


Fat-Soluble Vitamins & Micronutrients: Vitamins A and E and Carotenoids



Vitamins A (retinol) and E (tocopherol) and the carotenoids are fat-soluble micronutrients that are found in many foods, including some vegetables, fruits, meats, and animal products. Fish-liver oils, liver, egg yolks, butter, and cream are known for their higher content of vitamin A. Nuts and seeds are particularly rich sources of vitamin E (Thomas 2006). At least 700 carotenoids—fat-soluble red and yellow pigments—are found in nature (Britton 2004). Americans consume 40–50 of these carotenoids, primarily in fruits and vegetables (Khachik 1992), and smaller amounts in poultry products, including egg yolks, and in seafoods (Boylston 2007). Six major carotenoids are found in human serum: *alpha*-carotene, *beta*-carotene, *beta*-cryptoxanthin, lutein, *trans*-lycopene, and zeaxanthin. Major carotene sources are orange-colored fruits and vegetables such as carrots, pumpkins, and mangos. Lutein and zeaxanthin are also found in dark green leafy vegetables, where any orange coloring is overshadowed by chlorophyll. *Trans*-Lycopene is obtained primarily from tomato and tomato products. For information on the carotenoid content of U.S. foods, see the 1998 carotenoid database created by the U.S. Department of Agriculture and the Nutrition Coordinating Center at the University of Minnesota (<http://www.nal.usda.gov/fnic/foodcomp/Data/car98/car98.html>).

Vitamin A, found in foods that come from animal sources, is called preformed vitamin A. Some carotenoids found in colorful fruits and vegetables are called provitamin A; they are metabolized in the body to vitamin A. Among the carotenoids, *beta*-carotene, a retinol dimer, has the most significant provitamin A activity. Because of limitations in the body's ability to absorb and metabolize vitamin A, approximately 12 micrograms (μg) of dietary *beta*-carotene are needed to equal 1 μg of retinol. Other provitamin A carotenoids, such as *alpha*-carotene and *beta*-cryptoxanthin, are half as active as *beta*-carotene (Institute of Medicine 2000). The bioconversion of carotenoids to vitamin A is highly variable from person to person (Krinsky 2005). Vitamin E activity is derived from at least eight naturally occurring tocopherols, the most potent of which is *alpha*-tocopherol. Other less active forms of vitamin E are plentiful in the U.S. diet, with *gamma*-tocopherol being the predominant form.

The absorption of fat-soluble micronutrients from the gastrointestinal tract depends on processes responsible for fat absorption or metabolism. Thus, people with conditions resulting in fat malabsorption (e.g., celiac disease, Crohn's disease, pancreatic disorders) can develop vitamin A deficiency over time. Vitamin A also has interactions with other nutrients. Iron and zinc deficiency can affect vitamin A metabolism and transport of vitamin A stores from the liver to body tissues (Institute of Medicine 2001). The absorption of carotenoids from foods is highly dependent on cooking techniques that break down plant cell walls and release carotenoids and also on the availability of dietary fat to enhance carotenoid uptake (Krinsky 2005). The liver regulates the concentration of vitamin A in the circulation by releasing stored retinyl esters as needed; only when liver reserves are nearly exhausted does serum vitamin A fall into the deficient range (Napoli 2006). The variation in serum carotenoid concentrations among people in the United States is relatively large, primarily reflecting wide-ranging differences in dietary intake (Lacher 2005). Plasma concentrations of tocopherols vary widely among healthy individuals and are highly correlated with plasma lipid concentrations (Ford 1999; Ford 2006).

Inadequate or excessive intake of vitamins A or E can lead to various disorders. For example, vitamin A deficiency is considered to be the main cause of childhood blindness (Roodhooft 2002), a rare condition in the United States. Prominent signs of vitamin A deficiency include night blindness, corneal thinning, and conjunctival metaplasia. Vitamin A is also essential for proper immune function, epithelial growth and repair, bone growth, reproduction, and normal embryonic and fetal development (West 2006). Acute toxicity, resulting from single or short-term large doses of preformed vitamin A, is characterized by nausea, vomiting, headache, vertigo, blurred vision, increased cerebrospinal fluid pressure, and lack of muscular coordination. Central nervous system effects, liver abnormalities, bone and skin changes, and other nonspecific adverse effects can be indicative of chronic hypervitaminosis A. Consuming excess amounts of vitamin A during early pregnancy may lead to serious birth defects (Institute of Medicine 2001). The U.S. Food and Drug Administration (FDA) currently recommends that pregnant women obtain vitamin A from foods containing *beta*-carotene (U.S. Food and Drug Administration 1995).

Carotenoids are considered among the best biological markers for fruit and vegetable intake. The strongest dietary predictors of serum carotenoid concentrations are fruits (for sources of *beta*-cryptoxanthin), carrots and root vegetables (for sources of carotenes), and tomato products (for sources of *trans*-lycopene) (Al-Delaimy 2005). Research studies have shown inconsistencies in the relation between carotenoid intake and protection from cancer. Carotenoids in foods, even when consumed over long periods and in large amounts, are not known to produce adverse health effects. However, results of intervention studies of smokers who used 20-30 milligrams (mg) of *beta*-carotene per day showed that this group had more lung cancers than placebo-treated groups (Redlich 1998; Albanes 1996).

Vitamin E deficiency occurs only rarely in people, and overt deficiency symptoms in people consuming low-vitamin E diets have never been described (Institute of Medicine 2000). The main manifestation of vitamin E deficiency is peripheral neuropathy characterized by the degeneration of the large-caliber axons of sensory neurons

(Institute of Medicine 2000). The upper limit (UL) for vitamin E intake (1000 mg/day) was based on hemorrhagic effects; however, a causal association between excess *alpha*-tocopherol intake in apparently healthy individuals and adverse health outcomes has not consistently been shown (Institute of Medicine 2000). Studies evaluating tocopherols to reduce the risk for cardiovascular disease demonstrated inconsistent findings (Agency for Healthcare Research and Quality 2003). The American Heart Association currently advises that antioxidant supplements (such as vitamins E and C and *beta*-carotene) should not be used for primary or secondary prevention of cardiovascular disease (Lichtenstein 2006). Nevertheless, the American Heart Association recommends consuming food sources of antioxidant nutrients, principally from a variety of plant-derived foods such as fruits, vegetables, whole grains, and vegetable oils.

The National Academy of Sciences has established dietary-requirement intake values for vitamins A and E by determining the adequate intake (AI) for infants and the recommended dietary allowance (RDA) for older age groups (Institute of Medicine 2000 and 2001). The RDA for vitamin A for adults is 900 $\mu\text{g}/\text{day}$ of retinol equivalents; for children, the RDA ranges from 300–700 $\mu\text{g}/\text{day}$. For infants (aged 0–12 months), the AI is set at 400–500 $\mu\text{g}/\text{day}$ of retinol equivalents. For adults, the RDA for vitamin E is 15 mg/day of *alpha*-tocopherol; for children (1–18 years), the RDA ranges from 6 mg to 15 mg/day. There is no RDA for other forms of vitamin E such as *gamma*-tocopherol. Although no quantitative recommendations are available for the intake of carotenoids, existing recommendations support increased consumption of carotenoid-rich fruits and vegetables. Current public health guidelines advise that people consume 5 to 13 servings of fruits and vegetables a day, depending on caloric need, to ensure adequate nutrient intake (U.S. Department of Health and Human Services and U.S. Department of Agriculture 2005).

Clinical laboratories typically use conventional units for serum concentrations of these fat-soluble micronutrients (μg per deciliter [dL]). Conversion factors to international system (SI) units are 1 $\mu\text{g}/\text{dL} = 0.0349$ micromole per liter ($\mu\text{mol}/\text{L}$) for vitamin A and 1 $\mu\text{g}/\text{dL} = 0.02322$ $\mu\text{mol}/\text{L}$ for vitamin E. Depending on its molecular weight, each carotenoid has a specific conversion factor.

The diagnosis of vitamin A or E deficiency is supported by measuring these concentrations in the body. Vitamin A deficiency can be diagnosed in a number of ways.

People with serum concentrations of retinol of less than 20 $\mu\text{g}/\text{dL}$ are considered vitamin A deficient, and those with serum concentrations of less than 10 $\mu\text{g}/\text{dL}$ are considered severely deficient (West 2006). Carotenoid deficiency has no defined serum



Chemists perform extraction of fat-soluble vitamins from serum.

concentrations. The laboratory diagnosis of vitamin E deficiency is based on serum concentrations of *alpha*-tocopherol (less than 500 µg/dL or less than 0.8 mg of *alpha*-tocopherol per gram of total lipids) (Beers 2006). Such concentrations are associated with in vitro hydrogen peroxide-induced red blood cell lysis, not with clinical deficiency symptoms (Institute of Medicine 2000). Among most laboratories participating in an external quality assurance program, standardized high performance liquid chromatography (HPLC) methods for measuring fat-soluble micronutrients show consistent agreement of values (Deweer 2000).

For more information on these fat-soluble micronutrients, see the Institute of Medicine's Dietary Reference Intake reports (Institute of Medicine 2000 and 2001), the vitamin fact sheets from the National Institutes of Health, Office of Dietary Supplements (http://ods.od.nih.gov/Health_Information/Vitamin_and_Mineral_Supplement_Fact_Sheets.aspx), as well as information from the American Society for Nutrition (<http://jn.nutrition.org/nutinfo/>).

Since 1971, various fat-soluble micronutrients have been measured in the serum of NHANES participants. In NHANES III (1988–1994), clinically low concentrations of serum retinol were uncommon in U.S. residents aged 4 years and older, although racial/ethnic and socioeconomic differences existed (Ballew 2001). Variations in serum carotenoid concentrations by ethnicity and sex were found for adults, children, and adolescents (Ford 2000; Ford 2002). Ford et al. also found sociodemographic variations in serum concentrations of *alpha*-tocopherol among U.S. adults in NHANES III (1999) and *alpha*- and *gamma*-tocopherol in NHANES 1999–2000 (2006). Application of the most common cut-off value for serum *alpha*-tocopherol concentrations in NHANES 1999–2000 (500 µg/dL), resulted in a low prevalence of vitamin E deficiency, despite the fact that the U.S. Department of Agriculture (USDA) estimated dietary intakes of vitamin E were low and that most of the U.S. population (> 90 percent) did not meet dietary recommendations either in 1999–2000 (Ahuja 2004) or in 2001–2002 (Moshfegh 2005). However, the USDA report is based on intakes from food only and does not include dietary supplements. Furthermore, in NHANES only *alpha*-tocopherol is estimated for assessing dietary vitamin E intake. In NHANES 2001–2002, 44 percent of survey participants had an estimated dietary intake (from food only) of vitamin A (including carotenoids) that was less than the vitamin A estimated average requirement (EAR) (Moshfegh 2005). Low dietary intakes of certain micronutrients without widespread manifestation of deficiency suggest the need for further evaluations to determine whether improved estimates are necessary, either in the nutrient tables or in dietary intake.

Selected Observations and Highlights

The following sample observations are taken from the tables of 1999–2002 (for vitamins A and E) or 2001–2002 data (for all carotenoids) contained in this report. Statements about categorical differences between demographic groups noted below are based on non-overlapping confidence limits from univariate analysis without adjusting for demographic variables (e.g., age, sex, race/ethnicity) or other determinants of these blood concentrations (e.g., dietary intake, supplement usage, smoking, BMI). A multivariate analysis may alter the size and statistical significance of these categorical differences. Furthermore, additional significant differences of smaller magnitude may be present despite their lack of mention here (e.g., if confidence limits slightly overlap or if differences are unobservable before covariate adjustment has occurred). For a selection of citations of descriptive NHANES papers related to these biochemical indicators of diet and nutrition, see Appendix E.

General Observations

- Serum vitamin A and E concentrations are lower in children and adolescents than in adults.
- Serum *beta*-carotene concentrations are higher in older people (≥ 60 years), whereas serum *alpha*-carotene and lutein/zeaxanthin concentrations are higher in middle-aged and older people compared with people in younger age groups.
- Serum *beta*-cryptoxanthin concentrations are higher in children than in adolescents or adults.
- Serum *trans*-lycopene and *gamma*-tocopherol concentrations are lower in young children and older people than in people in other age groups.
- Serum *alpha*-carotene and lutein/zeaxanthin concentrations are lower in adolescents, whereas serum *beta*-carotene concentrations are lower in adolescents and in adults 20–39 years old than in people in other age groups.
- Females have lower concentrations of serum vitamin A and *trans*-lycopene than do males. Females have higher concentrations of serum vitamin E and *beta*-carotene than do males.
- Non-Hispanic blacks and Mexican Americans have lower serum concentrations of vitamin A than do non-Hispanic whites.
- Non-Hispanic blacks have lower serum concentrations of vitamin E than do Mexican Americans, who have lower serum concentrations of vitamin E than do non-Hispanic whites.
- Non-Hispanic blacks have higher serum concentrations of *gamma*-tocopherol than do Mexican Americans and non-Hispanic whites.

- Non-Hispanic blacks have lower serum concentrations of *alpha*-carotene than do non-Hispanic whites or Mexican Americans.
- Non-Hispanic whites have lower serum concentrations of *beta*-cryptoxanthin than do non-Hispanic blacks, who have lower serum concentrations of *beta*-cryptoxanthin than do Mexican Americans.
- Non-Hispanic blacks have higher serum concentrations of *trans*-lycopene than do Mexican Americans.

Highlights

The majority of the U.S. population (> 95 percent) has adequate serum concentrations of vitamin A ($\geq 20 \mu\text{g/dL}$) and vitamin E ($\geq 500 \mu\text{g/dL}$).



