of type 2 diabetes. Pooled estimated relative risks ranged from 1.20 to 1.28, and included 1.20 (95% CI = 1.12 to 1.29)/330 ml/day of sugar-sweetened soft drinks;[1] 1.26 (95% CI = 1.12 to 1.41) for sugar-sweetened beverages,[3] and 1.28 (95% CI = 1.04 to 1.59) for sugar-sweetened fruit juices.[5] Comparably, a hazard ratio of 1.29 (1.02, 1.63) was identified for sugar-sweetened beverages.[2] These consistently positive associations between sugar-sweetened beverages and type 2 diabetes were attenuated, but still existed, after adjustment for BMI, suggesting that body weight only partly explains the deleterious effects of sugar-sweetened beverages on type 2 diabetes. Although the studies were highly heterogeneous, findings from the MA by Malik et al. tentatively showed that consumption of more than one 12-ounce serving per day of sugar-sweetened beverage increased the risk of developing type 2 diabetes by 26 percent, compared to consuming less than one serving per month. Insufficient high-quality data are available to determine a dose-response line or curve between sugar-sweetened beverage consumption and type 2 diabetes risk.

The issue of generalizability, whether the participants included in this body of evidence are representative of the general U.S. population, was not specifically addressed in the literature reviewed, but the large sample sizes of the pooled data (several hundred thousand subjects from different populations) are noteworthy.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of added sugars and risk of type 2 diabetes?

Author, Year **Publication Type** **AMSTAR Rating***	**Added Sugars Definition** **Outcomes Considered**	**Date Range Searched** **Criteria Used**	**Included Studies** (Number and Design)**	**Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA**
Greenwood, 2014 Systematic Review and Meta-Analysis AMSTAR: 8/11	Sugar-sweetened beverages (carbonated, sugar-sweetened colas and soft drinks, total fruit punch, non-diet soda, full-energy sweetened soft drinks) Incidence of T2D	1990 to Nov 2009, with an update in June 2013 PCSs; English language; original research article; at least 3 yr duration; differentiated between sugar and artificially sweetened beverages; participants from a generally healthy population	11 publications from 9 cohorts (5 publications from 6 cohorts used in meta-analysis of SSBs)	**Conclusion:** The included studies were observational, so their results should be interpreted cautiously, but findings indicate a positive association between sugar-sweetened soft drink intake and T2D risk, attenuated by adjustment for BMI. **Main Results:** The summary relative risk for sugar-sweetened soft drinks was 1.20/330 ml per d. The association with sugar-sweetened soft drinks was slightly lower in studies adjusting for BMI, consistent with BMI being involved in the causal pathway.
Romaguera, 2013 *(Note: Included in Greenwood, 2014)* Meta-Analysis of eight cohorts from the EPIC study AMSTAR: N/A	Sweet beverages (juices [either from 100% fruit and vegetables or concentrates], nectars [juices with up to 20% added sugar], and total soft drinks [sugar-sweetened and artificially sweetened]) Incidence of T2D	N/A Excluded those with evidence of T2D and those within the lowest and highest 1% of the cohort distribution of the ratio of reported total energy intake: energy requirement and those with missing information on diet, physical activity, level of education, smoking status, or BMI	Eight cohorts of the EPIC study	**Conclusion:** This study corroborates the association between increased incidence of T2D and high consumption of sugar-sweetened soft drinks in European adults. **Main Results:** In adjusted models, one 336 g (12 oz) daily increment in sugar-sweetened soft drink consumption was associated with HR for T2D of 1.22 (95% CI: 1.09 to 1.38). After further adjustment for energy intake and BMI, the association of sugar-sweetened soft drinks with T2D persisted (HR 1.18, 95% CI: 1.06 to 1.32). Juice and nectar consumption was not associated with T2D incidence.
Malik, 2010 Meta-Analysis AMSTAR: 8/11	Sugar-sweetened beverages (soft drinks, carbonated soft drinks, fruitades, fruit drinks, sports drinks, energy and vitamin water drinks, sweetened iced tea, punch, cordials,	1966 to May 2010 PCSs; English language; presentation of relative risk and associated measure of variance; definition and metric for SSB intake; adults	8 PCSs	**Conclusion:** Higher consumption of SSBs is associated with development of T2D. **Main Results:** Individuals in the highest quantile of SSB intake (most often 1–2, 12-oz servings/day) had a 26% greater risk of developing T2D than those in the lowest quantile (none or <1 serving/month) (RR=1.26).

	squashes, and lemonade) Incidence of T2D			
Sonestedt, 2012 Systematic Review AMSTAR: 9/11	Sugar intake (intrinsic, added, and total sugar intake from sugar-sweetened beverages, sugars, sucrose, and fructose) Incidence of T2D (also searched for impaired glucose tolerance and insulin sensitivity)	2000 to 2010, with update through Dec 2011 PCSs with 4 or more yrs of follow-up; RCTs with at least 4 wks duration, drop-out rate <50%, and replacement of sugars with corresponding amount of CHO; English or Nordic language; generally healthy populations	9 PCSs (4 on total sugars, sucrose, or fructose and 6 reported on SSBs)	**Conclusion:** Data from PCSs suggest that SSBs probably increase the risk of T2D. The results were limited or inconsistent on the adverse effect of intake of total sugars, glucose, or fructose on the incidence of T2D. **Main Results:** The results from the 4 studies on the association between intake of total sugars, sucrose, or fructose and T2D were inconclusive, with studies showing positive, negative, and no association. The 6 studies reporting on SSBs were more conclusive, with 4 reporting a positive association, and a fifth reporting a positive association in the model not adjusting for BMI.
Xi, 2014 Systematic Review and Meta-Analysis AMSTAR: 10/11	Sugar-sweetened fruit juice and 100% fruit juice Incidence of T2D	Up to Dec 2013 PCSs; English language; reported covariate adjusted RRs or HRs with 95% CIs for highest vs. lowest category of fruit juice intake; for multiple articles from same cohort, selected only the study with the largest sample size	4 PCSs examined sugar-sweetened fruit juice and 4 PCSs examined 100% fruit juice	**Conclusion:** The findings support dietary recommendations to limit SSBs, such as fruit juice with added sugar, to prevent the development of T2D. **Main Results:** A higher intake of sugar-sweetened fruit juice was significantly associated with risk of T2D (RR = 1.28), while intake of 100% fruit juice was not associated with risk of developing T2D (RR = 1.03).

* A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

**Reference overlap: Of the 17 articles included in total across the reviews, 9 were included in two or more reviews.

References Included in Review

1. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. Br J Nutr. 2014:1-10. PMID: 24932880. http://www.ncbi.nlm.nih.gov/pubmed/24932880

2. Romaguera D, Norat T, Wark PA, Vergnaud AC, Schulze MB, van Woudenbergh GJ, et al. Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct. Diabetologia. 2013;56(7):1520-30. PMID: 23620057. http://www.ncbi.nlm.nih.gov/pubmed/23620057

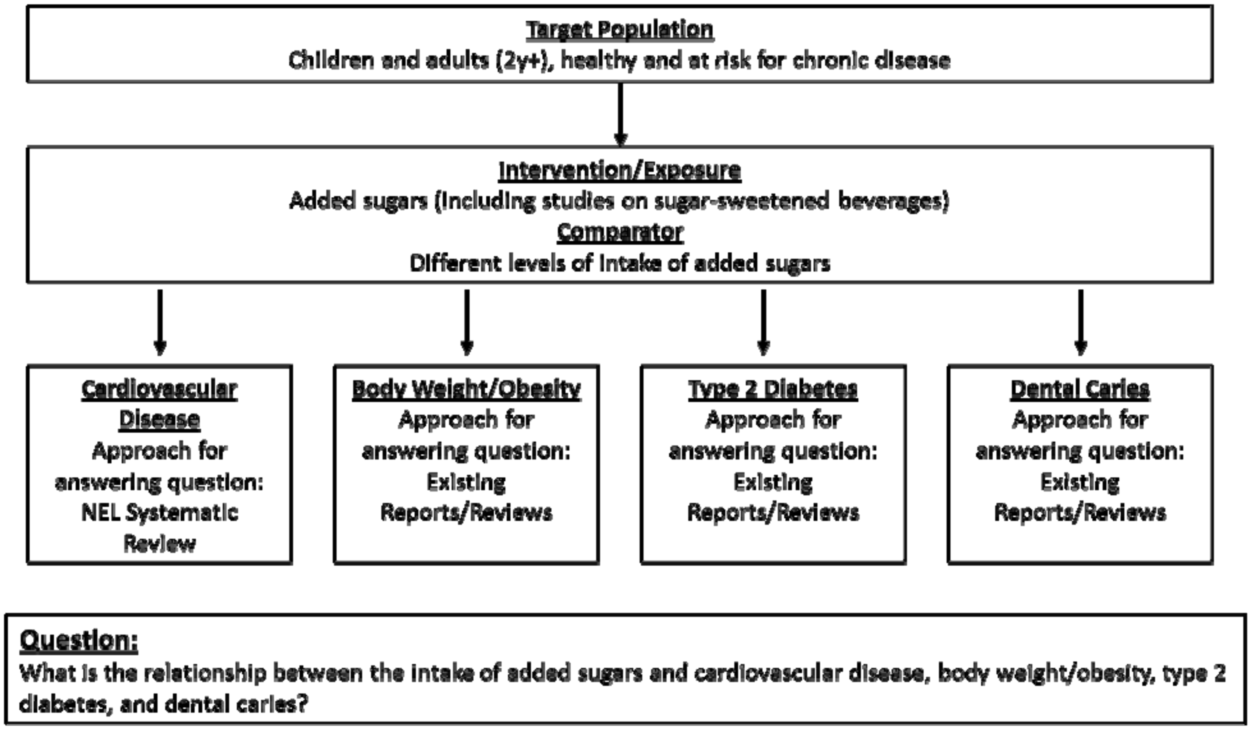
3. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. Diabetes Care. 2010;33(11):2477-83. PMID: 20693348. http://www.ncbi.nlm.nih.gov/pubmed/20693348

