

1. Water-Soluble Vitamins

B Vitamins and Related Biochemical Compounds

- Folate (serum and red blood cell)
- Vitamin B6
 - » Pyridoxal-5'-phosphate
 - » 4-Pyridoxic acid
- Vitamin B12
- Homocysteine
- Methylmalonic acid

Vitamin C (Ascorbic Acid)

B Vitamins and Related Biochemical Compounds

Background Information

Sources and Physiological Functions. Folate, vitamins B6, and B12 belong to the group of water-soluble B vitamins that occur naturally in food. Leafy green vegetables (such as spinach and turnip greens), fruits (such as citrus fruits and juices), and dried beans and peas are all natural sources of folate. Folic acid is the synthetic form of folate found in supplements and added to fortified foods. Because of wide consumption of fortified foods in the United States, these products have become an important contributor of folic acid to the U.S. diet. Folate functions as a coenzyme in single-carbon transfers in the metabolism of nucleic and amino acids. It is therefore especially important during periods of rapid cell division and growth, such as occurs during pregnancy and infancy.

The most abundant dietary sources of vitamin B6 are meats, whole grains (with the highest concentrations of B6 in the germ and aleuronic layer), vegetables, and nuts. Vitamin B6 is used as a cofactor for nearly 200 biochemical reactions in the human body, mostly related to amino acid metabolism. Its three major forms are pyridoxine (the major form in plants) and pyridoxal and pyridoxamine (the two most abundant forms in humans and animals); pyridoxal-5'-phosphate (PLP) is the most biologically active coenzyme form. 4-Pyridoxic acid (4PA) is the end product of vitamin B6 catabolism.

Vitamin B12 (cobalamin) is found naturally in animal foods, including fish, meat, poultry, eggs, milk, and milk products. For vegetarians, fortified breakfast cereals are a particularly valuable source of vitamin B12. The current Dietary Guidelines for Americans list vitamin B12 as a nutrient of concern for specific population groups. The guidelines recommend that persons 50 years and older consume foods fortified with vitamin B12 or dietary supplements (U.S. Department of Agriculture and U.S. Department of Health and Human Services 2010). Vitamin B12 functions as a coenzyme for a critical methyl transfer reaction that converts homocysteine to methionine and for a separate reaction that converts L-methylmalonyl-coenzyme A to succinyl-coenzyme A.

Homocysteine (Hcy) is an amino acid naturally found in the blood. Plasma Hcy concentrations are strongly influenced by diet as well as by genetic factors. Elevated concentrations of total Hcy (tHcy; the sum of free, protein-bound, and disulfides) are found in people whose folate, vitamin B12, or vitamin B6 status is suboptimal (Selhub 1993) and in people with impaired renal function (Wollensen 1999).

Methylmalonic acid (MMA) is a dicarboxylic acid naturally found in the blood. Plasma MMA concentrations are elevated when serum vitamin B12 concentrations are low or intermediate; such concentrations are therefore a useful diagnostic test for confirming vitamin B12 deficiency (Baik 1999). As with plasma tHcy, MMA concentrations are also elevated in people with impaired renal function (Rasmussen 1990).

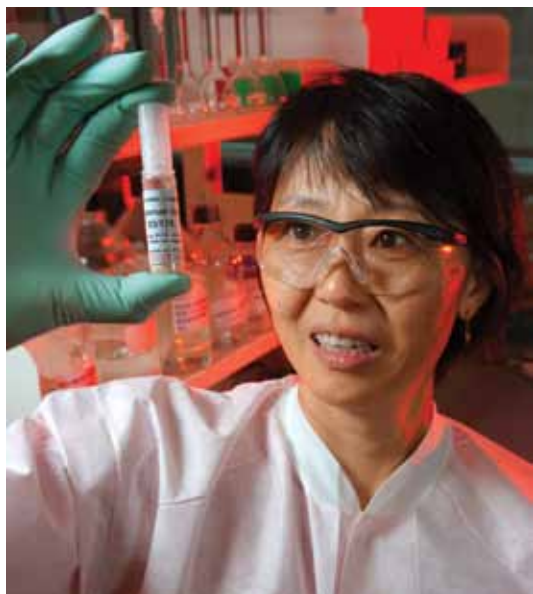
Health Effects. A chronic dietary deficiency of either folate or vitamin B12 causes macrocytic anemia, although strict dietary deficiencies are rare. Due to the wide abundance of vitamin B6 in foods, dietary deficiencies of vitamin B6 are also rare. Signs of vitamin B6 deficiency include dermatitis, glossitis (inflammation of the tongue), depression, confusion, convulsions, and anemia. Symptoms do not appear immediately, however, for ~80% of the vitamin B6 in the body is stored in muscle tissue and will remain stable until intake has been low for several weeks (Coburn 1990). Certain drugs (e.g., alcohol, methotrexate, anticonvulsants, sulfa drugs) may interfere with the absorption or utilization of folate, and disorders of the small bowel that limit