Table 2.1.a. Serum vitamin A: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	53.5 (52.7-54.3)	30.9 (30.3-31.7)	54.5 (53.6-55.4)	87.0 (85.8-88.4)	15819
3–5 years	33.1 (32.6-33.7)	22.7 (21.4-24.4)	33.7 (33.0-34.4)	46.5 (44.1-47.8)	782
6–11 years	36.3 (35.7-37.0)	26.0 (24.8-26.3)	36.4 (35.7-37.1)	51.2 (49.4-52.6)	1880
12–19 years	47.0 (46.3-47.6)	30.8 (30.1-31.4)	47.4 (46.6-48.0)	70.6 (68.9-72.1)	4317
20–39 years	53.6 (52.6-54.6)	33.6 (32.5-34.6)	54.6 (53.5-55.6)	82.3 (80.3-83.8)	3177
40–59 years	59.7 (58.8-60.6)	37.1 (35.0-38.7)	60.6 (59.4-61.4)	92.6 (88.9-95.2)	2665
60 years and older	63.8 (62.9-64.7)	40.2 (38.1-41.4)	64.5 (63.2-65.3)	98.8 (95.6-102)	2998
Males					
Total, 3 years and older	56.3 (55.3-57.3)	31.7 (30.8-32.9)	58.1 (56.9-59.3)	88.7 (86.5-91.2)	7701
3–5 years	32.9 (32.1-33.7)	21.9 (17.1-25.0)	33.9 (33.0-35.0)	45.4 (43.2-47.5)	410
6–11 years	36.1 (35.2-37.1)	26.0 (24.5-26.5)	36.1 (35.3-37.1)	51.3 (49.4-52.6)	956
12–19 years	49.1 (48.2-50.1)	32.1 (30.9-33.8)	49.8 (48.8-50.9)	71.3 (69.3-72.9)	2164
20–39 years	58.4 (57.5-59.4)	40.3 (39.0-41.6)	59.0 (58.0-60.1)	83.5 (80.9-85.5)	1349
40–59 years	64.6 (63.3-65.9)	42.4 (40.4-44.3)	66.0 (65.0-67.7)	95.3 (92.8-98.4)	1332
60 years and older	65.4 (63.9-66.9)	41.2 (38.7-42.7)	66.1 (64.6-68.2)	101 (96.4-106)	1490
Females					
Total, 3 years and older	50.9 (50.1-51.7)	30.3 (29.4-31.1)	50.9 (50.1-51.8)	85.2 (83.3-87.2)	8118
3–5 years	33.4 (32.7-34.1)	24.1 (22.2-25.3)	33.1 (32.5-34.5)	47.1 (44.7-49.7)	372
6–11 years	36.5 (35.8-37.2)	26.2 (24.7-26.9)	36.7 (36.1-37.5)	50.4 (49.0-52.2)	924
12–19 years	44.8 (43.9-45.6)	29.7 (29.0-30.9)	44.7 (43.5-45.9)	68.8 (66.0-71.9)	2153
20–39 years	49.2 (48.1-50.4)	30.7 (29.7-31.8)	49.1 (47.3-50.7)	80.8 (78.0-82.4)	1828
40–59 years	55.3 (54.3-56.3)	34.4 (32.4-35.4)	55.5 (54.2-56.4)	87.3 (84.8-91.3)	1333
60 years and older	62.6 (61.6-63.6)	39.4 (36.2-41.4)	63.0 (62.0-64.4)	96.8 (92.0-101)	1508

Table 2.1.b. Serum vitamin A: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	46.8 (46.0-47.7)	28.1 (27.2-28.9)	47.1 (46.0-48.1)	75.6 (73.7-77.8)	4662
3–5 years	31.6 (30.7-32.6)	22.6 (21.7-23.8)	31.9 (30.2-33.7)	43.2 (40.4-45.6)	261
6–11 years	35.4 (34.8-36.0)	24.6 (23.8-26.2)	35.6 (34.9-36.2)	48.9 (47.2-50.8)	644
12–19 years	44.8 (44.2-45.5)	30.7 (28.7-31.9)	45.0 (44.1-45.8)	64.6 (63.6-65.9)	1626
20–39 years	50.6 (49.6-51.6)	31.9 (29.8-33.5)	50.9 (49.0-52.8)	75.2 (73.8-77.8)	866
40–59 years	52.8 (51.4-54.3)	32.5 (30.4-35.0)	53.9 (52.4-55.3)	83.7 (78.8-87.4)	628
60 years and older	55.9 (52.9-59.2)	34.0 (31.2-36.5)	55.3 (52.2-59.9)	91.0 (82.4-107)	637
Males					
Total, 3 years and older	50.6 (49.7-51.6)	29.8 (28.8-30.5)	51.7 (50.5-53.2)	79.1 (77.0-82.4)	2277
3–5 years	32.5 (30.6-34.5)	22.4† (20.1-25.0)	32.9 (30.7-34.5)	45.2† (41.1-51.2)	136
6–11 years	35.4 (34.6-36.2)	24.6 (23.2-27.1)	35.4 (34.5-36.2)	49.2 (45.9-51.3)	333
12–19 years	48.1 (47.1-49.1)	33.7 (32.1-34.9)	48.3 (47.0-49.7)	67.8 (65.6-69.7)	807
20–39 years	56.6 (55.3-57.9)	39.3 (37.4-41.9)	57.5 (55.8-59.1)	78.3 (75.2-86.5)	382
40–59 years	57.9 (55.9-59.9)	36.3 (32.4-40.4)	57.9 (56.1-60.2)	87.4 (83.0-95.3)	298
60 years and older	57.0 (54.3-60.0)	35.3 (33.1-37.1)	55.5 (52.9-61.3)	93.4 (79.8-118)	321
Females					
Total, 3 years and older	43.0 (42.1-43.9)	27.0 (26.1-27.8)	42.6 (41.5-43.6)	69.8 (65.7-73.1)	2385
3–5 years	30.8 (29.4-32.2)	22.6† (20.3-24.7)	30.4 (27.9-33.3)	40.0† (38.9-43.7)	125
6–11 years	35.3 (34.4-36.3)	23.8 (23.1-26.5)	35.9 (34.7-36.7)	48.6 (47.2-51.2)	311
12–19 years	41.5 (40.8-42.3)	28.4 (26.9-30.8)	41.1 (40.5-41.5)	60.3 (57.6-62.2)	819
20–39 years	44.3 (43.1-45.5)	28.7 (26.4-30.7)	44.6 (42.8-46.3)	69.1 (63.4-72.8)	484
40–59 years	48.1 (46.4-49.9)	30.6 (25.7-34.1)	48.1 (46.4-50.1)	74.7 (68.3-77.1)	330
60 years and older	55.0 (51.2-59.0)	31.8 (27.8-39.3)	54.8 (51.3-59.9)	90.0 (82.9-99.0)	316

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.1.c. Serum vitamin A: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	46.0 (45.1-47.0)	27.3 (26.3-27.9)	45.7 (44.4-47.1)	79.3 (75.9-81.6)	3680
3–5 years	31.8 (30.6-33.1)	21.6 (19.3-23.9)	32.1 (30.8-33.3)	44.6 (41.6-47.9)	226
6–11 years	35.0 (34.1-35.9)	23.7 (21.9-25.6)	35.1 (34.0-36.5)	50.5 (48.2-52.2)	591
12–19 years	41.4 (40.6-42.2)	27.9 (26.7-28.6)	41.7 (40.6-42.6)	61.9 (60.2-64.1)	1252
20–39 years	46.1 (44.8-47.5)	28.4 (27.6-30.7)	46.8 (45.2-48.5)	72.0 (67.7-74.6)	590
40–59 years	52.2 (50.4-54.1)	30.6 (27.3-34.0)	52.1 (50.6-54.0)	87.3 (80.6-95.6)	540
60 years and older	58.6 (56.6-60.6)	33.5 (31.2-36.7)	59.0 (56.8-60.4)	102 (93.4-117)	481
Males					
Total, 3 years and older	48.5 (47.6-49.5)	27.9 (26.9-28.7)	49.6 (48.5-50.7)	80.7 (77.6-84.3)	1806
3–5 years	32.7 (31.2-34.2)	22.6† (19.3-24.9)	32.7 (31.0-34.6)	45.4† (41.9-53.6)	119
6–11 years	34.5 (33.5-35.5)	24.2 (20.8-25.5)	34.4 (33.2-35.6)	50.7 (47.2-54.3)	297
12–19 years	43.7 (42.7-44.6)	28.7 (28.0-30.0)	43.5 (42.4-44.6)	64.8 (62.6-67.5)	640
20–39 years	51.7 (50.1-53.4)	34.3 (28.8-37.8)	53.2 (51.2-55.2)	74.8 (70.3-79.6)	246
40–59 years	56.3 (53.8-58.9)	34.4 (30.2-38.1)	56.3 (53.1-59.3)	92.9 (80.8-107)	274
60 years and older	59.3 (56.1-62.7)	34.9 (30.0-39.9)	58.5 (53.5-62.8)	106 (87.7-144)	230
Females					
Total, 3 years and older	44.0 (42.7-45.3)	26.7 (25.5-27.9)	42.9 (41.9-43.9)	75.6 (72.6-80.4)	1874
3–5 years	30.9 (29.3-32.6)	19.5† (16.1-23.6)	31.7 (29.9-33.1)	42.7† (38.6-45.7)	107
6–11 years	35.5 (34.3-36.7)	23.6 (21.5-26.7)	36.0 (34.3-37.6)	50.4 (48.0-52.2)	294
12–19 years	39.2 (38.3-40.1)	26.0 (24.5-27.5)	39.5 (38.5-40.7)	56.8 (54.5-59.0)	612
20–39 years	42.3 (40.4-44.2)	27.6 (24.7-29.1)	41.7 (39.8-43.8)	66.3 (62.0-72.4)	344
40–59 years	48.9 (46.5-51.4)	29.3 (25.2-31.5)	47.7 (44.5-51.1)	82.0 (74.4-92.0)	266
60 years and older	58.1 (55.3-61.1)	32.9 (30.2-36.8)	59.4 (56.8-61.2)	97.8 (86.7-115)	251

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.1.d. Serum vitamin A: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	56.3 (55.3-57.4)	33.1 (32.1-34.2)	57.3 (56.2-58.8)	88.9 (87.4-90.9)	6128
3–5 years	34.0 (33.1-34.8)	24.0† (21.4-25.8)	34.2 (33.0-35.7)	47.2† (44.1-49.7)	217
6–11 years	36.8 (35.9-37.7)	26.5 (25.4-28.3)	36.7 (35.8-37.9)	51.3 (49.0-52.7)	489
12–19 years	49.0 (47.9-50.0)	32.6 (31.3-34.2)	49.0 (48.0-50.0)	72.9 (70.9-75.0)	1073
20–39 years	56.1 (54.8-57.4)	36.1 (34.6-37.6)	57.0 (55.0-58.7)	83.9 (81.9-86.8)	1377
40–59 years	62.0 (60.9-63.1)	40.1 (38.1-42.0)	63.1 (61.5-64.3)	93.5 (90.3-96.2)	1276
60 years and older	65.2 (64.3-66.2)	41.6 (40.1-43.1)	65.5 (64.4-67.5)	99.1 (96.1-102)	1696
Males					
Total, 3 years and older	58.9 (57.6-60.2)	33.6 (32.0-35.1)	60.8 (59.3-62.9)	91.4 (88.7-93.5)	3001
3–5 years	33.4 (32.3-34.4)	21.4† (17.1-25.8)	34.4 (32.7-36.6)	45.6† (41.4-47.8)	115
6–11 years	36.6 (35.2-38.0)	26.2 (24.3-28.6)	36.4 (35.1-38.4)	52.2 (48.6-53.0)	257
12–19 years	50.6 (49.3-51.9)	32.4 (30.5-36.0)	51.0 (49.8-52.3)	72.9 (70.0-74.9)	535
20–39 years	60.4 (59.1-61.7)	41.7 (40.5-43.1)	60.4 (59.2-63.0)	84.8 (81.6-87.5)	575
40–59 years	66.6 (65.1-68.1)	44.5 (42.5-47.8)	68.2 (66.3-69.8)	96.2 (92.9-99.9)	665
60 years and older	66.8 (65.2-68.4)	42.0 (40.4-44.6)	67.9 (65.3-70.1)	101 (96.6-105)	854
Females					
Total, 3 years and older	54.0 (52.9-55.2)	32.6 (31.6-34.1)	54.5 (52.8-55.8)	87.5 (85.9-89.4)	3127
3–5 years	34.7 (33.3-36.1)	26.2† (24.0-27.8)	34.0 (32.5-36.3)	49.1† (45.9-51.8)	102
6–11 years	37.0 (36.0-38.0)	26.2 (24.7-28.4)	36.8 (36.0-38.0)	50.2 (48.1-54.0)	232
12–19 years	47.3 (46.0-48.6)	33.2 (31.2-34.3)	46.9 (45.3-47.9)	72.1 (68.3-76.8)	538
20–39 years	52.2 (50.5-54.0)	34.1 (30.9-35.9)	51.7 (49.9-54.8)	83.1 (80.5-87.3)	802
40–59 years	57.7 (56.5-58.8)	36.0 (34.6-39.2)	57.2 (56.0-58.4)	88.8 (86.1-94.8)	611
60 years and older	64.1 (62.9-65.2)	41.4 (39.0-43.5)	64.5 (62.5-65.6)	97.4 (92.0-102)	842

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.2.a. Serum vitamin E: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	1090 (1070-1110)	615 (604-626)	1030 (1010-1050)	2380 (2300-2480)	15766
3–5 years	800 (777-824)	567 (547-593)	782 (758-813)	1160 (1110-1310)	777
6–11 years	794 (779-810)	556 (546-570)	790 (772-812)	1130 (1090-1180)	1873
12–19 years	762 (750-774)	532 (518-548)	753 (741-766)	1140 (1100-1200)	4314
20–39 years	991 (977-1010)	629 (618-645)	963 (943-980)	1740 (1650-1800)	3168
40–59 years	1300 (1280-1330)	774 (743-792)	1250 (1220-1280)	2620 (2470-2760)	2655
60 years and older	1530 (1500-1560)	808 (771-850)	1480 (1440-1520)	3220 (3010-3330)	2979
Males					
Total, 3 years and older	1070 (1040-1090)	605 (593-617)	1010 (984-1030)	2280 (2170-2380)	7673
3–5 years	796 (768-825)	569 (556-594)	791 (759-823)	1110 (1030-1300)	406
6–11 years	789 (770-809)	554 (543-576)	785 (760-815)	1130 (1040-1210)	951
12–19 years	749 (731-767)	521 (503-544)	739 (724-757)	1120 (1060-1200)	2163
20–39 years	993 (972-1020)	625 (611-646)	969 (940-985)	1750 (1660-1880)	1344
40–59 years	1310 (1270-1350)	752 (724-776)	1250 (1220-1280)	2570 (2390-2830)	1328
60 years and older	1420 (1380-1450)	769 (727-803)	1370 (1330-1400)	2850 (2740-3010)	1481
Females					
Total, 3 years and older	1120 (1100-1140)	626 (612-640)	1050 (1030-1070)	2480 (2350-2620)	8093
3–5 years	804 (772-838)	560 (513-602)	774 (750-812)	1270 (1120-1460)	371
6–11 years	801 (779-822)	560 (542-587)	799 (775-820)	1140 (1090-1190)	922
12–19 years	776 (763-788)	548 (539-556)	769 (756-784)	1160 (1110-1210)	2151
20–39 years	990 (974-1010)	630 (615-654)	955 (933-978)	1700 (1620-1830)	1824
40–59 years	1300 (1260-1340)	797 (744-820)	1240 (1200-1280)	2670 (2360-2970)	1327
60 years and older	1620 (1580-1660)	860 (819-889)	1590 (1530-1650)	3370 (3170-3550)	1498