4. Sonestedt E, Overby NC, Laaksonen DE, Birgisdottir BE. Does high sugar consumption exacerbate cardiometabolic risk factors and increase the risk of type 2 diabetes and cardiovascular disease? Food Nutr Res. 2012;56. PMID: 22855643. http://www.ncbi.nlm.nih.gov/pubmed/22855643

5. Xi B, Li S, Liu Z, Tian H, Yin X, Huai P, et al. Intake of fruit juice and incidence of type 2 diabetes: a systematic review and meta-analysis. PLoS One. 2014;9(3):e93471. PMID: 24682091. http://www.ncbi.nlm.nih.gov/pubmed/24682091

Supplementary Information:

Analytical Framework



Methodology

The Committee relied on existing SRs/MA published since January 2010 to address the intake of added sugars and risk of type 2 diabetes.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

Added Sugar* OR brown sugar*[tiab] OR white sugar*[tiab] OR raw sugar* OR syrup*[tiab] OR dextrose OR fructose OR fruit juice concentrate* OR glucose OR honey[mh] OR honey[tiab] OR jam[tiab] OR invert sugar* OR malt sugar* OR maltose[tiab] OR maltodextrin OR molasses OR turbinado sugar* OR cane sugar*[tiab] OR cane juice*[tiab] OR “sugar cane”[tiab] OR sugar beet*[tiab] OR trehalose[tiab] OR sucrose[tiab] OR sweetene* OR table sugar*[tiab] OR "Monosaccharides"[Mesh] OR Monosaccharide*[tiab] OR disaccharide*[tiab] OR "Disaccharides"[Mesh] OR "Sweetening Agents"[Mesh:noexp] OR "Nutritive Sweeteners"[Mesh] OR "Dietary Sucrose"[tiab] OR sugar based* OR sugar-based* OR HFCS OR candy[tiab] OR "Candy"[Mesh] OR “Carbonated beverages”[mh] OR Soft drink* OR Liquid sugar* OR Soda pop* OR soda[tiab] OR Carbonated drink*[tiab] OR dessert*[tiab] OR pastries[tiab] OR ice cream*[tiab] OR cookies[tiab] OR cake*[tiab] OR pie[tiab] OR pies[tiab] OR gelatin*[tiab] OR jello[tiab] OR fruit punch*[tiab] OR fruitade*[tiab] OR sugary[tiab] OR sweets[tiab] OR sugar-sweetene*[tiab] OR caramel OR "malt barley" OR "barley malt" OR "Sweetening Agents" [Pharmacological Action] (done; w/ food/diet terms 30; none selected; 8/7/2014) OR sugar-

coated[tiab] OR sugar coated*[tiab] OR sugar*[ti] OR sugar sweeten*[tiab] OR dietary sugar*[tiab] OR confectioner*[tiab] OR fizzy drink*[tiab] OR chewing gum*[tiab]
AND
(“insulin resistance”[mh] OR “insulin”[ti] OR inflammation[ti] OR glucose intoleran*[tiab] OR "Glucose Intolerance"[Mesh] OR diabetes[tiab] OR "Diabetes Mellitus, Type 2"[Mesh] OR "Hemoglobin A, Glycosylated"[Mesh] OR “hemoglobin A1c “[tiab] OR (“impaired fasting” AND (glucose OR glycemi*)) OR “onset diabetes” OR “impaired glucose” OR “insulin sensitivity” OR insulin-resist*[tiab] OR insulin resist*[tiab])

Embase:

(added NEXT/1 sugar*):ti,ab OR (raw NEXT/1 sugar*):ti,ab OR (white NEXT/1 sugar*):ti,ab OR (brown NEXT/1 sugar*):ti,ab OR 'sugar intake'/exp OR 'sucrose'/exp OR 'sweetening agent'/de OR 'fructose'/exp OR 'monosaccharide'/exp OR 'sugarcane'/exp OR 'lactose'/exp OR (milk NEXT/2 sugar*):ti,ab OR 'sugar beet'/exp OR 'sugar'/exp/mj OR (sugar NEXT/1 beet*):ti,ab OR sugarcane:ti,ab OR (sugar NEXT/1 cane):ti,ab OR dextrose:ti,ab OR 'glucose'/exp OR (corn NEXT/1 syrup*):ti,ab OR (maple NEXT/1 syrup*):ti,ab OR 'honey'/exp OR 'invert sugar'/exp OR (invert NEXT/1 sugar*):ti,ab OR 'maltose'/exp OR (malt NEXT/1 sugar*):ti,ab OR 'maltodextrin'/exp OR 'molasses'/exp OR (turbinado NEXT/1 sugar*):ti,ab OR 'disaccharide'/exp OR disaccharide*:ti,ab OR trehalose*:ti,ab OR (sugar NEXT/1 based*):ti,ab OR HFCS*:ti,ab OR candy:ti,ab OR candies:ti,ab OR 'carbonated beverage'/exp OR (carbonated NEXT/1 beverage*):ti,ab OR (Soft NEXT/1 drink*):ti,ab OR (Liquid NEXT/1 sugar*):ti,ab OR (Soda NEXT/1 pop*):ti,ab OR popsicle*:ti,ab OR (soda NEAR/10 (drink* OR beverage*)) OR (Carbonated NEXT/1 drink*):ti,ab OR 'soft drink'/exp OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEXT/1 cream*):ti,ab OR 'ice cream'/exp OR cookies:ti,ab OR cake*:ti OR pie:ti,ab OR pies:ti,ab OR gelatin*:ti,ab OR jello:ti,ab OR (fruit NEXT/1 punch*):ti,ab OR fruitade*:ti,ab OR (('fruit juice'/exp OR (fruit NEXT/1 juice*)) AND concentrate) OR sweets:ti,ab OR caramel:ti,ab OR (malt* NEAR/1 barley) OR ('syrup'/exp OR syrup*:ti,ab) OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab OR 'chewing gum'/exp
('food'/exp OR 'beverage'/exp OR diet/exp OR 'dietetics'/exp OR nutrition/exp OR cane OR rice OR sorghum OR malt OR golden OR 'food additive'/exp)
AND
(“insulin”:ti OR inflammation:ti,ab OR (glucose NEXT/1 intoleran*):ti,ab OR diabetes:ti,ab OR “hemoglobin A1c”:ti,ab OR (“impaired fasting” AND (glucose OR glycemi*)) OR “onset diabetes” OR “impaired glucose” OR 'insulin resistance'/exp OR (insulin NEXT/1 resistan*):ti,ab OR 'glucose intolerance'/exp OR 'non insulin dependent diabetes mellitus'/exp OR 'glycosylated hemoglobin'/exp OR 'impaired glucose tolerance'/exp OR 'maturity onset diabetes mellitus'/exp)
'systematic review'/exp OR 'meta analysis'/exp

Cochrane:

“insulin resistance”:ti,ab OR “insulin”:ti OR inflammation:ti OR (glucose NEXT intoleran*):ti,ab OR diabetes:ti OR ("Hemoglobin A":ti AND Glycosylated:ti) OR “hemoglobin A1c “:ti OR (“impaired fasting”:ti AND (glucose:ti OR glycemi*:ti)) OR “onset diabetes”:ti OR “impaired glucose”:ti