absorption (e.g., Crohn's disease, jejunal bypass surgery) can cause folate deficiency (Halsted 1990). Drugs that react with carbonyl groups have the potential to interact with PLP. Isoniazid—used in the treatment of tuberculosis—and L-DOPA have been shown to reduce plasma PLP concentrations, and a small decrease in vitamin B6 status has been seen in women taking high-dose oral contraceptives (Institute of Medicine 1998). Most people who develop a vitamin B12 deficiency have an underlying stomach or intestinal disorder that limits the absorption of vitamin B12. Subtly reduced cognitive function resulting from early vitamin B12 deficiency is sometimes the only symptom of these intestinal disorders. Severe vitamin B12 deficiency can cause permanent nerve damage and dementia. Hematologic signs, however, are not always present in vitamin B12 deficiency, and hematologic signs and neurologic abnormalities can be inversely correlated (Baik 1999).

Clinical trials have shown that folic acid supplementation effectively reduces the number of neural tube birth defects (NTDs) (Czeizel 1992; MRC Vitamin Study Research Group 1991). Thus, the U.S. Public Health Service recommended that every woman who could become pregnant consume at least 400 micrograms (μg) of folic acid each day (U.S. Centers for Disease Control and Prevention 1992). This recommendation has also been incorporated into the current Dietary Guidelines for Americans, which list folate as a nutrient of concern for specific population groups (U.S. Department of Agriculture 2010). Since 1998, the U.S. Food and Drug Administration (FDA) has required the addition of folic acid to enriched breads, cereals, flours, corn meals, pastas, rice, and other grain products (U.S. Food and Drug Administration 1996). After the introduction of fortification, NTD rates have decreased by 36% (U.S. Centers for Disease Control and Prevention 2010); nevertheless, in the era of folic acid fortification, NTD rates are still highest among Hispanic women (Williams 2005). The higher prevalence in Hispanics could be due to their lower consumption of total folic acid, which is specifically true for less acculturated populations (Hamner 2011). This suggests that there may be factors in addition to folate status, such as genetic or environmental factors, that modulate NTD prevalence and possibly lead to higher folate requirements for some population groups. Recent observational studies have also suggested other potential benefits of the U.S. folic acid fortification, such as decreased prevalence of inadequate serum and RBC folate concentrations (Pfeiffer 2007), and declines in the incidence of stroke (Yang 2006) and neuroblastoma (French 2003). Potential roles of B vitamins in modulating the risk for diseases (e.g., heart disease, cancer, and cognitive impairment) are currently being studied. Two national health objectives that relate to folate and maternal, infant, and child health are part of the objectives for Healthy People 2020: Objective MICH HP2020-14 (increase the proportion of women of childbearing potential with intake of at least 400 μg of folic acid from fortified foods or dietary supplements) and Objective MICH HP2020-15 (reduce the proportion of women of childbearing potential who have low red blood cell folate concentrations) (<http://www.healthypeople.gov/HP2020/>).

Intake Recommendations. The recommended dietary allowance (RDA) for both men and women is 400 μg per day of dietary folate equivalents (DFEs). DFEs adjust for the nearly 50% lower bioavailability of dietary folate compared to the bioavailability of folic acid: 1 mg of dietary folate equivalent equals 0.6 mg of folic acid from fortified food or from a supplement taken on an empty stomach (Institute of Medicine 1998). The RDA for vitamin B6 is 1.3 mg for both men and women (19–50 years), 1.7 mg for men and 1.5 mg for women aged 51 years and older, and 1.9 mg for pregnant women (2.0 mg if lactating) (Institute of Medicine 1998). The RDA for vitamin B12 for adults is 2.4 μg per day. Because as many as 10 to 30% of older people may be unable to absorb naturally occurring vitamin B12, it is advisable for people older than 50 years to meet their RDA mainly by consuming foods fortified with vitamin B12 or by taking a supplement containing vitamin B12. People with vitamin B12 deficiency caused by a lack of intrinsic factor or intestinal malabsorption require parenteral B12 treatment (Institute of Medicine 1998).