Table 2.2.b. Serum vitamin E: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	967 (944-990)	587 (572-602)	919 (904-938)	1800 (1720-1950)	4662
3–5 years	768 (748-788)	569 (514-593)	762 (737-787)	1050 (980-1110)	261
6–11 years	770 (758-782)	555 (538-573)	765 (746-780)	1090 (1050-1110)	640
12–19 years	754 (744-764)	516 (503-531)	744 (729-758)	1150 (1110-1200)	1628
20–39 years	987 (954-1020)	642 (605-667)	959 (931-983)	1680 (1550-1780)	867
40–59 years	1260 (1210-1310)	757 (720-804)	1230 (1160-1280)	2250 (2070-2620)	629
60 years and older	1380 (1320-1440)	762 (696-810)	1310 (1260-1390)	2810 (2610-3350)	637
Males					
Total, 3 years and older	968 (943-995)	580 (564-590)	922 (902-943)	1810 (1690-2010)	2277
3–5 years	766 (736-797)	567† (530-608)	749 (719-784)	1070† (971-1230)	135
6–11 years	768 (748-789)	544 (532-577)	758 (736-785)	1070 (1030-1160)	331
12–19 years	741 (723-759)	503 (490-516)	733 (718-753)	1110 (1080-1150)	808
20–39 years	999 (954-1050)	617 (587-662)	964 (923-1020)	1650 (1530-1920)	383
40–59 years	1300 (1210-1400)	790 (707-860)	1250 (1160-1340)	2370 (2060-3340)	299
60 years and older	1280 (1220-1350)	729 (651-799)	1230 (1200-1300)	2610 (2080-3530)	321
Females					
Total, 3 years and older	965 (939-992)	593 (574-616)	915 (898-939)	1780 (1690-1980)	2385
3–5 years	770 (740-800)	577† (495-594)	780 (735-819)	992† (953-1110)	126
6–11 years	772 (756-789)	558 (526-586)	768 (744-790)	1090 (1040-1170)	309
12–19 years	769 (761-777)	539 (529-551)	757 (732-778)	1220 (1130-1260)	820
20–39 years	972 (945-1000)	651 (592-675)	947 (921-981)	1670 (1480-1750)	484
40–59 years	1220 (1170-1260)	739 (715-795)	1190 (1130-1260)	2100 (1810-2400)	330
60 years and older	1470 (1380-1570)	780 (587-929)	1400 (1330-1470)	2850 (2670-3490)	316

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.2.c. Serum vitamin E: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	917 (897-936)	579 (564-595)	884 (865-903)	1700 (1620-1820)	3670
3–5 years	761 (736-787)	560† (511-586)	748 (728-768)	1120† (1080-1170)	222
6–11 years	769 (752-786)	548 (521-583)	765 (745-789)	1070 (1010-1120)	592
12–19 years	728 (714-741)	530 (512-542)	721 (707-740)	1030 (1010-1060)	1249
20–39 years	879 (860-899)	607 (567-627)	867 (840-895)	1390 (1300-1470)	589
40–59 years	1090 (1050-1120)	686 (636-712)	1040 (1010-1070)	2250 (1840-2390)	539
60 years and older	1200 (1140-1250)	692 (655-736)	1150 (1090-1190)	2280 (2070-2780)	479
Males					
Total, 3 years and older	888 (866-912)	573 (554-589)	864 (842-883)	1620 (1450-1770)	1802
3–5 years	761 (725-798)	550† (497-614)	749 (702-782)	1100† (989-1130)	117
6–11 years	780 (763-797)	565 (531-580)	772 (757-811)	1080 (1010-1160)	297
12–19 years	722 (706-738)	528 (506-539)	716 (701-732)	1020 (975-1050)	639
20–39 years	870 (834-908)	614 (567-643)	863 (809-900)	1340 (1200-1560)	246
40–59 years	1040 (995-1080)	636 (579-707)	1010 (971-1070)	1850 (1620-2250)	274
60 years and older	1110 (1060-1170)	655 (582-721)	1070 (1020-1140)	2180 (1910-2390)	229
Females					
Total, 3 years and older	942 (916-968)	588 (560-609)	907 (884-923)	1800 (1640-2080)	1868
3–5 years	761 (731-792)	545† (491-586)	748 (713-800)	1150† (1010-1240)	105
6–11 years	757 (732-783)	536 (505-588)	757 (726-788)	1010 (982-1120)	295
12–19 years	734 (719-748)	534 (503-560)	733 (706-758)	1050 (1000-1100)	610
20–39 years	886 (863-909)	605 (519-626)	877 (839-907)	1450 (1300-1510)	343
40–59 years	1130 (1090-1180)	712 (679-780)	1050 (1020-1090)	2410 (2020-2700)	265
60 years and older	1250 (1180-1330)	727 (686-815)	1180 (1140-1270)	2690 (1930-3650)	250

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.2.d. Serum vitamin E: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	1150 (1130-1180)	638 (620-652)	1090 (1050-1120)	2530 (2440-2630)	6085
3–5 years	822 (782-865)	567† (547-622)	803 (757-853)	1240† (1110-1460)	216
6–11 years	804 (782-826)	556 (545-577)	800 (772-825)	1150 (1090-1230)	485
12–19 years	774 (757-791)	543 (526-556)	763 (744-777)	1180 (1100-1250)	1071
20–39 years	1010 (991-1030)	646 (619-665)	978 (957-994)	1780 (1660-1930)	1368
40–59 years	1340 (1310-1370)	796 (770-820)	1280 (1250-1310)	2670 (2500-2980)	1266
60 years and older	1580 (1540-1610)	831 (795-868)	1530 (1500-1580)	3300 (3070-3460)	1679
Males					
Total, 3 years and older	1120 (1090-1150)	619 (598-643)	1060 (1020-1100)	2420 (2300-2540)	2977
3–5 years	819 (773-867)	576† (556-622)	818 (751-860)	1100† (1010-1470)	114
6–11 years	788 (759-818)	550 (502-575)	779 (746-825)	1130 (1030-1220)	254
12–19 years	758 (731-785)	532 (509-556)	742 (724-771)	1150 (1040-1300)	534
20–39 years	1010 (974-1040)	637 (607-669)	976 (939-1000)	1850 (1620-2060)	569
40–59 years	1350 (1310-1400)	774 (728-810)	1280 (1250-1330)	2630 (2470-3150)	660
60 years and older	1450 (1410-1500)	779 (734-815)	1400 (1370-1440)	2880 (2750-3240)	846
Females					
Total, 3 years and older	1180 (1150-1210)	654 (639-670)	1120 (1090-1160)	2640 (2490-2770)	3108
3–5 years	826 (770-886)	564† (430-662)	776 (742-874)	1440† (1150-1520)	102
6–11 years	822 (793-852)	557 (530-603)	811 (781-851)	1150 (1100-1400)	231
12–19 years	791 (773-810)	554 (537-568)	781 (761-811)	1180 (1110-1250)	537
20–39 years	1020 (996-1030)	647 (623-682)	982 (951-1010)	1760 (1620-1930)	799
40–59 years	1330 (1290-1380)	818 (783-852)	1280 (1230-1320)	2690 (2360-3090)	606
60 years and older	1680 (1630-1730)	884 (853-924)	1660 (1600-1740)	3460 (3230-3760)	833

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.3.a. Serum *gamma*-tocopherol: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	198 (190-206)	65.7 (61.0-71.0)	212 (204-221)	462 (438-482)	14738
3–5 years	176 (162-192)	63.0 (52.0-83.5)	186 (170-199)	364 (340-407)	730
6–11 years	207 (198-217)	97.8 (92.0-105)	217 (206-225)	389 (363-428)	1730
12–19 years	197 (190-204)	100 (93.0-108)	201 (192-208)	372 (359-386)	4009
20–39 years	206 (198-215)	83.0 (71.7-89.2)	219 (208-227)	442 (427-468)	3005
40–59 years	205 (194-218)	60.0 (55.0-68.0)	225 (213-238)	530 (478-568)	2491
60 years and older	174 (165-184)	47.8 (46.0-51.0)	190 (177-203)	496 (462-531)	2773
Males					
Total, 3 years and older	199 (191-208)	65.1 (59.0-72.0)	212 (204-221)	466 (442-481)	7169
3–5 years	167 (151-184)	58.6 (42.8-89.0)	178 (165-193)	340 (298-400)	380
6–11 years	201 (190-213)	92.0 (81.0-104)	213 (195-225)	366 (361-408)	870
12–19 years	193 (186-200)	98.1 (91.0-108)	193 (187-201)	371 (341-390)	2005
20–39 years	208 (200-217)	75.5 (66.0-88.5)	223 (210-233)	473 (436-481)	1279
40–59 years	214 (200-228)	61.0 (57.0-72.0)	230 (216-248)	548 (499-608)	1253
60 years and older	169 (160-180)	43.9 (40.0-47.8)	191 (176-200)	463 (427-510)	1382
Females					
Total, 3 years and older	197 (189-205)	65.8 (62.0-71.0)	213 (202-221)	457 (433-484)	7569
3–5 years	188 (172-205)	72.0 (56.0-95.9)	195 (176-215)	385 (328-446)	350
6–11 years	214 (203-226)	106 (95.0-117)	221 (206-238)	408 (361-473)	860
12–19 years	202 (194-211)	102 (89.0-111)	208 (198-219)	373 (357-391)	2004
20–39 years	203 (193-214)	85.0 (75.0-91.4)	216 (202-226)	424 (410-440)	1726
40–59 years	198 (186-210)	57.2 (51.0-67.0)	221 (206-233)	505 (453-559)	1238
60 years and older	178 (167-189)	51.3 (47.1-55.2)	189 (175-207)	508 (482-542)	1391

Table 2.3.b. Serum *gamma*-tocopherol: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	206 (199-214)	92.0 (87.9-99.0)	211 (203-218)	437 (404-466)	3983
3–5 years	180 (168-192)	93.0 (82.2-109)	185 (175-200)	318 (287-370)	224
6–11 years	219 (210-229)	112 (99.9-122)	226 (217-239)	419 (372-456)	546
12–19 years	203 (197-209)	108 (103-117)	206 (197-214)	370 (349-394)	1399
20–39 years	196 (185-208)	91.0 (84.0-99.6)	199 (187-213)	397 (363-456)	771
40–59 years	232 (220-244)	88.9 (74.0-104)	235 (220-251)	544 (469-631)	535
60 years and older	209 (194-225)	67.0 (56.0-80.7)	231 (205-254)	496 (449-527)	508
Males					
Total, 3 years and older	206 (198-215)	93.0 (84.0-101)	211 (203-217)	448 (402-473)	1937
3–5 years	180 (167-194)	93.5† (82.2-112)	183 (173-195)	312† (283-340)	115
6–11 years	222 (210-234)	116 (105-124)	221 (212-242)	440 (364-483)	272
12–19 years	198 (190-207)	106 (98.0-116)	201 (192-212)	367 (332-398)	691
20–39 years	197 (183-211)	91.5 (72.0-102)	199 (183-214)	408 (371-469)	346
40–59 years	234 (214-256)	78.0 (58.0-103)	246 (219-267)	544 (456-659)	258
60 years and older	212 (189-237)	66.0 (47.0-85.0)	237 (211-274)	443 (371-527)	255
Females					
Total, 3 years and older	206 (198-215)	92.0 (86.0-101)	212 (201-224)	428 (399-460)	2046
3–5 years	180 (161-201)	88.3† (45.0-116)	196 (160-209)	355† (252-392)	109
6–11 years	217 (204-231)	105 (83.5-123)	228 (216-243)	401 (361-452)	274
12–19 years	209 (200-218)	113 (105-123)	210 (194-226)	372 (338-418)	708
20–39 years	195 (183-209)	90.0 (76.0-102)	200 (186-216)	349 (336-418)	425
40–59 years	229 (216-243)	89.3 (74.0-105)	230 (216-250)	494 (460-640)	277
60 years and older	206 (189-225)	70.0 (52.9-80.0)	226 (183-252)	515 (462-683)	253