(Added NEXT Sugar*) OR (brown NEXT sugar*) OR (white NEXT sugar*) OR (raw NEXT sugar*) OR syrup*:ti,kw OR dextrose:ti OR fructose:ti OR (fruit NEXT juice NEXT concentrate*) OR glucose:ti OR honey:ti OR jam:ti OR (invert NEXT sugar*) OR (malt NEXT sugar*) OR maltose:ti OR maltodextrin:ti OR molasses OR (turbinado NEXT sugar*) OR (cane NEXT sugar*) OR (cane NEXT juice*) OR “sugar cane”:ti,ab OR (sugar NEXT beet*):ti,ab OR trehalose:ti OR sucrose:ti OR sweetene* OR (table NEXT sugar*) OR Monosaccharide*:ti OR disaccharide*:ti OR "Dietary Sucrose":ti,ab OR (sugar NEXT based*) OR sugar-based* OR HFCS OR candy:ti,ab OR candies:ti,ab OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEXT drink*) OR (Liquid NEXT sugar*) OR (Soda NEXT pop*) OR popsicle* OR soda:ti OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEAR/1 cream*) OR cookies:ti,ab OR cake*:ti OR pie:ti OR pies:ti OR gelatin*:ti OR jello:ti OR “fruit punch”:ti,ab OR fruitade*:ti,ab OR sugar*:ti OR sweets:ti OR (sugar-sweetene*:ti,kw,ab) OR caramel:ti,ab OR (malt* NEAR/1 barley) OR 'syrup':ti,ab,kw OR (dietary NEXT sugar*):ti,ab OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab (“body weight” OR obesity:ti,kw,ab OR overweight:ti,kw,ab OR “body fat”:ti,kw,ab OR adipos*:ti,kw,ab OR weight:ti,kw,ab OR waist:ti,kw,ab OR “body mass”:ti,kw,ab OR bmi:ti,kw,ab OR “Metabolic syndrome”:ti,kw,ab)

Navigator:

((Added NEXT Sugar*) OR (brown NEAR/1 sugar*) OR (white NEAR/1 sugar*) OR (raw NEAR/1 sugar*) OR title:syrup* OR title:dextrose OR title:fructose OR (fruit NEAR/1 juice NEAR/1 concentrate*) OR title:glucose OR title:honey OR title:jam OR (invert NEAR/1 sugar*) OR (malt NEAR/1 sugar*) OR title:maltose OR title:maltodextrin OR title:molasses OR (turbinado NEAR/1 sugar*) OR (cane NEAR/1 sugar*) OR (cane NEAR/1 juice*) OR “sugar cane” OR (sugar NEAR/1 beet*) OR title:trehalose OR title:sucrose OR title:sweetene* OR (table NEAR/1 sugar*) OR title:Monosaccharide* OR title:disaccharide* OR "Dietary Sucrose" OR (sugar NEAR/1 based*) OR sugar-based* OR HFCS OR title:candy OR title:candie* OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEAR/1 drink*) OR (Liquid NEAR/1 sugar*) OR (Soda NEAR/1 pop*) OR popsicle* OR title:soda OR title:dessert* OR title:pastries OR (ice NEAR/1 cream*) OR title:cookies OR title:cake* OR title:pie OR pies:ti OR title:gelatin* OR title:jello OR “fruit punch” OR title:fruitade* OR title:sweets OR (sugar-sweetene*) OR title:caramel OR (malt* NEAR/1 barley) OR (dietary NEAR/1 sugar*) OR title:sugar* OR (sugar NEAR/3 sweet*) OR (sugar NEAR/3 coat*) OR (dietary NEAR/1/1 sugar*) OR title:confectioner* OR (fizzy NEAR/1 drink*) OR chewing NEAR/1 gum*)

Inclusion Criteria

Date Range:

- Published between December 2011 and August 2014 (in English in a peer-reviewed journal)

Study Design:

- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

Study Subjects:

- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:

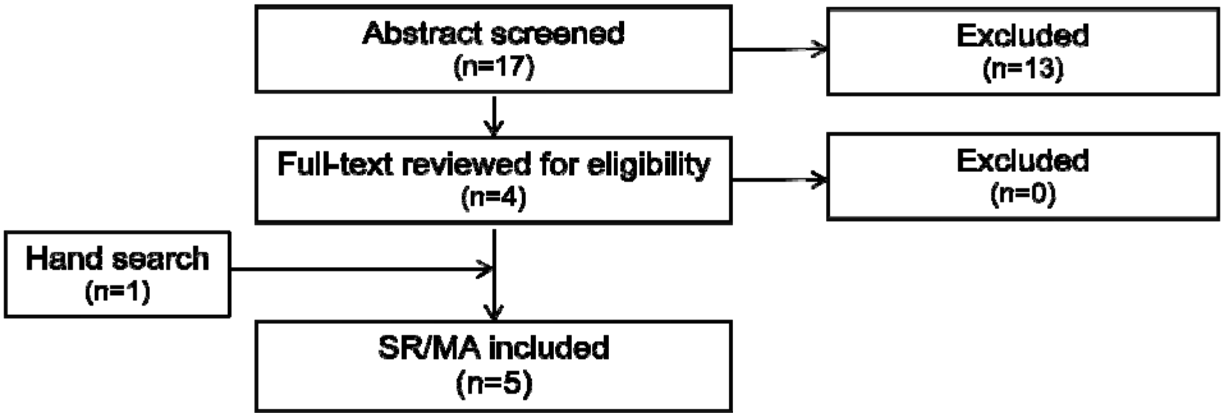
- Added sugars, including sugar-sweetened beverages

- Added sugars are sugars that are either added during the processing of foods, or are packaged as such, and include sugars (free, mono- and disaccharides), syrups, naturally occurring sugars that are isolated from a whole food and concentrated so that sugar is the primary component (e.g., fruit juice concentrates), and other caloric sweeteners.[28]

Outcome:
- Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

Quality:
- Reviews rated 8-11 on AMSTAR (A measurement tool for the 'assessment of multiple systematic reviews')

Search Results



Excluded Articles with Reason for Exclusion

6. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. Metab Syndr Relat Disord. 2010;8(6):471-6. PMID: 20958207. http://www.ncbi.nlm.nih.gov/pubmed/20958207. EXCLUDE: Focused on dietary patterns, not added sugars

7. Ha V, Jayalath VH, Cozma AI, Mirrahimi A, de Souza RJ, Sievenpiper JL. Fructose-containing sugars, blood pressure, and cardiometabolic risk: a critical review. Curr Hypertens Rep. 2013;15(4):281-97. PMID: 23793849. http://www.ncbi.nlm.nih.gov/pubmed/23793849. EXCLUDE: Narrative review

8. Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. Obes Rev. 2013;14(8):606-19. PMID: 23763695. http://www.ncbi.nlm.nih.gov/pubmed/23763695. EXCLUDE: Narrative review

9. Kelishadi R, Mansourian M, Heidari-Beni M. Association of fructose consumption and components of metabolic syndrome in human studies: a systematic review and meta-analysis. Nutrition. 2014;30(5):503-10. PMID: 24698343. http://www.ncbi.nlm.nih.gov/pubmed/24698343. EXCLUDE: Did not include incidence of type 2 diabetes as an outcome

10. Liu K, Zhou R, Wang B, Mi MT. Effect of resveratrol on glucose control and insulin sensitivity: a meta-analysis of 11 randomized controlled trials. Am J Clin Nutr. 2014;99(6):1510-9. PMID: 24695890. http://www.ncbi.nlm.nih.gov/pubmed/24695890. EXCLUDE: Examine resveratrol, not added sugars

11. Nettleton JA, Hivert MF, Lemaitre RN, McKeown NM, Mozaffarian D, Tanaka T, et al. Meta-analysis investigating associations between healthy diet and fasting glucose and insulin levels and modification by loci associated with glucose homeostasis in data from 15 cohorts. Am J Epidemiol. 2013;177(2):103-15. PMID: 23255780. http://www.ncbi.nlm.nih.gov/pubmed/23255780. EXCLUDE: Did not examine relationship between added sugars and type 2 diabetes

12. Pereira M, Carreira H, Lunet N, Azevedo A. Trends in prevalence of diabetes mellitus and mean fasting glucose in Portugal (1987-2009): a systematic review. Public Health. 2014;128(3):214-21. PMID: 24559769. http://www.ncbi.nlm.nih.gov/pubmed/24559769. EXCLUDE: Did not examine added sugars

13. Pereira MA. Diet beverages and the risk of obesity, diabetes, and cardiovascular disease: a review of the evidence. Nutr Rev. 2013;71(7):433-40. PMID: 23815142. http://www.ncbi.nlm.nih.gov/pubmed/23815142. EXCLUDE: Focused on diet beverages