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.3.c. Serum *gamma*-tocopherol: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	223 (215-232)	97.9 (86.0-106)	235 (223-245)	444 (427-458)	3578
3–5 years	188 (174-203)	90.0† (75.0-109)	196 (182-209)	336† (309-367)	220
6–11 years	218 (207-230)	116 (104-124)	221 (206-237)	393 (365-441)	569
12–19 years	208 (202-215)	109 (101-121)	212 (204-218)	356 (334-384)	1217
20–39 years	222 (209-236)	98.5 (86.0-115)	234 (213-253)	426 (394-452)	571
40–59 years	234 (223-247)	84.4 (65.0-111)	257 (241-271)	470 (440-508)	529
60 years and older	238 (223-254)	69.0 (54.0-90.0)	270 (256-282)	515 (492-575)	472
Males					
Total, 3 years and older	214 (205-224)	97.1 (80.4-109)	222 (212-233)	417 (402-442)	1756
3–5 years	189 (171-207)	83.5† (63.0-119)	194 (180-211)	331† (287-364)	116
6–11 years	213 (201-224)	107 (93.0-120)	213 (201-229)	386 (365-427)	288
12–19 years	202 (194-209)	104 (95.0-118)	206 (195-215)	351 (321-386)	620
20–39 years	215 (199-231)	98.5 (80.3-115)	226 (202-248)	404 (370-450)	237
40–59 years	224 (206-243)	84.0 (44.7-130)	249 (219-268)	418 (393-553)	267
60 years and older	223 (206-242)	69.0 (54.0-103)	248 (214-265)	511 (449-583)	228
Females					
Total, 3 years and older	231 (221-242)	97.9 (84.4-109)	244 (230-257)	460 (437-480)	1822
3–5 years	188 (167-210)	78.0† (74.0-111)	195 (167-220)	356† (314-380)	104
6–11 years	224 (209-240)	124 (114-138)	224 (210-247)	393 (351-455)	281
12–19 years	216 (207-225)	122 (104-132)	215 (206-226)	369 (338-428)	597
20–39 years	229 (212-247)	98.0 (79.0-124)	245 (212-270)	435 (390-469)	334
40–59 years	244 (226-264)	84.4 (70.6-109)	271 (244-293)	478 (440-559)	262
60 years and older	249 (229-270)	61.8 (45.2-91.0)	282 (265-304)	524 (492-583)	244

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.3.d. Serum *gamma*-tocopherol: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 3 years and older	194 (184-205)	60.0 (55.0-65.0)	211 (200-221)	473 (444-499)	5877
3–5 years	176 (155-199)	56.0† (42.8-83.0)	188 (162-215)	366† (329-441)	211
6–11 years	204 (192-218)	90.9 (82.2-102)	215 (199-231)	408 (359-484)	469
12–19 years	195 (185-204)	94.9 (88.0-103)	199 (188-210)	375 (357-393)	1036
20–39 years	207 (196-219)	77.4 (65.6-88.9)	221 (208-232)	453 (430-477)	1326
40–59 years	199 (185-215)	57.0 (51.0-64.8)	221 (203-235)	532 (481-573)	1217
60 years and older	170 (160-180)	46.7 (44.9-50.7)	186 (170-198)	498 (460-537)	1618
Males					
Total, 3 years and older	196 (186-208)	59.0 (51.0-67.0)	212 (202-224)	473 (446-502)	2885
3–5 years	164 (142-189)	47.1† (22.5-89.0)	186 (153-199)	355† (298-489)	112
6–11 years	195 (180-211)	82.2 (78.0-97.7)	212 (174-230)	365 (327-408)	246
12–19 years	191 (181-201)	94.3 (86.0-108)	189 (183-200)	378 (340-399)	519
20–39 years	211 (198-224)	71.0 (51.2-89.2)	230 (214-242)	473 (441-484)	554
40–59 years	209 (192-227)	59.0 (53.0-69.6)	226 (211-249)	548 (471-617)	635
60 years and older	165 (154-177)	42.8 (39.8-46.7)	186 (170-197)	463 (426-520)	819
Females					
Total, 3 years and older	192 (182-203)	61.9 (56.9-65.6)	209 (196-221)	478 (439-506)	2992
3–5 years	190 (164-220)	58.0† (52.0-96.0)	204 (164-241)	388† (313-482)	99
6–11 years	216 (199-234)	99.0† (87.0-112)	221 (197-248)	418† (361-555)	223
12–19 years	199 (186-212)	95.1 (82.0-108)	207 (188-224)	367 (345-402)	517
20–39 years	204 (190-218)	84.0 (65.0-97.0)	217 (199-227)	428 (406-478)	772
40–59 years	190 (174-207)	51.0 (43.8-60.2)	213 (187-230)	511 (452-572)	582
60 years and older	173 (161-186)	51.3 (47.0-55.9)	185 (167-203)	525 (479-546)	799

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.4.a. Serum *alpha*-carotene: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	2.48 (2.23-2.76)	.700 (<LOD-.800)	2.36 (2.10-2.70)	8.50 (7.40-9.30)	8359
3–5 years	2.41 (2.13-2.74)	.800 (<LOD-1.00)	2.20 (1.90-2.50)	8.50 (7.00-10.3)	430
6–11 years	2.24 (2.00-2.51)	.800 (.800-900)	2.00 (1.80-2.30)	6.10 (5.20-7.70)	1014
12–19 years	1.68 (1.52-1.86)	< LOD	1.40 (1.30-1.60)	5.10 (4.40-6.20)	2206
20–39 years	2.22 (1.93-2.56)	< LOD	2.20 (1.90-2.50)	7.80 (6.70-8.80)	1716
40–59 years	2.98 (2.60-3.42)	.800 (.700-1.00)	2.80 (2.50-3.30)	10.7 (8.60-13.0)	1470
60 years and older	3.08 (2.74-3.46)	.800 (<LOD-1.00)	3.10 (2.70-3.60)	9.10 (8.60-9.80)	1523
Males					
Total, 3 years and older	2.22 (1.98-2.49)	< LOD	2.10 (1.90-2.30)	7.20 (6.30-8.60)	4052
3–5 years	2.29 (1.91-2.74)	.700 (<LOD-.800)	2.00 (1.70-2.40)	7.20 (5.00-11.1)	217
6–11 years	2.28 (1.96-2.65)	.800 (.800-1.00)	2.00 (1.80-2.40)	6.60 (5.00-8.50)	507
12–19 years	1.55 (1.38-1.75)	< LOD	1.40 (1.20-1.60)	4.40 (3.80-6.00)	1092
20–39 years	1.99 (1.72-2.31)	< LOD	1.80 (1.50-2.10)	6.90 (5.60-8.60)	724
40–59 years	2.53 (2.17-2.95)	.800 (<LOD-.900)	2.40 (2.00-2.90)	8.60 (6.30-11.3)	763
60 years and older	2.81 (2.48-3.18)	.800 (<LOD-.900)	2.90 (2.50-3.50)	8.40 (7.40-9.30)	749
Females					
Total, 3 years and older	2.75 (2.47-3.07)	.700 (<LOD-.900)	2.70 (2.30-3.00)	9.20 (8.20-10.5)	4307
3–5 years	2.55 (1.99-3.26)	.700 (<LOD-1.50)	2.30 (1.80-3.10)	9.70 (7.10-12.4)	213
6–11 years	2.20 (1.97-2.45)	.800 (.800-900)	2.10 (1.80-2.30)	5.80 (4.90-6.50)	507
12–19 years	1.83 (1.63-2.04)	< LOD	1.70 (1.50-2.00)	5.40 (4.60-6.90)	1114
20–39 years	2.45 (2.10-2.86)	< LOD	2.30 (1.90-2.70)	8.10 (6.80-9.20)	992
40–59 years	3.55 (3.10-4.06)	1.10 (.900-1.30)	3.40 (2.90-3.70)	12.4 (10.5-15.8)	707
60 years and older	3.30 (2.87-3.79)	1.00 (.800-1.20)	3.20 (2.80-3.90)	9.70 (8.70-10.4)	774

< LOD means less than the limit of detection, which may vary for some compounds by year. See Appendix D for LOD.

Table 2.4.b. Serum *alpha*-carotene: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	2.72 (2.39-3.10)	1.00 (.900-1.10)	2.50 (2.30-2.80)	7.40 (6.30-8.90)	2116
3–5 years	2.56 (2.12-3.08)	1.00 (.800-1.50)	2.20 (2.10-2.50)	6.40 (4.50-9.00)	126
6–11 years	2.43 (2.12-2.79)	.900 (.800-1.10)	2.20 (2.00-2.70)	5.40 (4.70-6.70)	290
12–19 years	1.90 (1.71-2.11)	.700 (<LOD-.800)	1.70 (1.50-2.10)	5.30 (3.90-6.40)	696
20–39 years	2.92 (2.48-3.43)	1.00 (.800-1.30)	2.80 (2.50-3.40)	8.00 (6.60-9.10)	460
40–59 years	3.39 (2.71-4.24)	1.10 (.900-1.40)	3.30 (2.60-4.10)	8.70 (7.20-14.3)	289
60 years and older	3.04 (2.35-3.94)	.900 (<LOD-1.30)	2.90 (2.30-4.00)	8.90 (6.20-13.7)	255
Males					
Total, 3 years and older	2.46 (2.13-2.83)	.800 (.700-1.00)	2.44 (2.20-2.70)	6.60 (5.30-8.00)	1019
3–5 years	2.37 (1.70-3.32)	.800† (<LOD-1.50)	2.20 (1.70-2.80)	5.90† (2.90-12.1)	62
6–11 years	2.39 (1.89-3.03)	.800 (.700-1.00)	2.20 (1.70-2.90)	5.50 (3.90-8.40)	140
12–19 years	1.69 (1.48-1.92)	.700 (<LOD-.800)	1.50 (1.30-1.90)	4.20 (3.30-6.20)	330
20–39 years	2.51 (2.06-3.06)	.800 (<LOD-1.10)	2.60 (2.10-3.10)	6.70 (5.20-7.90)	213
40–59 years	3.33 (2.61-4.23)	1.20 (.800-1.70)	3.20 (2.50-4.10)	8.10 (5.90-13.2)	149
60 years and older	2.49 (1.83-3.38)	.700 (<LOD-1.10)	2.60 (1.90-3.00)	7.00 (5.50-9.10)	125
Females					
Total, 3 years and older	3.04 (2.66-3.48)	1.00 (.900-1.20)	2.80 (2.50-3.30)	8.50 (7.10-10.8)	1097
3–5 years	2.75 (2.28-3.32)	1.20† (<LOD-1.60)	2.40 (2.00-3.10)	6.00† (4.20-9.00)	64
6–11 years	2.48 (2.16-2.85)	1.20 (.900-1.50)	2.30 (1.90-3.00)	5.00 (4.00-6.00)	150
12–19 years	2.16 (1.92-2.43)	.800 (.700-900)	2.00 (1.60-2.50)	5.80 (4.40-7.30)	366
20–39 years	3.45 (2.87-4.15)	1.20 (.900-1.40)	3.20 (2.60-4.30)	9.10 (8.00-12.7)	247
40–59 years	3.46 (2.66-4.49)	.900 (.700-1.40)	3.30 (2.40-4.80)	10.8 (8.00-14.8)	140
60 years and older	3.58 (2.63-4.86)	1.30 (.900-1.80)	3.60 (2.40-4.80)	11.5 (6.00-15.2)	130

< LOD means less than the limit of detection, which may vary for some compounds by year. See Appendix D for LOD.

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.4.c. Serum *alpha*-carotene: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	1.77 (1.51-2.08)	< LOD	1.60 (1.30-1.90)	6.10 (4.80-8.20)	1992
3–5 years	1.75 (1.40-2.17)	< LOD	1.40 (1.10-1.80)	5.00 (3.20-13.9)	128
6–11 years	1.92 (1.69-2.19)	.900 (.800-1.00)	1.70 (1.40-1.90)	4.30 (3.50-5.60)	340
12–19 years	1.38 (1.20-1.59)	< LOD	1.20 (1.10-1.50)	3.90 (2.80-5.30)	671
20–39 years	1.71 (1.27-2.29)	< LOD	1.50 (1.10-2.10)	5.80 (3.90-11.4)	319
40–59 years	1.88 (1.65-2.13)	< LOD	1.80 (1.50-2.00)	7.20 (6.10-9.70)	291
60 years and older	2.22 (1.70-2.90)	< LOD	2.00 (1.40-2.70)	9.30 (4.90-15.1)	243
Males					
Total, 3 years and older	1.65 (1.38-1.96)	< LOD	1.40 (1.20-1.80)	5.80 (4.20-7.40)	984
3–5 years	1.54 (1.18-2.02)	< LOD†	1.30 (1.00-1.90)	3.90† (2.20-13.9)	64
6–11 years	2.08 (1.82-2.36)	.900 (.800-1.20)	1.90 (1.70-2.20)	4.60 (3.50-6.60)	175
12–19 years	1.32 (1.11-1.57)	< LOD	1.10 (1.00-1.34)	3.30 (2.70-5.50)	340
20–39 years	1.55 (1.07-2.24)	< LOD	1.40 (.900-2.30)	6.10 (3.40-9.60)	132
40–59 years	1.71 (1.44-2.03)	< LOD	1.80 (1.20-2.10)	6.60 (4.50-8.40)	154
60 years and older	1.94 (1.56-2.43)	< LOD	1.50 (1.30-2.40)	6.70 (4.20-12.5)	119
Females					
Total, 3 years and older	1.88 (1.58-2.23)	< LOD	1.70 (1.40-1.90)	6.50 (4.90-9.40)	1008
3–5 years	1.98 (1.52-2.60)	< LOD†	1.70 (1.30-2.20)	6.00† (3.20-33.8)	64
6–11 years	1.76 (1.40-2.22)	.700 (<LOD-.900)	1.60 (1.30-1.90)	3.70 (2.60-8.30)	165
12–19 years	1.45 (1.27-1.65)	< LOD	1.30 (1.10-1.60)	4.00 (2.90-5.50)	331
20–39 years	1.83 (1.33-2.50)	< LOD	1.80 (1.10-2.20)	5.30 (3.90-11.5)	187
40–59 years	2.04 (1.69-2.46)	< LOD	1.70 (1.50-2.10)	7.90 (5.90-13.8)	137
60 years and older	2.44 (1.71-3.47)	< LOD	2.10 (1.40-3.20)	9.40 (5.90-17.6)	124

< LOD means less than the limit of detection, which may vary for some compounds by year. See Appendix D for LOD.