14. Quinn TJ, Dawson J, Walters MR. Sugar and stroke: cerebrovascular disease and blood glucose control. Cardiovasc Ther. 2011;29(6):e31-42. PMID: 20491782. http://www.ncbi.nlm.nih.gov/pubmed/20491782. EXCLUDE: Narrative review

15. Ruxton CH, Gardner EJ, McNulty HM. Is sugar consumption detrimental to health? A review of the evidence 1995-2006. Crit Rev Food Sci Nutr. 2010;50(1):1-19. PMID: 20047137. http://www.ncbi.nlm.nih.gov/pubmed/20047137. EXCLUDE: Did not examine incidence of type 2 diabetes

16. Schwingshackl L, Hoffmann G. Comparison of the long-term effects of high-fat v. low-fat diet consumption on cardiometabolic risk factors in subjects with abnormal glucose metabolism: a systematic review and meta-analysis. Br J Nutr. 2014;111(12):2047-58. PMID: 24666665. http://www.ncbi.nlm.nih.gov/pubmed/24666665. EXCLUDE: Focused on high-fat versus low-fat diet

17. Weed DL, Althuis MD, Mink PJ. Quality of reviews on sugar-sweetened beverages and health outcomes: a systematic review. Am J Clin Nutr. 2011;94(5):1340-7. PMID: 21918218. http://www.ncbi.nlm.nih.gov/pubmed/21918218. EXCLUDE: Reviews quality of existing reviews

18. Wiebe N, Padwal R, Field C, Marks S, Jacobs R, Tonelli M. A systematic review on the effect of sweeteners on glycemic response and clinically relevant outcomes. BMC Med. 2011;9:123. PMID: 22093544. http://www.ncbi.nlm.nih.gov/pubmed/22093544. EXCLUDE: Did not incidence of type 2 diabetes as an outcome

Appendix E2.46: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between the intake of added sugars and dental caries?

Conclusion Statement: The DGAC concurs with the World Health Organization's commissioned systematic review that moderate consistent evidence supports a relationship between the amount of free sugars intake and the development of dental caries among children and adults. Moderate evidence also indicates that caries are lower when free-sugars intake is less than 10 percent of energy intake.

DGAC Grade: Moderate

Review of Evidence

These findings were extracted from a World Health Organization (WHO)-commissioned SR by Moynihan et al. published in 2014 examining the association between the amount of sugars intake and dental caries.[1] The search for SRs/MA published since completion of the WHO review did not yield any additional reviews that met the DGAC's inclusion criteria.

Moynihan et al. examined total sugars, free sugars,[i] added sugars, sucrose, and non-milk extrinsic (NME) sugars. In the review, eligible studies reported the absolute amount of sugars. Dental caries outcomes included caries prevalence, incidence and/or severity.

Several databases were searched from 1950 through 2011. From 5,990 papers identified, 55 studies (from 65 papers) were eligible, including 3 interventions, 8 cohort studies, 20 population studies, and 24 cross-sectional studies. No RCTs were included. Data variability limited the ability to conduct meta-analysis. Of the 55 studies included in the review, the majority were in children and only four studies were conducted in adults. The terminology used for reporting sugars varied, but most were described as pertaining to free sugars or added sugars.

The findings indicated consistent evidence of moderate quality supporting a relationship between the amount of sugars consumed and dental caries development across age groups. Of the studies, 42 out of 50 studies in children and five out of five in adults reported at least one result for an association between sugars intake with increased caries. Moderate evidence also showed that caries incidence is lower when free sugars intake is less than 10 percent of energy intake. When a less than 5 percent energy intake cutoff was used, a significant relationship between sugars and caries was observed, but the evidence was judged to be of very low

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[i] Free sugar is defined by WHO as "all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices." It is used to distinguish between the sugars that are naturally present in fully unrefined carbohydrates such as brown rice, whole wheat pasta, and fruit and those sugars (or carbohydrates) that have been, to some extent, refined (normally by humans but sometimes by animals, such as the free sugars present in honey). They are referred to as "sugars" since they cover multiple chemical forms, including sucrose, glucose, fructose, dextrose, and others.[2]

quality. Although meta-analysis was limited, analysis of existing data indicated a large effect size (e.g., Standardized Mean Difference for Decayed/Missing/Filled Teeth [DMFT] = 0.82 [CI = 0.67 to 0.97]) for the relationship of sugars intake and risk of dental caries. A strength of the in-depth SR was the consistency of data, despite methodological weaknesses in many studies, which included unclear definitions of endpoints, questions about outcomes ascertainment, and lack of clarity about the generalizability of individual study results given the study populations used.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of added sugars and risk of dental caries

Author, Year **Publication Type** **AMSTAR Rating***	**Added Sugars Definition** **Outcomes Considered**	**Date Range Searched** **Criteria Used**	**Included Studies (Number and Design)**	**Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA**
Moynihan, 2013 Systematic Review (data variability limited meta-analysis) AMSTAR: 11/11	Total sugars, free sugars, added sugars, sucrose, non-milk extrinsic (NME) sugars, expressed as g or kg/d or /yr or as percentage energy Caries prevalence, incidence, and/or severity	1950 to November 2011 Healthy humans (no acute illness); developing, transitional, or industrialized countries; all ages; no language restrictions; studies had to report amount of added sugars, frequency only was excluded	65 papers (55 studies) 3 intervention, 8 cohort, 20 population, and 24 cross-sectional	This in-depth systematic review has identified largely consistent evidence supporting a relationship between the amount of sugars intake and the development of dental caries across age groups. Of the studies, 42 out of 50 of those in children and 5 out of 5 in adults reported at least one positive association between sugars and caries. The evidence has been classified as of moderate quality. There is also evidence of moderate quality showing that caries is lower when free-sugars intake is <10% energy. With the <5% energy cutoff, a significant relationship was observed, but the evidence was judged to be of very low quality.

* A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

References Included in Review

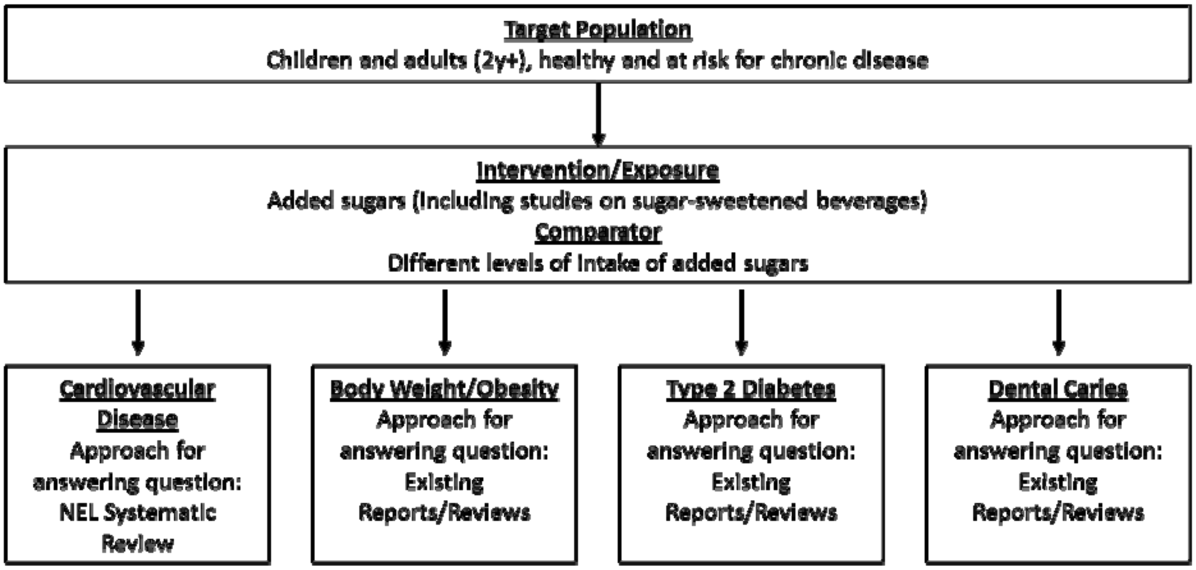
1. Moynihan PJ, Kelly SA. Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines. Journal of dental research. 2014;93(1):8-18. PMID: 24323509. http://www.ncbi.nlm.nih.gov/pubmed/24323509

Additional Reference

2. The science behind the sweetness in our diets. Bull World Health Organ. 2014;92(11):780-1. PMID: 25378738. http://www.ncbi.nlm.nih.gov/pubmed/25378738.

Supplementary Information:

Analytical Framework



Question:
What is the relationship between the intake of added sugars and cardiovascular disease, body weight/obesity, type 2 diabetes, and dental caries?

Methodology

To answer this question, the DGAC relied on a systematic review commissioned by the World Health Organization (WHO).[1] Additionally, to capture new research, the Committee searched for SRs and MA published since November 2011, the completion of the WHO review.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

Added Sugar* OR brown sugar*[tiab] OR white sugar*[tiab] OR raw sugar* OR syrup*[tiab] OR dextrose OR fructose OR fruit juice concentrate* OR glucose OR honey[mh] OR honey[tiab] OR jam[tiab] OR invert sugar* OR malt sugar* OR maltose[tiab] OR maltodextrin OR molasses OR turbinado sugar* OR cane sugar*[tiab] OR cane juice*[tiab] OR “sugar cane”[tiab] OR sugar beet*[tiab] OR trehalose[tiab] OR sucrose[tiab] OR sweetene* OR table sugar*[tiab] OR "Monosaccharides"[Mesh] OR Monosaccharide*[tiab] OR disaccharide*[tiab] OR "Disaccharides"[Mesh] OR "Sweetening Agents"[Mesh:noexp] OR "Nutritive Sweeteners"[Mesh] OR "Dietary Sucrose"[tiab] OR sugar based* OR sugar-based* OR HFCS OR candy[tiab] OR "Candy"[Mesh] OR “Carbonated beverages”[mh] OR Soft drink* OR Liquid sugar* OR Soda pop* OR soda[tiab] OR Carbonated drink*[tiab] OR dessert*[tiab] OR pastries[tiab] OR ice cream*[tiab] OR cookies[tiab] OR cake*[tiab] OR pie[tiab] OR pies[tiab] OR gelatin*[tiab] OR

jello[tiab] OR fruit punch*[tiab] OR fruitade*[tiab] OR sugary[tiab] OR sweets[tiab] OR sugar-sweetene*[tiab] OR caramel OR "malt barley" OR "barley malt" OR "Sweetening Agents" [Pharmacological Action] (done; w/ food/diet terms 30; none selected; 8/7/2014) OR sugar-coated[tiab] OR sugar coated*[tiab] OR sugar*[ti] OR sugar sweeten*[tiab] OR dietary sugar*[tiab] OR confectioner*[tiab] OR fizzy drink*[tiab] OR chewing gum*[tiab]
AND
Dental caries*[tiab] OR "Tooth Demineralization"[Mesh] OR "Diet, Cariogenic"[Mesh] OR Cariogen*[tiab] OR "Cariogenic Agents"[Mesh] OR “oral health”[tiab] OR “oral hygiene”[tiab] OR ((dental[tiab] OR dentin*[tiab] OR tooth[tiab] OR teeth[tiab]) AND (cavit*[tiab] OR carious[tiab] OR caries[tiab] OR decay*[tiab] OR demineral*[tiab] OR plaque[tiab])) OR "Dental Plaque"[Mesh] OR "Dental Plaque"[tiab] OR "Dental Pulp"[Mesh] OR "Dental Caries Susceptibility"[Mesh]

Embase:

(added NEXT/1 sugar*):ti,ab OR (raw NEXT/1 sugar*):ti,ab OR (white NEXT/1 sugar*):ti,ab OR (brown NEXT/1 sugar*):ti,ab OR 'sugar intake'/exp OR 'sucrose'/exp OR 'sweetening agent'/de OR 'fructose'/exp OR 'monosaccharide'/exp OR 'sugarcane'/exp OR 'lactose'/exp OR (milk NEXT/2 sugar*):ti,ab OR 'sugar beet'/exp OR 'sugar'/exp/mj OR (sugar NEXT/1 beet*):ti,ab OR sugarcane:ti,ab OR (sugar NEXT/1 cane):ti,ab OR dextrose:ti,ab OR 'glucose'/exp OR (corn NEXT/1 syrup*):ti,ab OR (maple NEXT/1 syrup*):ti,ab OR 'honey'/exp OR 'invert sugar'/exp OR (invert NEXT/1 sugar*):ti,ab OR 'maltose'/exp OR (malt NEXT/1 sugar*):ti,ab OR 'maltodextrin'/exp OR 'molasses'/exp OR (turbinado NEXT/1 sugar*):ti,ab OR 'disaccharide'/exp OR disaccharide*:ti,ab OR trehalose*:ti,ab OR (sugar NEXT/1 based*):ti,ab OR HFCS*:ti,ab OR candy:ti,ab OR candies:ti,ab OR 'carbonated beverage'/exp OR (carbonated NEXT/1 beverage*):ti,ab OR (Soft NEXT/1 drink*):ti,ab OR (Liquid NEXT/1 sugar*):ti,ab OR (Soda NEXT/1 pop*):ti,ab OR popsicle*:ti,ab OR (soda NEAR/10 (drink* OR beverage*)) OR (Carbonated NEXT/1 drink*):ti,ab OR 'soft drink'/exp OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEXT/1 cream*):ti,ab OR 'ice cream'/exp OR cookies:ti,ab OR cake*:ti OR pie:ti,ab OR pies:ti,ab OR gelatin*:ti,ab OR jello:ti,ab OR (fruit NEXT/1 punch*):ti,ab OR fruitade*:ti,ab OR (('fruit juice'/exp OR (fruit NEXT/1 juice*)) AND concentrate) OR sweets:ti,ab OR caramel:ti,ab OR (malt* NEAR/1 barley) OR ('syrup'/exp OR syrup*:ti,ab) OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab OR 'chewing gum'/exp
AND
'dental caries'/exp OR 'tooth plaque'/exp OR 'cariogenic diet'/exp OR Cariogen*:ti,ab OR “oral health”:ti,ab OR “oral hygiene”:ti,ab OR ((dental:ti,ab OR dentin*:ti,ab OR tooth:ti,ab OR teeth:ti,ab) AND (carious:ti,ab OR caries:ti,ab OR decay*:ti,ab OR plaque:ti,ab OR demineral*:ti,ab OR cavit*:ti,ab)) OR 'tooth plaque'/exp OR "Dental Plaque":ti,ab OR 'cariogenic agent'/exp OR 'tooth pulp'/exp OR 'mouth hygiene'/exp

Cochrane:
(Added NEXT Sugar*) OR (brown NEXT sugar*) OR (white NEXT sugar*) OR (raw NEXT sugar*) OR syrup*:ti,kw OR dextrose:ti OR fructose:ti OR (fruit NEXT juice NEXT concentrate*) OR glucose:ti OR honey:ti OR jam:ti OR (invert NEXT sugar*) OR (malt NEXT sugar*) OR maltose:ti OR maltodextrin:ti OR molasses OR (turbinado NEXT sugar*) OR (cane NEXT sugar*) OR (cane NEXT juice*) OR “sugar cane”:ti,ab OR (sugar NEXT beet*):ti,ab OR trehalose:ti OR sucrose:ti OR sweetene* OR (table NEXT sugar*) OR Monosaccharide*:ti OR disaccharide*:ti OR "Dietary Sucrose":ti,ab OR (sugar NEXT based*) OR sugar-based* OR HFCS OR candy:ti,ab OR candies:ti,ab OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEXT drink*) OR (Liquid NEXT sugar*) OR (Soda NEXT pop*) OR popsicle* OR soda:ti OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEAR/1 cream*) OR cookies:ti,ab OR cake*:ti OR pie:ti OR pies:ti OR gelatin*:ti OR jello:ti OR “fruit punch”:ti,ab OR fruitade*:ti,ab OR sugar*:ti OR sweets:ti OR (sugar-sweetene*:ti,kw,ab) OR caramel:ti,ab OR (malt* NEAR/1 barley) OR 'syrup':ti,ab,kw OR (dietary NEXT sugar*):ti,ab OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab

Navigator:

((Added NEXT Sugar*) OR (brown NEAR/1 sugar*) OR (white NEAR/1 sugar*) OR (raw NEAR/1 sugar*) OR title:syrup* OR title:dextrose OR title:fructose OR (fruit NEAR/1 juice NEAR/1 concentrate*) OR title:glucose OR title:honey OR title:jam OR (invert NEAR/1 sugar*) OR (malt NEAR/1 sugar*) OR title:maltose OR title:maltodextrin OR title:molasses OR (turbinado NEAR/1 sugar*) OR (cane NEAR/1 sugar*) OR (cane NEAR/1 juice*) OR “sugar cane” OR (sugar NEAR/1 beet*) OR title:trehalose OR title:sucrose OR title:sweetene* OR (table NEAR/1 sugar*) OR title:Monosaccharide* OR title:disaccharide* OR "Dietary Sucrose" OR (sugar NEAR/1 based*) OR sugar-based* OR HFCS OR title:candy OR title:candie* OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEAR/1 drink*) OR (Liquid NEAR/1 sugar*) OR (Soda NEAR/1 pop*) OR popsicle* OR title:soda OR title:dessert* OR title:pastries OR (ice NEAR/1 cream*) OR title:cookies OR title:cake* OR title:pie OR pies:ti OR title:gelatin* OR title:jello OR “fruit punch” OR title:fruitade* OR title:sweets OR (sugar-sweetene*) OR title:caramel OR (malt* NEAR/1 barley) OR (dietary NEAR/1 sugar*) OR title:sugar* OR (sugar NEAR/3 sweet*) OR (sugar NEAR/3 coat*) OR (dietary NEAR/1/1 sugar*) OR title:confectioner* OR (fizzy NEAR/1 drink*) OR chewing NEAR/1 gum*)