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.4.d. Serum *alpha*-carotene: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	2.57 (2.25-2.94)	.800 (<LOD-.900)	2.40 (2.10-2.90)	8.80 (7.70-10.2)	3583
3–5 years	2.46 (1.95-3.11)	.800 (<LOD-1.40)	2.10 (1.70-3.00)	8.50 (5.60-11.1)	133
6–11 years	2.29 (1.98-2.65)	.700 (<LOD-.900)	2.20 (1.80-2.50)	6.50 (4.90-10.2)	301
12–19 years	1.69 (1.48-1.93)	< LOD	1.40 (1.20-1.70)	5.30 (4.40-6.50)	656
20–39 years	2.17 (1.86-2.55)	< LOD	2.00 (1.60-2.30)	8.10 (6.30-9.20)	772
40–59 years	3.12 (2.66-3.67)	.900 (.800-1.20)	2.90 (2.50-3.40)	11.3 (8.60-14.2)	777
60 years and older	3.16 (2.78-3.58)	.900 (<LOD-1.00)	3.30 (2.80-3.80)	9.20 (8.50-9.90)	944
Males					
Total, 3 years and older	2.28 (1.99-2.62)	< LOD	2.10 (1.90-2.60)	7.80 (6.30-9.20)	1739
3–5 years	2.44 (1.99-2.98)	1.00† (<LOD-1.30)	2.20 (1.70-2.50)	8.50† (4.40-11.3)	72
6–11 years	2.35 (1.87-2.96)	.900 (<LOD-1.10)	2.00 (1.60-2.70)	8.10 (4.40-13.4)	157
12–19 years	1.53 (1.31-1.79)	< LOD	1.30 (1.10-1.70)	4.40 (3.80-6.20)	323
20–39 years	1.95 (1.66-2.28)	< LOD	1.90 (1.50-2.10)	7.30 (5.20-8.90)	312
40–59 years	2.59 (2.16-3.11)	.800 (<LOD-.900)	2.50 (2.00-3.00)	8.80 (5.70-12.0)	407
60 years and older	2.86 (2.47-3.32)	.800 (<LOD-.900)	3.00 (2.30-3.70)	8.40 (7.40-9.80)	468
Females					
Total, 3 years and older	2.89 (2.49-3.35)	.700 (<LOD-.900)	2.90 (2.40-3.20)	9.70 (8.30-11.5)	1844
3–5 years	2.49 (1.49-4.17)	< LOD†	2.20 (1.50-4.70)	8.50† (5.40-14.7)	61
6–11 years	2.22 (1.97-2.50)	.700 (<LOD-.900)	2.20 (1.80-2.60)	6.00 (4.40-8.40)	144
12–19 years	1.86 (1.58-2.19)	< LOD	1.70 (1.50-2.20)	5.90 (4.80-7.50)	333
20–39 years	2.40 (2.00-2.89)	< LOD	2.30 (1.80-2.80)	8.30 (7.20-10.5)	460
40–59 years	3.83 (3.26-4.51)	1.20 (.900-1.40)	3.60 (3.10-4.50)	12.7 (10.4-17.0)	370
60 years and older	3.40 (2.92-3.96)	1.10 (.800-1.30)	3.37 (2.90-4.10)	9.50 (8.60-10.5)	476

< LOD means less than the limit of detection, which may vary for some compounds by year. See Appendix D for LOD.

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.5.a. Serum *trans*-beta-carotene: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	12.2 (11.5-13.0)	4.30 (4.10-4.70)	11.9 (11.3-12.5)	34.3 (31.7-37.4)	8358
3–5 years	13.6 (12.6-14.6)	5.80 (4.90-7.10)	13.5 (12.1-15.3)	31.1 (27.5-35.9)	429
6–11 years	13.3 (12.7-13.9)	6.50 (6.10-6.90)	13.2 (12.6-13.9)	27.0 (23.3-29.8)	1012
12–19 years	9.69 (9.20-10.2)	4.20 (3.90-4.70)	9.60 (9.00-10.4)	21.6 (20.1-23.7)	2206
20–39 years	10.3 (9.38-11.2)	3.70 (3.30-4.20)	9.90 (9.10-10.9)	29.0 (25.7-32.8)	1716
40–59 years	13.3 (12.1-14.7)	4.20 (3.70-4.90)	12.9 (12.0-14.2)	42.8 (35.3-49.8)	1471
60 years and older	16.5 (14.9-18.3)	5.50 (4.40-6.10)	17.6 (15.3-19.6)	46.0 (41.5-50.9)	1524
Males					
Total, 3 years and older	10.9 (10.2-11.7)	3.90 (3.60-4.30)	11.0 (10.3-11.7)	30.2 (26.8-33.0)	4053
3–5 years	13.3 (11.7-15.2)	5.60 (5.00-6.80)	14.2 (11.9-16.1)	30.1 (23.8-44.8)	216
6–11 years	13.5 (12.4-14.7)	6.50 (6.10-7.10)	13.4 (11.9-14.7)	26.4 (23.0-31.3)	507
12–19 years	9.27 (8.57-10.0)	4.10 (3.80-4.40)	9.10 (8.30-10.2)	20.1 (18.8-22.0)	1092
20–39 years	9.07 (8.24-10.0)	3.40 (2.90-4.10)	8.80 (7.90-9.80)	24.6 (21.3-29.6)	724
40–59 years	11.3 (10.2-12.7)	3.70 (3.30-4.10)	11.6 (10.2-12.6)	33.0 (27.0-43.9)	764
60 years and older	14.5 (13.0-16.2)	4.30 (3.60-5.20)	15.5 (13.6-17.3)	42.2 (35.0-47.0)	750
Females					
Total, 3 years and older	13.6 (12.7-14.6)	5.10 (4.70-5.50)	13.0 (12.2-14.2)	38.2 (35.3-41.4)	4305
3–5 years	13.8 (12.1-15.7)	5.80 (4.30-7.90)	12.6 (10.9-15.7)	32.6 (24.6-55.1)	213
6–11 years	13.0 (12.3-13.7)	6.30 (5.70-7.10)	12.6 (12.0-13.5)	28.0 (22.3-31.3)	505
12–19 years	10.1 (9.53-10.8)	4.50 (3.90-5.30)	10.3 (9.60-11.0)	23.3 (20.3-26.4)	1114
20–39 years	11.4 (10.3-12.6)	4.20 (3.50-4.80)	10.8 (9.50-12.3)	32.1 (28.9-37.0)	992
40–59 years	15.8 (14.1-17.8)	5.50 (4.70-5.90)	15.1 (13.4-17.1)	49.9 (39.1-63.2)	707
60 years and older	18.1 (16.0-20.6)	6.00 (5.00-7.60)	19.0 (16.9-21.8)	48.1 (42.6-55.8)	774

Table 2.5.b. Serum *trans*-beta-carotene: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	12.5 (11.7-13.4)	4.70 (4.20-5.50)	12.8 (11.7-13.9)	31.0 (28.4-33.6)	2116
3–5 years	13.9 (11.7-16.5)	7.10 (4.80-9.70)	13.0 (10.9-16.1)	24.3 (22.0-29.0)	126
6–11 years	13.4 (12.4-14.4)	6.60 (5.70-7.60)	13.6 (12.1-14.9)	28.2 (24.2-30.8)	289
12–19 years	10.0 (9.53-10.5)	4.50 (4.10-4.80)	10.2 (9.60-10.6)	21.8 (19.3-25.4)	696
20–39 years	12.4 (11.2-13.7)	4.30 (3.70-5.70)	13.0 (10.8-14.5)	30.6 (27.0-34.1)	460
40–59 years	13.8 (11.7-16.4)	4.30 (3.70-5.70)	13.9 (11.1-17.4)	37.7 (33.1-45.6)	289
60 years and older	14.6 (12.7-16.7)	4.10 (3.20-5.00)	15.8 (13.2-17.6)	39.1 (35.5-52.1)	256
Males					
Total, 3 years and older	11.3 (10.4-12.3)	4.20 (3.80-5.10)	11.4 (9.90-13.2)	28.0 (25.2-29.4)	1020
3–5 years	13.8 (10.4-18.4)	7.20† (4.80-10.6)	12.6 (9.70-17.3)	24.1† (17.4-41.5)	62
6–11 years	13.0 (11.4-14.9)	5.80 (4.70-7.70)	13.4 (10.0-16.4)	24.6 (22.0-31.4)	140
12–19 years	8.98 (8.36-9.65)	4.20 (3.80-4.70)	9.10 (7.90-10.0)	18.9 (17.0-20.9)	330
20–39 years	10.6 (9.13-12.3)	3.90 (3.00-5.20)	11.1 (9.00-13.5)	25.8 (22.4-29.4)	213
40–59 years	13.3 (11.4-15.6)	4.30 (3.60-6.50)	13.0 (10.2-17.1)	33.9 (28.6-45.6)	149
60 years and older	11.8 (9.61-14.5)	3.60 (1.90-5.50)	12.6 (9.20-16.5)	37.3 (27.6-58.4)	126
Females					
Total, 3 years and older	14.1 (13.0-15.2)	5.60 (5.00-6.10)	14.2 (13.3-15.0)	33.9 (29.2-40.8)	1096
3–5 years	14.0 (12.0-16.4)	6.70† (4.60-9.70)	13.0 (10.2-20.1)	25.1† (21.9-32.6)	64
6–11 years	13.7 (12.5-15.1)	7.00 (5.70-8.40)	13.7 (12.0-14.7)	26.5 (22.1-33.5)	149
12–19 years	11.3 (10.3-12.3)	4.70 (4.10-5.90)	11.4 (10.1-12.7)	25.4 (21.6-29.7)	366
20–39 years	14.8 (12.7-17.1)	5.70 (3.70-7.60)	14.8 (13.0-17.4)	36.7 (27.4-48.1)	247
40–59 years	14.4 (11.3-18.4)	4.30 (3.10-5.70)	14.4 (10.9-20.4)	39.3 (29.3-64.9)	140
60 years and older	17.3 (14.0-21.3)	4.20 (3.30-8.30)	18.4 (13.9-21.6)	40.1 (36.1-52.1)	130

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.5.c. Serum *trans*-beta-carotene: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	10.8 (9.96-11.8)	4.00 (3.40-4.50)	10.8 (10.0-11.5)	28.7 (25.8-33.0)	1992
3–5 years	11.5 (10.3-12.9)	5.10 (4.00-6.00)	11.3 (10.0-13.4)	24.6 (18.9-31.4)	128
6–11 years	12.9 (12.1-13.6)	6.50 (5.90-7.40)	12.4 (11.5-12.9)	27.7 (22.7-31.8)	340
12–19 years	9.64 (8.86-10.5)	4.40 (4.00-5.00)	9.70 (8.70-10.7)	20.5 (18.4-23.4)	671
20–39 years	9.62 (7.80-11.9)	3.50 (2.90-4.50)	9.50 (7.50-12.3)	25.6 (17.6-37.0)	319
40–59 years	10.3 (9.20-11.6)	3.00 (2.50-4.20)	10.4 (9.10-11.4)	30.5 (24.5-39.4)	291
60 years and older	16.6 (13.8-19.9)	5.00 (4.10-6.80)	17.0 (14.4-20.9)	46.6 (36.0-65.7)	243
Males					
Total, 3 years and older	10.1 (9.24-11.0)	4.10 (3.20-4.50)	10.3 (9.60-11.2)	25.6 (22.4-28.7)	984
3–5 years	11.3 (9.60-13.2)	5.10† (4.60-7.00)	12.0 (8.30-14.3)	22.7† (16.0-30.1)	64
6–11 years	14.4 (13.0-16.0)	7.40 (6.30-8.40)	13.5 (12.7-15.5)	28.7 (22.7-35.1)	175
12–19 years	9.20 (8.22-10.3)	4.20 (3.30-5.20)	9.40 (8.30-10.8)	20.1 (17.6-22.5)	340
20–39 years	8.88 (6.97-11.3)	3.40 (2.90-4.40)	9.10 (6.60-11.7)	23.6 (14.8-34.0)	132
40–59 years	9.09 (7.95-10.4)	2.90 (1.90-4.10)	9.60 (8.00-10.9)	25.8 (18.6-37.1)	154
60 years and older	13.0 (10.6-15.9)	3.80 (3.20-5.00)	14.1 (10.8-17.0)	42.1 (26.8-51.3)	119
Females					
Total, 3 years and older	11.5 (10.4-12.7)	4.00 (3.50-4.80)	11.2 (10.3-12.7)	32.5 (27.1-38.2)	1008
3–5 years	11.8 (9.69-14.3)	4.60† (3.60-6.50)	11.4 (9.20-14.4)	31.1† (16.5-57.7)	64
6–11 years	11.3 (9.51-13.5)	5.80 (5.10-6.60)	10.5 (9.30-12.5)	21.7 (17.0-35.5)	165
12–19 years	10.1 (9.10-11.2)	4.70 (4.30-5.40)	10.0 (8.50-11.3)	20.9 (18.3-26.2)	331
20–39 years	10.2 (7.98-12.9)	3.50 (2.80-4.90)	10.0 (7.50-13.6)	27.3 (17.6-42.6)	187
40–59 years	11.6 (9.90-13.7)	3.00 (2.10-5.60)	12.2 (9.50-15.3)	37.1 (26.1-45.6)	137
60 years and older	19.6 (15.1-25.3)	6.80 (3.00-11.9)	19.7 (15.2-25.2)	51.7 (36.9-93.4)	124