Inclusion Criteria

Date Range:
- Published between December 2011 and August 2014 (in English in a peer-reviewed journal)

Study Design:
- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

Study Subjects:

- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:

- Added sugars, including sugar-sweetened beverages
- Added sugars are sugars that are either added during the processing of foods, or are packaged as such, and include sugars (free, mono- and disaccharides), syrups, naturally occurring sugars that are isolated from a whole food and concentrated so that sugar is the primary component (e.g., fruit juice concentrates), and other caloric sweeteners.

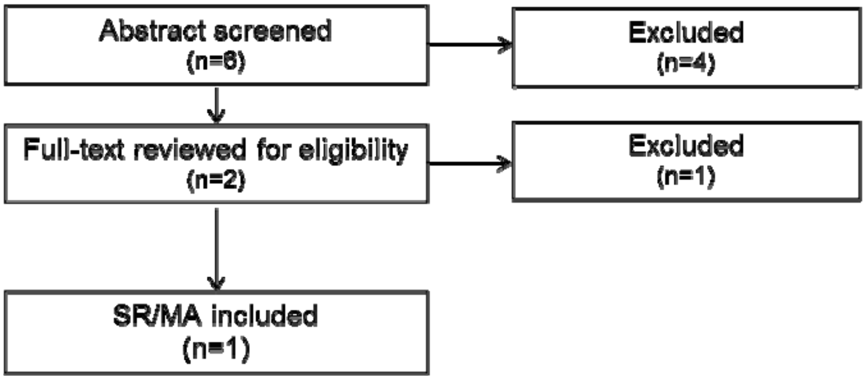
Outcome:

- Dental caries

Quality:

- Reviews rated 8-11 on AMSTAR (A measurement tool for the 'assessment of multiple systematic reviews')

Search Results



Excluded Articles with Reason for Exclusion

3. Chi DL. Reducing Alaska Native paediatric oral health disparities: a systematic review of oral health interventions and a case study on multilevel strategies to reduce sugar-sweetened beverage intake. International journal of circumpolar health. 2013;72:21066. PMID: 24377091. http://www.ncbi.nlm.nih.gov/pubmed/24377091. EXCLUDE: Did not examine relationship between added sugars and dental caries

4. Delpier T, Giordana S, Wedin BM. Decreasing sugar-sweetened beverage consumption in the rural adolescent population. Journal of pediatric health care: official publication of National Association of Pediatric Nurse Associates & Practitioners. 2013;27(6):470-8. PMID: 22932228. http://www.ncbi.nlm.nih.gov/pubmed/22932228. EXCLUDE: Original research article; did not examine relationship between added sugars and dental caries

5. Harris R, Gamboa A, Dailey Y, Ashcroft A. One-to-one dietary interventions undertaken in a dental setting to change dietary behaviour. The Cochrane database of systematic reviews. 2012;3:CD006540. PMID: 22419315. http://www.ncbi.nlm.nih.gov/pubmed/22419315.

EXCLUDE: Examined interventions in dental care setting, not relationship between added sugars and dental caries

6. Keukenmeester RS, Slot DE, Putt MS, Van der Weijden GA. The effect of sugar-free chewing gum on plaque and clinical parameters of gingival inflammation: a systematic review. International journal of dental hygiene. 2013;11(1):2-14. PMID: 22747775. http://www.ncbi.nlm.nih.gov/pubmed/22747775. EXCLUDE: Focused on sugar-free chewing gum, not added sugars

7. Ruxton CH, Gardner EJ, McNulty HM. Is sugar consumption detrimental to health? A review of the evidence 1995-2006. Critical reviews in food science and nutrition. 2010;50(1):1-19. PMID: 20047137. http://www.ncbi.nlm.nih.gov/pubmed/20047137. EXCLUDE: Working group focused on WHO review due to limited nature of the review

Appendix E2.48: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

What is the relationship between the intake of low-calorie sweeteners (LCS) and risk of type 2 diabetes?

Conclusion Statement: Long-term observational studies conducted in adults provide inconsistent evidence of an association between LCS and risk of type 2 diabetes.

DGAC Grade: Limited

Review of Evidence

Evidence to address the impact of LCSs (specifically artificially sweetened soft drinks, ASSD) on risk of type 2 diabetes comes from two SRs/MA published between January 2010 and August 2014.[1, 2] The data from one of the reviews also is represented in the second review.

Greenwood et al. reported that higher consumption of ASSD predicts increased risk of type 2 diabetes.[1] The summary RR for ASSD on type 2 diabetes risk was 1.13 (95% CI = 1.02 to 1.25, p<0.02) per 330 ml/day, based on four analyses from three prospective observational studies. Although the finding indicates a positive association between ASSD and type 2 diabetes risk, the trend was not consistent and may indicate an alternative explanation, such as confounding by lifestyle factors or reverse causality (e.g., individuals with higher BMI at baseline may use ASSD as a means to control weight).

Romaguera et al. also reported that higher consumption of ASSD was associated with increased risk of type 2 diabetes.[2] In adjusted models, one 336 g (12 oz) daily increment in ASSD consumption was associated with a hazard ratio for type 2 diabetes of 1.52 (95% CI = 1.26 to 1.83). High consumers of ASSD showed almost twice the hazard ratio of developing type 2 diabetes compared with low consumers (adjusted HR = 1.93; 95% CI = 1.47 to 2.54; p for trend <0.0001). However, the association was attenuated and became statistically not significant when BMI was included in the model (HR = 1.13, 95% CI = 0.85 to 1.52; p for trend = 0.24). The authors offered these interpretations of the findings: "In light of these findings, we have two possible explanations of the association between artificially sweetened soft drinks and diabetes: (1) the observed association is driven by reverse causality and residual confounding, given that the underlying health of people consuming artificially sweetened soft drinks may be compromised and their risk of type 2 diabetes increased; or (2) the association between artificially sweetened soft drinks and type 2 diabetes is mediated through increased BMI." The authors argued that explanation 1 is more likely correct based on reverse causality, but new research would be needed to clarify the issue.

Collectively, both studies report a positive association between ASSD and type 2 diabetes risk that was confounded by baseline BMI. The experimental designs of the studies included in these reviews analyzed associations, but precluded the assessment of cause and effect relationships, and future experimental studies should examine the relationship between ASSD and biomarkers of insulin resistance and other diabetes biomarkers.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of low-calorie sweeteners (LCS) and risk of type 2 diabetes

Author, Year Publication Type AMSTAR Rating*	Low-calorie sweeteners (LCS) Definition Outcomes Considered	Date Range Searched Criteria Used	Included Studies (Number and Design)	Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA
Greenwood, 2014 Systematic Review and Meta-Analysis AMSTAR: 8/11	Carbonated artificially sweetened soft drinks (ASSD) Converted consumption to ml/d to explore linear & non-linear dose-response trends Incidence of T2D	1990 to Nov 2009, with an update in June 2013 PCSs; English language; original research article; at least 3 yr duration; differentiated between sugar and artificially sweetened beverages; participants from a generally healthy population	3 publications on 4 cohorts examined association of artificially sweetened soft drink (ASSD) intake and T2D risk. A pooled estimate of RR from linear dose-response meta-analysis was also produced.	**Conclusion:** ASSD conclusion: Included studies were observational, thus results should be interpreted cautiously. Meta-analyses demonstrate positive association of ASSD intake and T2D risk. Association was stronger and more consistent for sugar-sweetened beverages than for ASSD and together with the effect of adjusting for BMI (attenuation), may indicate an alternative explanation for observed association such as lifestyle or reverse causality. **Main Results:** ASSD pooled estimate of relative risk from linear dose-response meta-analysis was 1.13 (95% CI: 1.02 to 1.25)/330 ml ASSD (*p*=0.02). Substantial heterogeneity between cohort studies (I^2=87%); few studies available to explore sources of heterogeneity. Some evidence of mild nonlinearity in the dose-response curve; number of included studies was small
Romaguera, 2013 *(Note: Included in Greenwood, 2014)* Meta-Analysis of eight cohorts from the EPIC study AMSTAR: N/A	Artificially sweetened soft drink (ASSD) Incidence of T2D	N/A Excluded those with evidence of T2D and those within the lowest and highest 1% of the cohort distribution of the ratio of reported total energy intake: energy requirement and those with missing information on diet, physical activity, level of education, smoking status, or BMI	Eight cohorts of the EPIC study	**Conclusion:** Study reported association between ASSD and T2D that disappears when models are adjusted for baseline BMI. **Main Results:** High consumers of ASSD showed almost twice the hazard ratio (HR) of developing T2D compared with low consumers (adjusted HR 1.93, 95% CI: 1.47 to 2.54; *p* for trend < 0.0001); association was attenuated and became statistically not significant when BMI was included in the model (HR 1.13, 95% CI: 0.85 to 1.52; *p* for trend 0.24). Adjusted HR of T2D associated with 12 oz. increment in consumption of ASSD was 1.52 (95% CI: 1.26 to 1.83), which was attenuated and not significant after adjustment for body adiposity measurement. Significant interaction (*p*=0.03) between consumption of

				ASSD and BMI category on T2D incidence. In stratified analyses, ASSD consumption was sig. assoc. with T2D incidence in normal weight subjects and was unchanged with adjustment for BMI: HR: 1.43, 95% CI: 1.05 to 1.95). Borderline significance among overweight; no association among obese.

* A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

References Included in the Review

1. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. Br J Nutr. 2014:1-10. PMID: 24932880. http://www.ncbi.nlm.nih.gov/pubmed/24932880

2. Romaguera D, Norat T, Wark PA, Vergnaud AC, Schulze MB, van Woudenbergh GJ, et al. Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct. Diabetologia. 2013;56(7):1520-30. PMID: 23620057. http://www.ncbi.nlm.nih.gov/pubmed/23620057

Supplementary Information:

(Note: One search for low-calorie sweeteners and body weight, type 2 diabetes, cardiovascular disease, and dental caries was conducted. Only reviews on body weight and type 2 diabetes were identified and are presented below.)

Methodology

This question was answered using existing SRs/MA published from January 2010 to August 2014.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

(Non-caloric sweeten* OR non caloric sweeten* OR "Non-Nutritive Sweeteners"[Mesh] OR Non-Nutritive Sweetener*[tiab] OR Non Nutritive Sweetener*[tiab] OR low calorie sweeten* OR (artificial* sweeten*) OR “sugar free” OR sugar-free OR saccharin OR aspartame OR acetosulfame OR sucralose OR trichlorosucrose OR neotame OR erythritol OR rebaudioside* OR rebiana OR diet soda* OR diet drink* OR (intense* sweeten*[tiab]))
pooled analysis* OR systematic[sb] OR systematic review* OR meta-analys* OR meta analys* OR lim to SR/MA

Embase:

(Non-caloric NEXT/1 sweeten*) OR (“non caloric” NEXT/1 sweeten*) OR (Non-Nutritive NEXT/1 Sweeten*) OR “Non-Nutritive” NEXT/1 Sweeten* OR “Non Nutritive” NEXT/1 Sweeten* OR “low calorie” NEXT/1 sweeten* OR (artificial* NEXT/1 sweeten*) OR “sugar free” OR sugar-free OR saccharin OR aspartame OR acetosulfame OR sucralose OR trichlorosucrose OR neotame OR erythritol OR rebaudioside* OR rebiana OR diet soda* OR diet drink* OR (intense* NEXT/1 sweeten*) OR advantame OR (sugar NEXT/1 substitute*) OR stevia OR cyclamate* OR (monk NEXT/1 fruit*)
'systematic review'/exp OR 'meta analysis'/exp OR pooled NEXT/1 analysis* OR “systematic review” OR meta NEXT/1 analys*

Cochrane:

(Non-caloric NEXT/1 sweeten*) OR (“non caloric” NEXT/1 sweeten*) OR (Non-Nutritive NEXT/1 Sweeten*) OR “Non-Nutritive” NEXT/1 Sweeten* OR “Non Nutritive” NEXT/1 Sweeten* OR “low calorie” NEXT/1 sweeten* OR (artificial* NEXT/1 sweeten*) OR “sugar free” OR sugar-free OR saccharin OR aspartame OR acetosulfame OR sucralose OR trichlorosucrose OR neotame OR erythritol OR rebaudioside* OR rebiana OR diet soda* OR diet drink* OR (intense* NEXT/1 sweeten*) OR advantame OR (sugar NEXT/1 substitute*) OR stevia OR cyclamate* OR (monk NEXT/1 fruit*)

Inclusion Criteria

Date Range:

- Published between January 2010 and August 2014 (in English in a peer-reviewed journal)

Study Design:

- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

Study Subjects:

- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:

- Low-calorie sweetener - The Committee approached this topic broadly, including sweeteners labeled as low-calorie sweeteners, non-caloric sweeteners, non-nutritive sweeteners, artificial sweeteners, and diet beverages.

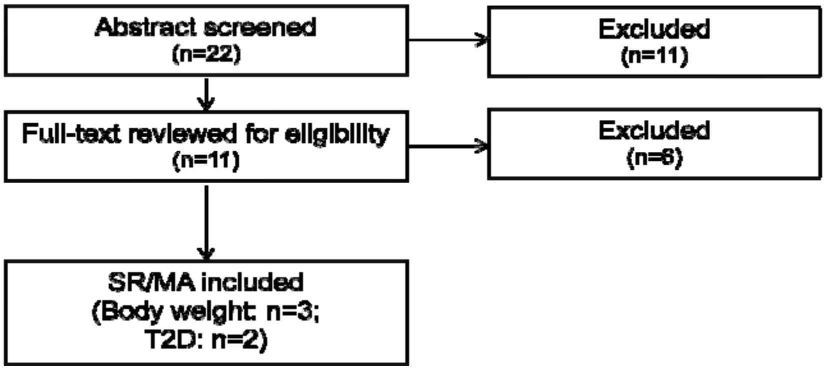
Outcome:

- Body weight: Body mass index, body weight, percent body fat, waist circumference, incidence of overweight or obesity
- Type 2 diabetes: Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

Quality:

- Reviews rated 8-11 on AMSTAR (A measurement tool for the 'assessment of multiple systematic reviews')

Search Results



Excluded Articles with Reason for Exclusion

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dental carries not included as outcome; review focused on comparisons with no chewing gum as a control

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Appendix E-2.49: Existing Reports Data Table

Part D. Chapter 7: Physical Activity

The DGAC agreed to use existing systematic reviews and reports to address the physical activity topic area. The Committee used the *Physical Activity Guidelines for Americans, 2008* (PAG) and two related reports—the *Physical Activity Guidelines Advisory Committee Report, 2008* (PAGAC) and the *Physical Activity Guidelines for Americans Midcourse Report*—as primary sources of evidence[1-3] and discussed at its public meetings questions that could be developed to frame the reports' key findings.

#	Subtopic Area	Question	Existing Report (page #)	Key Findings from Report
1	Physical Activity and Health Outcomes in Children and Adolescents	What is the relationship between physical activity, body weight, and health outcomes in children and adolescents?	2008 PAGAC Report (pp. E22-E23)	In children and youth major benefits supported by strong evidence include enhanced cardiorespiratory and muscular fitness, cardiovascular and metabolic health biomarkers, bone health, body mass and composition. Less strong evidence supports selected measures of mental health.
2	Physical Activity and Health Outcomes in Adults	What is the relationship between physical activity and body weight?	2008 PAGAC Report (pp. E22-E23)	In adults and older adults strong evidence demonstrates that, compared to less active counterparts, more active men and women have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, type 2 diabetes, metabolic syndrome, colon cancer, breast cancer, and depression. Strong evidence also supports the conclusion that, compared to less active people, physically active adults and older adults exhibit a higher level of cardiorespiratory and muscular fitness, have a healthier body mass and composition, and a biomarker profile that is more favorable for the preventing cardiovascular disease and type 2 diabetes and enhancing bone health. Modest evidence indicates that physically active adults and older adults have better quality sleep and health-related quality of life.
3		What is the relationship between physical	2008 PAGAC Report	There is a clear inverse relation between PA and cardiorespiratory health (CHD, CVD, stroke, hypertension, and atherogenic dyslipidemia). The data imply relations with