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.5.d. Serum *trans*-beta-carotene: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	12.6 (11.6-13.7)	4.50 (4.10-5.00)	12.1 (11.4-13.1)	36.4 (32.8-40.6)	3582
3–5 years	14.0 (12.2-16.0)	6.10 (4.20-7.90)	14.7 (11.7-16.7)	30.9 (26.1-36.4)	132
6–11 years	13.6 (12.5-14.8)	6.80 (5.70-8.20)	13.4 (12.0-14.9)	27.9 (22.7-31.1)	300
12–19 years	9.69 (8.94-10.5)	4.20 (3.60-4.90)	9.30 (8.60-10.5)	22.0 (19.6-24.9)	656
20–39 years	10.1 (8.99-11.3)	3.90 (3.20-4.60)	9.50 (8.60-10.7)	29.0 (23.7-36.2)	772
40–59 years	13.9 (12.5-15.5)	4.70 (4.00-5.30)	13.5 (12.2-14.7)	44.4 (35.2-55.1)	778
60 years and older	16.5 (14.7-18.5)	5.50 (4.30-6.40)	17.6 (15.1-19.9)	45.8 (40.8-51.5)	944
Males					
Total, 3 years and older	11.2 (10.3-12.3)	3.90 (3.50-4.30)	11.3 (10.2-12.1)	32.1 (27.9-36.2)	1739
3–5 years	14.1 (12.2-16.2)	5.60† (3.80-6.80)	15.0 (11.9-16.6)	31.4† (23.8-46.0)	71
6–11 years	13.8 (12.2-15.7)	6.70 (5.60-8.40)	13.8 (11.9-15.9)	25.8 (22.1-33.0)	157
12–19 years	9.28 (8.36-10.3)	4.00 (3.50-4.60)	9.00 (8.00-10.3)	20.3 (18.4-24.0)	323
20–39 years	9.02 (8.00-10.2)	3.80 (3.10-4.60)	8.60 (7.70-9.50)	26.4 (19.3-33.6)	312
40–59 years	11.7 (10.5-13.2)	3.80 (3.40-4.30)	11.9 (10.2-12.9)	35.0 (28.4-44.4)	408
60 years and older	14.7 (13.0-16.7)	4.50 (3.40-5.70)	15.6 (13.7-17.9)	43.0 (35.2-50.9)	468
Females					
Total, 3 years and older	14.0 (12.7-15.5)	5.10 (4.70-5.70)	13.5 (12.1-15.1)	40.1 (36.0-45.1)	1843
3–5 years	13.8 (10.4-18.4)	7.60† (3.20-9.50)	12.8 (9.60-17.3)	30.6† (17.1-73.7)	61
6–11 years	13.3 (12.1-14.7)	6.70 (5.30-8.00)	12.8 (11.8-15.1)	28.6 (21.5-31.3)	143
12–19 years	10.1 (9.16-11.2)	4.50 (3.50-5.70)	10.0 (8.60-11.5)	24.2 (19.4-30.0)	333
20–39 years	11.1 (9.78-12.6)	4.30 (3.40-5.00)	10.4 (9.10-12.1)	32.8 (27.4-39.8)	460
40–59 years	16.8 (14.5-19.4)	5.70 (5.30-6.60)	15.7 (13.8-18.4)	54.7 (40.2-76.2)	370
60 years and older	18.0 (15.7-20.7)	5.70 (4.80-7.60)	19.0 (16.8-23.0)	48.1 (41.1-56.3)	476

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.6.a. Serum *beta*-cryptoxanthin: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	7.51 (7.12-7.93)	3.20 (3.00-3.50)	7.50 (7.00-7.90)	17.8 (16.5-19.2)	8317
3–5 years	9.43 (8.40-10.6)	4.10 (3.30-5.50)	9.00 (7.80-10.5)	22.8 (18.3-27.8)	427
6–11 years	9.40 (8.71-10.2)	4.60 (4.10-5.10)	9.10 (8.20-10.1)	20.0 (17.0-22.9)	1006
12–19 years	7.63 (7.20-8.09)	3.70 (3.40-4.00)	7.50 (7.00-8.00)	15.8 (14.4-17.6)	2199
20–39 years	7.11 (6.57-7.69)	3.10 (2.80-3.50)	6.80 (6.30-7.50)	17.1 (15.2-19.3)	1707
40–59 years	7.28 (6.75-7.86)	3.00 (2.70-3.40)	7.10 (6.70-7.80)	17.4 (15.3-19.7)	1459
60 years and older	7.44 (6.84-8.09)	2.80 (2.50-3.20)	7.70 (7.00-8.30)	18.6 (17.5-19.6)	1519
Males					
Total, 3 years and older	7.35 (6.96-7.77)	3.14 (2.80-3.40)	7.50 (6.90-7.90)	17.1 (16.0-18.5)	4032
3–5 years	9.80 (8.43-11.4)	4.20 (3.20-5.60)	9.60 (7.90-11.8)	22.8 (15.6-31.9)	217
6–11 years	9.63 (8.84-10.5)	5.00 (4.10-5.50)	9.30 (8.40-10.2)	21.2 (16.5-25.9)	503
12–19 years	7.64 (7.14-8.19)	3.70 (3.30-4.20)	7.50 (7.00-8.10)	15.5 (14.2-17.7)	1085
20–39 years	7.15 (6.49-7.88)	3.20 (2.80-3.50)	7.10 (6.10-8.00)	16.8 (15.2-19.8)	723
40–59 years	6.98 (6.57-7.42)	2.90 (2.50-3.30)	7.00 (6.50-7.60)	16.1 (14.6-18.5)	756
60 years and older	6.64 (6.02-7.31)	2.40 (1.90-2.90)	7.00 (6.00-7.60)	16.7 (15.8-17.7)	748
Females					
Total, 3 years and older	7.67 (7.23-8.12)	3.40 (3.10-3.50)	7.50 (7.00-7.90)	18.2 (16.7-19.7)	4285
3–5 years	9.07 (7.79-10.6)	3.90 (3.00-5.30)	8.20 (6.40-10.4)	23.3 (17.3-32.1)	210
6–11 years	9.15 (8.21-10.2)	4.30 (4.00-4.80)	8.70 (7.80-10.7)	18.4 (16.1-21.6)	503
12–19 years	7.61 (7.10-8.16)	3.70 (3.40-4.00)	7.50 (7.00-8.00)	16.0 (14.3-17.5)	1114
20–39 years	7.07 (6.50-7.70)	3.10 (2.60-3.50)	6.70 (6.10-7.50)	17.5 (14.6-19.6)	984
40–59 years	7.61 (6.88-8.43)	3.10 (2.80-3.50)	7.30 (6.70-8.10)	18.5 (15.4-21.9)	703
60 years and older	8.10 (7.41-8.86)	3.10 (2.70-3.50)	8.20 (7.40-8.80)	20.1 (18.1-22.7)	771

Table 2.6.b. Serum *beta*-cryptoxanthin: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	12.1 (11.1-13.1)	5.10 (4.80-5.70)	12.1 (10.8-13.5)	27.1 (25.0-29.8)	2114
3–5 years	11.0 (9.50-12.8)	5.20 (4.20-6.70)	10.3 (9.10-12.3)	23.6 (18.8-42.0)	126
6–11 years	11.9 (10.6-13.3)	6.20 (5.30-7.10)	11.1 (10.0-13.4)	24.1 (19.9-28.7)	290
12–19 years	9.72 (9.07-10.4)	4.80 (4.20-5.40)	9.70 (9.00-10.5)	19.8 (17.2-21.4)	696
20–39 years	13.4 (11.9-15.1)	5.60 (4.90-6.80)	14.0 (11.6-15.9)	30.0 (26.9-33.7)	460
40–59 years	12.2 (10.4-14.3)	4.70 (3.80-5.80)	12.7 (10.4-15.2)	27.3 (23.2-36.9)	287
60 years and older	11.0 (9.19-13.2)	3.70 (3.20-4.50)	11.1 (9.20-13.4)	28.5 (21.2-37.1)	255
Males					
Total, 3 years and older	11.8 (10.7-13.1)	5.20 (4.70-5.70)	11.7 (10.4-13.4)	26.6 (23.8-29.9)	1018
3–5 years	11.1 (8.25-14.8)	5.50† (3.60-6.90)	10.3 (6.80-15.9)	22.8† (14.1-43.1)	62
6–11 years	11.6 (10.2-13.0)	5.60 (4.90-7.20)	10.9 (9.70-12.6)	24.1 (19.9-28.7)	140
12–19 years	9.32 (8.39-10.4)	4.70 (3.50-5.50)	9.34 (8.10-10.8)	18.5 (15.2-22.2)	330
20–39 years	12.9 (11.3-14.8)	5.30 (4.80-7.00)	13.4 (10.6-15.4)	29.8 (24.1-35.1)	213
40–59 years	12.9 (10.7-15.6)	5.10 (3.20-7.50)	13.1 (9.70-18.4)	28.7 (24.1-38.3)	147
60 years and older	9.87 (8.17-11.9)	3.50 (2.40-4.40)	10.8 (8.40-13.2)	23.9 (16.7-37.1)	126
Females					
Total, 3 years and older	12.3 (11.4-13.3)	5.30 (4.90-6.00)	12.2 (10.9-13.9)	27.7 (25.3-32.1)	1096
3–5 years	11.0 (9.59-12.6)	4.70† (3.20-7.50)	9.90 (7.70-12.7)	25.7† (17.7-44.1)	64
6–11 years	12.2 (10.7-14.0)	6.80 (5.30-7.30)	11.4 (9.50-14.3)	25.4 (19.1-28.8)	150
12–19 years	10.2 (9.61-10.8)	5.10 (4.50-5.80)	10.0 (9.40-10.7)	20.8 (18.8-22.5)	366
20–39 years	13.9 (12.1-16.1)	6.00 (4.80-7.10)	14.6 (11.3-17.6)	32.2 (26.1-37.6)	247
40–59 years	11.5 (9.71-13.7)	4.50 (3.80-5.80)	11.9 (10.1-13.8)	26.5 (18.8-42.9)	140
60 years and older	12.0 (9.47-15.3)	4.30 (3.20-6.10)	11.7 (8.50-17.3)	29.7 (21.2-43.4)	129

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.6.c. Serum *beta*-cryptoxanthin: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	8.13 (7.50-8.81)	3.90 (3.40-4.20)	7.90 (7.40-8.50)	18.0 (15.7-20.7)	1987
3–5 years	10.9 (9.72-12.2)	5.80 (5.30-6.30)	10.2 (8.30-12.7)	20.9 (16.7-23.5)	128
6–11 years	12.0 (10.7-13.4)	6.50 (5.50-7.90)	11.8 (9.90-13.9)	23.0 (20.4-26.3)	338
12–19 years	8.94 (8.44-9.47)	4.70 (4.40-5.10)	8.80 (8.30-9.30)	16.6 (14.9-17.6)	670
20–39 years	7.60 (6.69-8.63)	4.00 (3.60-4.30)	7.00 (6.20-8.20)	15.4 (12.7-21.9)	318
40–59 years	6.79 (6.35-7.26)	3.10 (2.90-3.50)	6.60 (6.10-7.50)	15.5 (13.2-18.8)	290
60 years and older	7.89 (6.22-10.0)	3.00 (2.30-3.40)	7.80 (5.70-10.2)	20.5 (15.7-29.6)	243
Males					
Total, 3 years and older	8.26 (7.59-8.99)	4.00 (3.50-4.30)	8.10 (7.30-9.10)	17.8 (15.7-20.4)	982
3–5 years	10.7 (9.29-12.3)	5.90† (5.30-6.40)	10.2 (8.70-12.6)	20.1† (16.1-22.7)	64
6–11 years	12.7 (11.2-14.4)	6.70 (5.60-8.30)	12.8 (10.9-14.2)	23.1 (18.6-30.9)	174
12–19 years	8.91 (8.29-9.58)	5.00 (4.50-5.40)	8.90 (8.20-9.30)	16.3 (14.4-18.8)	339
20–39 years	8.00 (6.63-9.67)	4.00 (2.80-5.00)	7.80 (5.70-10.2)	15.9 (13.9-21.9)	132
40–59 years	6.69 (6.09-7.34)	3.30 (2.90-3.70)	6.50 (5.80-7.30)	14.8 (12.1-19.1)	154
60 years and older	7.02 (5.69-8.66)	3.10 (2.20-3.50)	6.80 (5.70-8.20)	15.7 (9.30-27.1)	119
Females					
Total, 3 years and older	8.02 (7.38-8.73)	3.70 (3.30-4.10)	7.80 (7.20-8.30)	18.0 (15.3-21.6)	1005
3–5 years	11.1 (9.30-13.2)	5.60† (5.00-6.40)	10.6 (7.70-14.9)	20.9† (15.4-53.1)	64
6–11 years	11.3 (9.47-13.4)	6.30 (4.40-7.70)	11.0 (8.50-13.8)	21.6 (14.7-28.4)	164
12–19 years	8.97 (8.48-9.49)	4.60 (4.00-5.00)	8.90 (8.60-9.80)	17.0 (15.2-17.7)	331
20–39 years	7.33 (6.38-8.42)	3.80 (3.40-4.30)	6.30 (6.10-7.30)	15.3 (10.8-24.6)	186
40–59 years	6.89 (6.31-7.52)	3.20 (2.50-3.70)	6.70 (5.90-7.80)	16.1 (12.9-19.1)	136
60 years and older	8.55 (6.37-11.5)	2.70 (2.30-4.10)	8.80 (5.10-13.9)	23.0 (16.5-34.7)	124

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.6.d. Serum *beta*-cryptoxanthin: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	6.84 (6.47-7.24)	3.00 (2.70-3.30)	6.80 (6.30-7.20)	15.6 (14.6-16.9)	3552
3–5 years	8.53 (7.14-10.2)	3.90 (2.80-5.50)	7.90 (6.40-10.4)	19.8 (14.4-31.9)	130
6–11 years	8.49 (7.67-9.38)	4.20 (3.80-4.90)	8.30 (7.40-9.10)	16.6 (14.6-21.8)	296
12–19 years	6.87 (6.41-7.36)	3.30 (2.80-3.80)	6.60 (6.10-7.00)	14.3 (12.5-16.6)	651
20–39 years	6.16 (5.63-6.73)	2.90 (2.60-3.40)	5.90 (5.40-6.50)	13.3 (11.1-16.4)	765
40–59 years	6.87 (6.39-7.38)	2.90 (2.70-3.30)	6.80 (6.20-7.40)	15.6 (13.9-18.0)	770
60 years and older	7.14 (6.56-7.76)	2.70 (2.30-3.20)	7.50 (6.70-8.10)	17.6 (16.4-19.1)	940
Males					
Total, 3 years and older	6.64 (6.31-6.99)	2.90 (2.60-3.30)	6.50 (6.20-7.00)	14.7 (13.8-16.1)	1724
3–5 years	9.29 (7.45-11.6)	3.80† (2.20-6.10)	8.90 (6.50-11.3)	23.9† (12.1-56.4)	72
6–11 years	8.68 (7.70-9.77)	4.10 (3.70-5.10)	8.30 (7.40-9.20)	18.4 (13.8-26.3)	155
12–19 years	6.80 (6.30-7.33)	3.20 (2.80-3.60)	6.60 (6.10-7.40)	14.0 (11.8-16.6)	318
20–39 years	6.23 (5.54-7.01)	3.10 (2.70-3.50)	6.00 (5.40-6.70)	13.3 (10.8-16.5)	311
40–59 years	6.50 (6.17-6.84)	2.80 (2.35-3.30)	6.50 (5.90-7.10)	14.3 (12.5-16.0)	402
60 years and older	6.34 (5.77-6.96)	2.10 (1.90-2.60)	6.80 (5.70-7.60)	16.2 (15.2-17.2)	466
Females					
Total, 3 years and older	7.04 (6.57-7.55)	3.10 (2.90-3.40)	6.80 (6.30-7.40)	16.4 (14.8-18.4)	1828
3–5 years	7.73 (5.91-10.1)	3.90† (2.00-5.70)	7.10 (5.30-11.3)	15.0† (11.7-33.0)	58
6–11 years	8.27 (6.92-9.87)	4.10 (3.50-4.90)	8.20 (6.40-10.9)	15.4 (13.5-18.7)	141
12–19 years	6.93 (6.33-7.59)	3.50 (3.00-4.00)	6.60 (6.00-7.10)	14.5 (12.7-16.9)	333
20–39 years	6.09 (5.54-6.70)	2.80 (2.40-3.40)	6.00 (5.40-6.60)	13.5 (10.8-17.8)	454
40–59 years	7.29 (6.52-8.16)	3.10 (2.90-3.70)	7.00 (6.10-7.90)	17.5 (13.5-22.2)	368
60 years and older	7.82 (7.06-8.66)	3.20 (2.70-3.60)	8.00 (7.30-8.60)	19.5 (16.9-21.6)	474

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.7.a. Serum lutein/zeaxanthin: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	13.0 (12.5-13.6)	7.00 (6.60-7.30)	12.8 (12.2-13.5)	25.0 (24.0-25.8)	8353
3–5 years	12.5 (11.8-13.2)	7.30 (7.00-7.90)	12.5 (12.0-13.4)	20.7 (18.5-22.7)	430
6–11 years	12.5 (11.9-13.2)	7.60 (7.00-8.20)	12.4 (11.6-13.2)	20.3 (19.1-21.8)	1014
12–19 years	10.4 (9.91-11.0)	6.10 (5.70-6.60)	10.4 (9.80-11.1)	17.8 (16.5-19.1)	2205
20–39 years	12.1 (11.5-12.9)	6.30 (6.00-6.80)	12.0 (11.2-12.8)	23.0 (21.7-24.4)	1714
40–59 years	14.4 (13.6-15.2)	7.70 (7.40-8.30)	14.2 (13.5-15.0)	27.3 (25.5-29.6)	1468
60 years and older	15.2 (14.3-16.2)	7.60 (7.00-8.30)	15.3 (14.3-16.5)	30.0 (27.3-32.5)	1522
Males					
Total, 3 years and older	13.0 (12.5-13.5)	7.00 (6.70-7.30)	13.0 (12.4-13.6)	24.9 (23.5-26.0)	4049
3–5 years	12.2 (11.0-13.5)	7.30 (6.40-8.00)	12.1 (10.8-13.8)	19.5 (18.2-21.8)	217
6–11 years	12.6 (11.7-13.4)	7.70 (6.40-8.60)	12.5 (11.5-13.5)	21.3 (19.4-24.6)	507
12–19 years	10.3 (9.71-10.9)	5.90 (5.30-6.30)	10.2 (9.60-10.9)	17.7 (16.5-18.9)	1091
20–39 years	12.4 (11.7-13.1)	6.70 (6.20-7.10)	12.4 (11.2-13.2)	22.8 (21.6-24.5)	724
40–59 years	14.5 (13.8-15.3)	7.90 (7.30-8.50)	14.5 (13.7-15.5)	27.6 (25.5-30.4)	761
60 years and older	14.5 (13.4-15.8)	7.30 (6.30-8.50)	14.7 (13.3-16.4)	28.5 (24.9-32.0)	749
Females					
Total, 3 years and older	13.1 (12.5-13.7)	6.80 (6.50-7.10)	12.7 (12.2-13.5)	25.0 (24.1-25.9)	4304
3–5 years	12.8 (11.6-14.1)	7.50 (6.40-8.10)	12.6 (11.8-13.8)	21.4 (17.6-26.5)	213
6–11 years	12.5 (11.9-13.2)	7.90 (7.00-8.90)	12.2 (11.5-13.3)	19.4 (18.0-20.7)	507
12–19 years	10.6 (9.95-11.3)	6.50 (5.60-7.00)	10.4 (9.90-11.3)	17.9 (16.5-20.2)	1114
20–39 years	11.9 (11.1-12.8)	6.20 (5.80-6.90)	11.6 (10.7-12.5)	23.0 (20.8-25.1)	990
40–59 years	14.2 (13.2-15.2)	7.60 (7.10-8.40)	13.9 (13.0-14.7)	26.8 (24.8-30.2)	707
60 years and older	15.8 (14.9-16.7)	8.00 (7.10-8.70)	15.7 (14.6-17.5)	32.0 (27.6-33.7)	773

Table 2.7.b. Serum lutein/zeaxanthin: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	13.7 (13.3-14.1)	7.70 (7.30-8.10)	13.5 (13.1-14.0)	24.1 (23.0-25.1)	2114
3–5 years	12.5 (11.3-13.9)	7.20 (5.80-9.70)	12.5 (11.8-13.8)	19.1 (16.9-22.5)	126
6–11 years	12.4 (11.5-13.2)	8.00 (6.40-9.20)	12.2 (11.6-12.8)	19.2 (17.2-21.2)	290
12–19 years	10.8 (10.4-11.1)	6.70 (6.00-6.80)	10.6 (10.2-11.0)	18.0 (16.7-18.9)	696
20–39 years	14.4 (13.5-15.4)	8.10 (7.10-8.60)	14.9 (13.8-15.9)	24.4 (23.0-25.7)	460
40–59 years	15.7 (14.3-17.1)	8.90 (8.20-9.50)	15.5 (13.9-16.7)	28.4 (23.9-32.9)	287
60 years and older	15.8 (15.0-16.7)	8.00 (6.00-9.70)	16.0 (14.4-17.4)	32.5 (27.3-34.3)	255
Males					
Total, 3 years and older	14.1 (13.6-14.6)	8.10 (7.40-8.40)	14.2 (13.7-14.6)	24.1 (22.6-26.1)	1018
3–5 years	12.8 (10.6-15.4)	6.70† (5.30-10.8)	13.1 (11.3-15.4)	19.1† (15.9-25.7)	62
6–11 years	12.2 (11.2-13.2)	8.20 (6.30-9.30)	12.3 (11.4-12.9)	19.1 (15.7-22.5)	140
12–19 years	10.7 (10.1-11.3)	6.60 (5.70-7.00)	10.4 (9.60-11.4)	18.2 (15.6-20.1)	330
20–39 years	15.0 (14.0-15.9)	8.60 (7.30-9.90)	15.8 (14.4-16.5)	23.9 (22.1-26.2)	213
40–59 years	17.4 (15.7-19.3)	9.50 (8.90-11.4)	17.3 (14.8-19.9)	31.6 (26.6-36.4)	147
60 years and older	15.3 (14.0-16.6)	7.70 (5.70-9.80)	14.9 (13.4-17.4)	29.5 (25.8-37.9)	126
Females					
Total, 3 years and older	13.2 (12.8-13.6)	7.40 (6.90-7.70)	13.0 (12.5-13.5)	23.9 (21.9-25.1)	1096
3–5 years	12.3 (10.8-14.0)	6.70† (5.00-10.0)	12.4 (9.90-14.9)	18.5† (16.0-22.5)	64
6–11 years	12.6 (11.7-13.6)	8.30 (6.40-9.30)	12.4 (11.6-13.5)	19.2 (16.6-24.2)	150
12–19 years	10.9 (10.4-11.4)	6.80 (6.10-7.40)	10.9 (10.2-11.3)	17.5 (16.2-19.7)	366
20–39 years	13.8 (12.7-15.0)	7.30 (6.60-8.20)	13.8 (12.2-15.8)	24.9 (23.8-26.5)	247
40–59 years	14.0 (12.5-15.6)	8.20 (6.80-9.10)	13.9 (12.3-15.9)	22.7 (18.7-30.8)	140
60 years and older	16.3 (15.2-17.6)	8.60 (6.00-11.3)	16.0 (13.8-19.0)	32.5 (26.4-34.3)	129

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.7.c. Serum lutein/zeaxanthin: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	14.3 (13.2-15.5)	8.10 (7.30-8.80)	14.2 (12.8-15.5)	26.1 (24.1-28.5)	1992
3–5 years	15.4 (14.0-17.1)	9.80 (8.50-11.2)	15.3 (13.0-18.2)	24.5 (19.6-32.5)	128
6–11 years	15.3 (14.4-16.3)	9.50 (8.50-10.3)	15.7 (14.7-16.6)	24.7 (22.4-25.3)	340
12–19 years	12.5 (11.6-13.5)	7.80 (7.20-8.50)	12.5 (11.4-13.7)	19.6 (17.9-22.2)	671
20–39 years	13.3 (11.9-14.8)	7.50 (6.70-8.10)	12.8 (11.4-14.4)	25.3 (21.8-28.6)	319
40–59 years	14.9 (13.6-16.4)	8.60 (7.00-9.40)	15.5 (13.2-17.2)	28.2 (24.7-31.2)	291
60 years and older	17.6 (15.1-20.5)	9.10 (7.30-11.2)	17.7 (14.7-21.5)	33.7 (29.7-36.5)	243
Males					
Total, 3 years and older	14.5 (13.4-15.7)	8.00 (7.40-9.00)	14.6 (13.4-15.8)	26.2 (24.1-28.5)	984
3–5 years	15.4 (13.4-17.7)	10.6† (8.50-12.7)	14.5 (13.0-18.4)	21.8† (18.5-34.3)	64
6–11 years	16.4 (15.2-17.7)	10.1 (8.90-11.4)	16.4 (15.6-17.2)	25.1 (23.9-27.0)	175
12–19 years	12.3 (11.5-13.0)	7.80 (7.50-8.30)	12.0 (11.4-13.3)	19.6 (18.2-20.8)	340
20–39 years	13.8 (12.0-15.8)	7.50 (6.80-8.40)	13.5 (11.0-15.6)	25.9 (21.9-29.8)	132
40–59 years	15.1 (13.5-17.0)	8.60 (7.10-9.70)	15.5 (13.5-17.5)	28.7 (24.2-31.2)	154
60 years and older	16.1 (14.2-18.1)	7.50 (5.80-10.4)	16.0 (14.7-18.4)	29.6 (22.7-38.9)	119
Females					
Total, 3 years and older	14.1 (12.9-15.5)	8.10 (7.10-8.80)	13.9 (12.2-15.4)	26.0 (23.3-29.5)	1008
3–5 years	15.5 (12.9-18.5)	9.40† (7.90-11.8)	15.6 (12.3-18.2)	25.7† (19.3-37.1)	64
6–11 years	14.2 (12.8-15.9)	8.90 (7.40-10.1)	14.8 (12.3-16.1)	21.8 (19.2-25.3)	165
12–19 years	12.8 (11.5-14.2)	8.10 (6.80-9.40)	12.8 (11.3-14.4)	20.4 (17.6-24.2)	331
20–39 years	12.9 (11.4-14.6)	7.10 (6.30-8.10)	12.7 (11.3-14.3)	23.3 (19.5-28.9)	187
40–59 years	14.7 (13.2-16.3)	8.70 (6.20-9.60)	14.2 (12.5-17.1)	27.4 (22.1-33.3)	137
60 years and older	18.8 (15.5-22.7)	9.40 (8.00-12.2)	19.3 (14.4-25.4)	35.0 (31.0-36.7)	124

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.7.d. Serum lutein/zeaxanthin: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	12.6 (11.9-13.2)	6.80 (6.40-7.10)	12.4 (11.6-13.1)	24.1 (22.5-25.7)	3580
3–5 years	11.5 (10.8-12.3)	7.20 (6.40-7.60)	11.8 (10.4-12.8)	17.7 (16.9-21.4)	133
6–11 years	11.7 (10.9-12.6)	7.20 (6.70-7.90)	11.4 (10.8-12.4)	18.7 (17.0-21.8)	301
12–19 years	9.87 (9.21-10.6)	5.90 (5.20-6.40)	9.80 (9.10-10.5)	16.8 (15.2-19.3)	656
20–39 years	11.3 (10.6-12.1)	6.00 (5.70-6.50)	11.3 (10.3-12.4)	21.2 (19.3-22.9)	770
40–59 years	13.8 (13.0-14.8)	7.50 (7.10-7.80)	13.7 (13.1-14.4)	26.3 (24.1-28.5)	777
60 years and older	14.7 (13.8-15.7)	7.40 (6.80-8.10)	14.9 (13.5-16.4)	28.0 (25.6-31.7)	943
Males					
Total, 3 years and older	12.5 (11.9-13.1)	6.80 (6.30-7.10)	12.5 (11.7-13.2)	23.9 (22.0-26.0)	1738
3–5 years	11.2 (9.93-12.6)	7.10† (6.20-7.70)	10.7 (9.00-13.5)	17.1† (15.2-21.7)	72
6–11 years	11.7 (10.6-13.0)	7.10 (5.70-8.30)	11.3 (10.2-13.0)	19.6 (17.2-25.5)	157
12–19 years	9.65 (9.05-10.3)	5.50 (4.90-6.20)	9.60 (9.10-10.2)	16.7 (15.5-18.7)	323
20–39 years	11.6 (10.7-12.6)	6.20 (5.70-6.90)	11.7 (10.6-13.0)	20.7 (17.7-23.7)	312
40–59 years	13.9 (13.2-14.8)	7.70 (7.10-8.50)	13.9 (13.3-14.9)	26.8 (24.9-28.3)	407
60 years and older	13.9 (12.8-15.2)	7.30 (6.20-8.10)	14.1 (12.6-16.0)	26.1 (24.2-28.9)	467
Females					
Total, 3 years and older	12.6 (11.9-13.4)	6.60 (6.20-7.00)	12.2 (11.6-13.0)	24.4 (22.8-25.8)	1842
3–5 years	11.9 (10.6-13.5)	7.30† (4.30-8.30)	12.6 (10.8-13.8)	18.4† (15.2-23.2)	61
6–11 years	11.7 (11.0-12.5)	7.50 (6.60-8.10)	11.5 (10.9-12.3)	17.9 (15.5-20.2)	144
12–19 years	10.1 (9.25-11.0)	6.10 (5.00-6.70)	10.1 (9.10-10.7)	16.8 (14.8-20.8)	333
20–39 years	11.1 (10.2-12.0)	5.90 (5.60-6.60)	10.6 (9.50-12.0)	21.4 (18.4-23.3)	458
40–59 years	13.7 (12.6-15.0)	7.40 (6.50-8.00)	13.5 (12.3-14.3)	26.4 (23.4-31.6)	370
60 years and older	15.4 (14.4-16.4)	7.70 (6.70-8.70)	15.5 (14.0-17.4)	30.4 (25.8-34.3)	476