		activity and cardiorespiratory health?	(pp. E5-E6)	physical activity volume, with less information about intensity and none for frequency and duration per session for CVD clinical events. Physical activity improves cardiorespiratory fitness. Fitness has direct dose-response relations between intensity, frequency, duration, and volume. There is limited evidence for an accumulation effect (Strong). These associations exist for both men and women and individuals of all ages. There is no evidence for sex-specific, age-specific, or race/ethnic specific effects when volume is the exposure rather than relative intensity (Sex = Strong, Age = Strong, Race/Ethnicity = Reasonable).
4		What is the relationship between physical activity and metabolic health and risk of type 2 diabetes?	2008 PAGAC Report (pp. E6-E7)	There is a clear inverse relationship between PA and metabolic health, including the prevention of type 2 diabetes and metabolic syndrome. There is a 30% to 40% lower risk for type 2 diabetes and metabolic syndrome in at least moderately active people compared to sedentary individuals (Strong). This association exists for both men and women, as well as for older and younger persons. There is reasonable evidence to show the association exists for different race/ethnic groups (Sex = Strong, Age = Strong, Race/Ethnicity = Reasonable).
5		What is the relationship between physical activity and musculoskeletal health?	2008 PAGAC Report (pp. E10-E13)	Increases in exercise training enhance skeletal muscle mass, strength, power, and intrinsic neuromuscular activation. The magnitude of the effect of resistance types of PA on muscle mass and function is highly variable and dose-dependent (Strong). Benefits are similar in men and women and pervasive across the life span (Strong), although the magnitude of the benefits may be attenuated in old age (Moderate). Information on race and ethnic specificity is lacking.
6		What is the relationship between physical activity and incidence of breast and colon cancer?	2008 PAGAC Report (pp. E15-E16)	There is a clear inverse association between PA and prevention of breast and colon cancer. There is about a 30% lower risk for colon cancer and about a 20% lower risk for breast cancer (Strong). This association exists for both men and women for colon cancer, as well as for adults of different ages. There is reasonable evidence to show an association exists for different race/ethnic groups (Sex = Strong, Age = Strong, Race/Ethnicity = Reasonable).

7		What is the relationship between physical activity and mental health?	2008 PAGAC Report (pp. E16-E17)	There is clear evidence that PA reduces risk of depression and cognitive decline in adults and older adults. There is some evidence that PA improves sleep. There is limited evidence that PA reduces distress/well-being and anxiety. (Depression and cognitive health = Strong; Sleep = Moderate; Distress/wellbeing and Anxiety = Limited). There is about a 20% to 30% lower risk for depression, distress/well-being, and dementia (Strong). Risk reduction has been observed for men and women of all ages, but few studies have directly compared results according to sex or age. Racial/ethnic minority groups have been underrepresented in most studies, but limited results from prospective cohort studies suggest that risk reduction among blacks and Hispanic/Latinos is similar to that among whites (Limited).
8	Physical Activity and Health Outcomes in People with Disabilities	What is the relationship between physical activity and health outcomes in people with disabilities?	2008 PAGAC Report (p. E33)	For many physical and cognitive disabilities, scientific evidence for various health and fitness outcomes is still limited due to the lack of research. The goal of the scientific review in persons with disabilities was not to consider exercise as a therapy for disability but to evaluate the evidence that physical activity provides the general health and fitness benefits frequently reported in populations without these disabilities (e.g., improvements in physical fitness, biomarkers for chronicdisease, physical independence, health-related quality of life). Moderate to strong evidence indicates that increases in aerobic exercise improve cardiorespiratory fitness in individuals with lower limb loss, multiple sclerosis, stroke, spinal cord injury, and mental illness. Limited data show similar results for people with cerebral palsy, muscular dystrophy, and Alzheimer’s disease. Moderate to strong evidence also exists for improvements in walking speed and walking distance in patients with stroke, multiple sclerosis, and intellectual disabilities. Quite strong evidence indicates that resistance exercise training improves muscular strength in persons with such conditions as stroke, multiple sclerosis, cerebral palsy, spinal cord injury, and intellectual disability. Although evidence of benefit is suggestive for such outcomes as flexibility, atherogenic lipids, bone mineral density, and quality of life, the data are still very limited.

9	Physical Activity and Health Outcomes During Pregnancy and the Postpartum Period	Does being physically active during pregnancy and the postpartum period provide health benefits?	2008 PAGAC Report (p. E34)	Substantial data from observational studies indicates that moderate-intensity physical activity by generally healthy women during pregnancy increases cardiorespiratory fitness without increasing the risk of low birth weight, preterm delivery, or early pregnancy loss. For moderate-intensity activity during pregnancy, the scientific evidence is strong that the risks are very low, but the science is less strong in documenting improved health outcomes for the mother or child. The few studies that have been conductedon the risks and benefits of vigorous activity by women who are pregnant provide very limited data that this level of activity is associated with small reductions in birth weight compared to birth weights of infants born to less active women. Moderate-intensity physical activity during the postpartum period does not appear to adversely affect milk volume or composition or infant growth, and moderately strong evidence suggests that it results in enhanced cardiorespiratory fitness and mood of the mother. Physical activity alone does not produce weight loss except when combined with dietary changes. Dose-response studies of physical activity and health outcomes for moderate- or vigorous-intensity physical activity during pregnancy or the postpartum period have not been conducted. Most studies evaluating possible benefits have promoted moderate-intensity activity for 120 to 150 minutes per week.
10	Physical Activity and Adverse Events	What is the relationship between the amount and type of physical activity and the risk of adverse events?	2008 PAGAC Report (pp. E27-E28)	Much of the research that addresses this question has evaluated the risk of musculoskeletal injuries or sudden cardiac death during vigorous physical activity (e.g., jogging, running, competitive sports, military training) with few well conductedstudies evaluating the risk during moderate-intensity activity intended primarily to improve health. Activities with fewer and less forceful contact with other people or objects have appreciably lower injury rates than do collision or contact sports. Walking for exercise, gardening or yard work, bicycling or exercise cycling, dancing, swimming, and golf, which are already popular in the United States, are activities with the lowest injury rates. Risk of musculoskeletal injury during activity increases with the total volume of activity (e.g., MET-hours perweek). Intensity, frequency, and duration of activity all contribute to the risk of musculoskeletal injuries but their relative contributions are unknown. For sudden cardiac adverse events, intensity appears to be more important than frequency or duration. The limited data that do exist for medical risks during moderate-intensity activity indicate that the risks are very low for activities like walking and that the health benefits from such activity outweigh the risk.

11	Physical Activity Dose	What dose of physical activity is most likely to provide health benefits in children and adolescents?	2008 PAG (pp. 16-17) [2008 PAGAC Report; pp. E23-E24, E32]	Children and adolescents should do 60 minutes (1 hour) or more of physical activity daily. Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least 3 days a week. As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week, as well as bone-strengthening physical activity on at least 3 days of the week.
12		What dose of physical activity is most likely to provide health benefits in adults?	2008 PAG (pp. 22-23) [2008 PAGAC Report; pp. E23-E24, E29]	For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous intensity aerobic activity. For additional and more extensive health benefits, adults should increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate intensity, or 150 minutes a week of vigorous intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity. Additional health benefits are gained by engaging in physical activity beyond this amount. Adults should also do muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.
13		Are there any special considerations for dose of physical activity for older adults?	2008 PAG (pp. 30-31) [2008 PAGAC Report; pp. E23-E24, E32]	Recommendations for adults also apply to older adults. When older adults cannot do 150 minutes of moderate-intensity aerobic activity a week because of chronic conditions, they should be as physically active as their abilities and conditions allow.
14	Physical Activity Interventions in Children and Adolescents	What is the relationship between physical activity participation and interventions in school-based settings?	PAG Midcourse Report (pp. 9-14)	Evidence is sufficient that enhanced PE can increase overall physical activity among youth and can increase physical activity time during PE class. Evidence is sufficient that multi-component school based interventions can increase physical activity during school hours among youth. Evidence is emerging that school-based physical activity breaks can increase physical activity among youth.

15		What is the relationship between physical activity participation and interventions to change the built environment?	PAG Midcourse Report (pp. 16-17)	Evidence is suggestive that modifying aspects of the built environment can increase physical activity among youth.
16		What is the relationship between physical activity participation and interventions based in home settings?	PAG Midcourse Report(p. 19)	Evidence is insufficient that intervention strategies in the family and home increase physical activity among youth.
17		What is the relationship between physical activity participation and interventions based in early care and education centers?	PAG Midcourse Report (p. 15)	Evidence is suggestive that interventions to modify the social and/or physical environment in early care and education centers can increase physical activity among young children during the school day.
18		What is the relationship between physical activity participation and interventions based in primary health care settings?	PAG Midcourse Report (p. 20)	Evidence is insufficient that strategies implemented in primary health care settings increase physical activity among youth.

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