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.8.a. Serum *trans*-lycopene: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	20.5 (19.8-21.1)	10.5 (10.0-11.0)	22.0 (21.2-22.8)	37.5 (36.1-38.6)	8348
3–5 years	16.1 (15.2-17.1)	7.90 (7.30-8.90)	17.4 (16.2-18.1)	30.7 (28.5-32.8)	427
6–11 years	21.6 (20.7-22.5)	11.4 (10.4-12.7)	22.7 (21.4-23.7)	36.0 (35.0-37.2)	1012
12–19 years	21.6 (21.1-22.1)	12.8 (11.9-13.6)	22.3 (21.8-22.8)	36.1 (35.1-37.5)	2205
20–39 years	22.7 (21.5-23.9)	12.5 (11.7-13.8)	23.7 (22.5-24.8)	39.1 (37.6-41.0)	1714
40–59 years	21.1 (20.1-22.1)	10.7 (9.80-11.7)	22.6 (21.3-24.1)	38.1 (36.6-39.8)	1468
60 years and older	15.4 (14.6-16.3)	6.70 (5.70-7.30)	17.1 (15.9-17.9)	33.4 (31.5-34.5)	1522
Males					
Total, 3 years and older	21.2 (20.5-22.0)	10.8 (10.3-11.3)	23.1 (22.2-24.0)	39.0 (37.4-40.6)	4048
3–5 years	16.0 (14.9-17.2)	7.80 (7.10-9.00)	17.7 (16.0-19.1)	28.4 (27.1-30.9)	216
6–11 years	21.7 (20.4-23.1)	11.5 (9.40-13.3)	23.0 (21.2-25.0)	36.4 (34.1-40.1)	507
12–19 years	22.5 (21.8-23.2)	13.4 (12.4-14.0)	23.5 (22.5-24.5)	37.5 (35.3-39.8)	1091
20–39 years	24.2 (22.6-25.9)	13.8 (11.7-15.0)	25.0 (23.6-26.3)	42.1 (39.1-45.2)	724
40–59 years	21.7 (20.4-23.2)	11.1 (9.20-11.9)	23.7 (21.9-25.5)	39.8 (37.5-41.7)	761
60 years and older	15.2 (14.1-16.4)	6.30 (5.60-7.50)	16.8 (15.5-17.9)	33.2 (30.5-36.0)	749
Females					
Total, 3 years and older	19.7 (19.1-20.4)	10.3 (9.70-10.9)	21.1 (20.1-21.9)	35.6 (34.3-36.7)	4300
3–5 years	16.2 (14.6-18.1)	8.00 (6.20-10.3)	16.6 (14.9-18.6)	32.5 (29.1-34.3)	211
6–11 years	21.5 (20.6-22.4)	10.7 (9.70-13.0)	22.2 (20.6-23.3)	35.5 (34.1-37.3)	505
12–19 years	20.6 (20.0-21.3)	12.3 (11.5-13.1)	21.4 (20.0-22.2)	34.8 (32.1-36.3)	1114
20–39 years	21.3 (20.2-22.5)	12.2 (10.5-13.6)	22.3 (21.2-23.6)	36.7 (33.8-39.3)	990
40–59 years	20.4 (19.4-21.4)	10.7 (9.30-12.1)	21.8 (20.9-22.8)	36.5 (34.4-37.8)	707
60 years and older	15.6 (14.5-16.9)	6.70 (5.60-7.50)	17.3 (15.7-18.6)	33.3 (30.6-34.5)	773

Table 2.8.b. Serum *trans*-lycopene: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	19.7 (18.9-20.5)	10.6 (9.90-11.6)	20.6 (19.8-21.5)	34.6 (33.0-36.0)	2111
3–5 years	15.0 (12.9-17.4)	7.30 (5.80-9.20)	15.7 (12.5-19.4)	30.4 (23.0-39.8)	124
6–11 years	19.7 (18.3-21.3)	10.5 (9.20-13.1)	20.5 (18.7-22.5)	33.7 (29.6-36.1)	289
12–19 years	20.4 (19.4-21.4)	12.3 (11.2-13.4)	20.7 (19.6-22.0)	32.9 (30.4-36.2)	696
20–39 years	21.4 (20.1-22.8)	12.1 (11.2-13.6)	21.7 (20.6-22.5)	36.0 (33.1-39.9)	460
40–59 years	19.1 (17.5-20.9)	10.2 (8.70-11.3)	20.0 (17.9-22.3)	34.4 (29.9-39.1)	287
60 years and older	13.9 (11.7-16.6)	6.20 (2.20-9.60)	15.3 (13.1-17.7)	30.1 (26.6-31.6)	255
Males					
Total, 3 years and older	20.4 (19.6-21.2)	11.4 (10.2-12.0)	21.3 (20.6-21.9)	35.9 (32.7-39.4)	1018
3–5 years	15.2 (13.3-17.2)	8.60† (1.80-11.3)	15.7 (12.4-18.1)	28.5† (23.8-33.3)	62
6–11 years	20.8 (18.5-23.4)	12.6 (8.70-14.7)	20.6 (19.2-24.1)	33.4 (28.4-45.7)	140
12–19 years	21.1 (20.2-22.0)	12.9 (11.6-13.9)	21.5 (20.4-22.6)	34.6 (30.3-39.4)	330
20–39 years	22.0 (20.7-23.5)	12.4 (11.2-14.1)	22.2 (20.7-23.6)	39.1 (33.0-43.7)	213
40–59 years	20.0 (17.9-22.3)	10.2 (8.90-11.8)	20.9 (16.8-24.5)	35.5 (30.2-43.3)	147
60 years and older	13.0 (10.4-16.3)	5.20 (1.90-7.50)	14.2 (10.6-17.7)	27.8 (24.0-31.4)	126
Females					
Total, 3 years and older	19.0 (18.0-20.0)	10.2 (9.10-11.3)	20.0 (18.6-21.4)	33.7 (31.6-34.9)	1093
3–5 years	14.8 (11.0-19.8)	6.70† (4.30-9.50)	15.0 (9.50-22.8)	32.7† (20.3-37.9)	62
6–11 years	18.7 (16.8-20.7)	9.90 (9.10-11.0)	20.0 (16.9-22.9)	33.2 (28.6-35.4)	149
12–19 years	19.6 (18.4-20.9)	11.7 (10.2-13.6)	19.8 (18.3-21.2)	31.7 (29.7-35.9)	366
20–39 years	20.6 (18.9-22.5)	11.6 (10.3-13.2)	21.3 (19.0-22.7)	34.8 (30.1-37.6)	247
40–59 years	18.2 (16.4-20.2)	9.10 (5.30-13.2)	19.3 (17.9-20.8)	30.5 (28.2-36.9)	140
60 years and older	14.7 (12.1-18.0)	6.80 (1.90-10.3)	15.8 (13.7-20.7)	30.5 (24.4-36.1)	129

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.8.c. Serum *trans*-lycopene: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	21.6 (21.0-22.3)	10.9 (10.1-11.7)	23.4 (22.1-24.2)	40.1 (37.9-42.2)	1992
3–5 years	20.8 (18.3-23.6)	10.9 (8.90-13.4)	20.8 (18.6-24.9)	40.9 (28.5-54.9)	128
6–11 years	25.9 (24.1-27.9)	15.0 (13.1-16.8)	27.1 (24.1-29.6)	42.1 (36.7-47.1)	340
12–19 years	24.7 (23.6-25.8)	13.9 (12.4-16.0)	25.4 (24.0-27.0)	41.0 (38.4-43.0)	671
20–39 years	24.3 (23.3-25.4)	13.1 (12.4-14.6)	25.2 (23.5-26.8)	41.6 (39.0-46.9)	319
40–59 years	19.0 (17.7-20.5)	8.70 (6.20-11.3)	20.6 (19.6-22.0)	35.9 (34.4-41.3)	291
60 years and older	14.1 (12.9-15.4)	5.40 (4.50-7.10)	14.5 (13.3-16.7)	31.4 (28.8-34.1)	243
Males					
Total, 3 years and older	22.3 (21.4-23.2)	10.7 (9.90-12.4)	23.8 (22.8-24.6)	41.2 (37.4-44.1)	984
3–5 years	21.6 (18.2-25.5)	9.90† (5.10-15.1)	23.8 (19.3-27.0)	41.7† (30.5-57.7)	64
6–11 years	27.1 (24.3-30.1)	15.9 (13.0-18.5)	28.0 (23.9-32.2)	44.0 (36.4-49.1)	175
12–19 years	25.1 (23.9-26.4)	15.2 (13.4-16.7)	25.9 (24.4-27.6)	40.1 (36.8-44.6)	340
20–39 years	25.6 (24.4-26.9)	14.2 (12.5-16.2)	26.5 (23.8-28.1)	45.3 (37.4-56.2)	132
40–59 years	19.4 (17.8-21.0)	9.20 (6.20-11.2)	21.3 (19.3-22.7)	35.7 (32.4-41.2)	154
60 years and older	13.5 (11.8-15.4)	5.40 (4.30-7.10)	14.0 (11.4-16.4)	30.9 (26.2-34.9)	119
Females					
Total, 3 years and older	21.1 (20.2-22.0)	11.0 (10.1-11.6)	22.6 (20.9-24.2)	39.7 (37.1-41.3)	1008
3–5 years	20.0 (17.2-23.2)	11.1† (7.60-14.4)	19.6 (15.7-25.5)	40.9† (26.3-44.6)	64
6–11 years	24.7 (22.7-26.9)	13.8 (11.7-16.8)	25.9 (23.6-28.2)	39.2 (35.2-44.8)	165
12–19 years	24.3 (22.7-26.0)	12.5 (11.3-15.8)	25.2 (22.7-27.6)	41.0 (38.8-44.4)	331
20–39 years	23.5 (22.1-25.0)	13.0 (11.8-14.6)	24.4 (22.1-26.6)	39.7 (37.1-46.5)	187
40–59 years	18.7 (16.9-20.7)	7.90 (5.40-11.9)	19.9 (17.7-22.0)	36.2 (30.9-43.9)	137
60 years and older	14.5 (12.8-16.5)	5.60 (4.50-8.20)	14.8 (12.5-18.6)	31.4 (28.0-34.1)	124

† Estimate is subject to greater uncertainty due to small cell size.

Table 2.8.d. Serum *trans*-lycopene: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2001–2002.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	20.7 (19.9-21.4)	10.8 (10.2-11.4)	22.1 (21.0-23.2)	37.6 (36.3-38.7)	3578
3–5 years	15.4 (14.0-17.0)	7.90 (6.20-9.30)	16.6 (14.8-17.9)	27.5 (25.3-31.2)	132
6–11 years	21.5 (20.2-22.9)	11.4 (9.70-13.2)	22.2 (20.6-23.6)	35.8 (33.3-37.8)	300
12–19 years	21.1 (20.5-21.8)	12.8 (11.5-13.8)	21.9 (20.8-22.6)	35.3 (34.0-36.8)	656
20–39 years	22.9 (21.3-24.6)	13.1 (11.7-14.2)	24.2 (22.8-25.7)	39.6 (37.7-42.1)	770
40–59 years	21.9 (20.7-23.1)	11.8 (10.3-13.4)	23.2 (21.3-24.9)	38.5 (36.8-40.0)	777
60 years and older	16.1 (15.2-17.0)	7.00 (6.20-7.70)	17.8 (16.4-18.6)	33.9 (31.7-35.9)	943
Males					
Total, 3 years and older	21.4 (20.5-22.4)	11.0 (9.90-11.6)	23.5 (22.3-24.5)	39.5 (37.9-40.9)	1737
3–5 years	14.4 (12.6-16.5)	7.80† (4.40-9.50)	16.4 (14.3-19.1)	27.4† (24.7-30.9)	71
6–11 years	21.7 (19.9-23.6)	12.2 (9.40-14.1)	22.2 (20.3-25.2)	36.0 (32.0-40.1)	157
12–19 years	22.1 (21.2-23.1)	12.9 (11.5-14.0)	23.2 (21.4-24.6)	37.0 (34.3-40.2)	323
20–39 years	24.8 (22.4-27.3)	13.9 (11.1-16.6)	25.8 (23.9-28.9)	42.4 (38.8-45.6)	312
40–59 years	22.6 (21.0-24.2)	11.4 (9.20-13.5)	24.5 (22.4-26.9)	40.0 (37.9-42.9)	407
60 years and older	15.7 (14.6-17.0)	6.90 (5.80-7.70)	17.5 (15.7-18.6)	33.8 (30.6-37.6)	467
Females					
Total, 3 years and older	19.9 (19.2-20.7)	10.6 (9.90-11.4)	21.1 (20.1-22.1)	35.4 (33.9-36.7)	1841
3–5 years	16.6 (14.7-18.8)	8.70† (6.20-13.1)	16.6 (14.7-18.9)	26.8† (22.8-31.8)	61
6–11 years	21.3 (19.8-22.9)	11.0 (9.40-13.8)	21.7 (20.0-23.7)	34.2 (32.5-38.0)	143
12–19 years	20.2 (19.4-21.0)	12.6 (11.0-13.9)	21.3 (19.4-22.2)	32.4 (28.9-35.8)	333
20–39 years	21.3 (19.8-23.0)	12.3 (9.40-14.3)	22.4 (20.9-24.1)	36.5 (33.1-39.6)	458
40–59 years	21.2 (20.2-22.3)	12.6 (10.7-13.7)	22.0 (20.7-23.5)	36.6 (34.0-37.8)	370
60 years and older	16.4 (15.1-17.7)	6.90 (5.70-8.40)	17.9 (15.9-19.0)	33.8 (31.4-36.1)	476

† Estimate is subject to greater uncertainty due to small cell size.

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