Prolonged consumption of very high daily intakes of folic acid has the potential to delay the diagnosis of anemia among adults with vitamin B12 deficiency. This may result in increased risk of progressive, unrecognized neurological damage from untreated vitamin B12 deficiency. Consequently, the Institute of Medicine (1998) set the Tolerable Upper Intake Level (UL) for folic acid intake for adults (aged 19 years and older) at 1000 µg per day. The UL is defined as the “maximum daily intake levels at which no risk of adverse health effects is expected for almost all individuals in the general population—including sensitive individuals—when the nutrient is consumed over long periods of time” (Institute of Medicine 2000). Because no data were available for children, the Institute of Medicine used the UL for adults adjusted by weight: 300–800 µg per day, depending on the age group. Folate intake from food is not associated with any health risk. The UL for vitamin B6 for adults is 100 mg per day (Institute of Medicine 1998). If more is ingested through supplements, sensory neuropathy, dermatological lesions, and reversible nerve damage to the arms and legs can occur. No adverse effects have been seen, however, from getting large amounts of vitamin B6 through food sources (Institute of Medicine 1998). No adverse effects have been associated with excess vitamin B12 intake from food or supplements in healthy individuals, and no UL has been set (Institute of Medicine 1998).



Biochemical Indicators and Methods. Folate status can be assessed by measuring serum or plasma folate, which provides information on recent intake, and red blood cell (RBC) folate, indicative of body folate stores and long-term nutritional status. Vitamin B6 status is typically assessed by measuring the level of one or more of the B6 vitamers in serum or plasma. Serum PLP is generally viewed as the best single indicator of status. Serum or urinary 4PA, the end product of vitamin B6 catabolism, is an

indicator of recent intake. Vitamin B12 status can be assessed by measuring serum or plasma total cobalamins or serum holo-transcobalamin II, the transport protein of absorbed cobalamin. Urinary or serum MMA is a specific functional indicator of vitamin B12 status. Plasma tHcy is a functional indicator of folate, vitamin B6, and/or B12 status, but it is not specific for either vitamin. As B vitamin concentrations decrease, plasma tHcy concentrations increase.

Clinical laboratories typically use conventional units for measuring concentrations of folate (nanograms per milliliter [ng/mL]) and vitamin B12 (picograms [pg]/mL) and international system (SI) units for vitamin B6 (nanomole per liter [nmol/L]), tHcy (micromole [µmol]/L), and MMA (nmol/L). Conversion factors to SI units are as follows: 1 ng/mL = 2.266 nmol/L for folate and 1 pg/mL = 0.738 picomol (pmol)/L for vitamin B12.

Traditionally, folate has been measured by microbiologic assay; however, in clinical settings, radioprotein-binding assays or commercial non-radio-protein-binding assays on automated clinical analyzers offering high throughput are used (Shane 2011). In research settings, chromatography-based methods, nowadays coupled to tandem mass spectrometry (LC-MS/MS), are often used to measure individual forms of folate in serum or whole blood (Pfeiffer 2010). International reference materials for serum folate from the U.S. National Institute of Standards and Technology (NIST) and the United Kingdom National Institute for Biological Standards and Control (NIBSC), with certified or reference values by higher-order reference methods (LC-MS/MS), have been available only for the last few years: NIST SRM 1955 and 1950, and NIBSC 03/178. A reference material for whole blood folate has been available from the NIBSC (95/528)

for several years; however, the value assignment for this material was by consensus of various protein-binding and microbiological assays. Because of observed method differences in measuring folate concentrations (Gunter 1996, Pfeiffer 2010), caution should be used in comparing other datasets to the tables in this report. Method-specific cutoff values and reference intervals for use in medical diagnostics have been suggested previously (Life Sciences Research Office 1994, Gunter 1996) and may be required until clinical assays have been standardized.

Vitamin B6 forms in serum are most commonly measured by high performance liquid chromatography (HPLC) with fluorometric detection; chemical derivatization (sample, online, or post-column) is almost always used to enhance PLP fluorescence (Rybak 2004). Enzymatic (radioactive or nonradioactive) and microbiological methods have also been employed (Coburn 2000). LC-MS/MS methods are emerging (Midttun 2005). The comparability of methods could be improved (Rybak 2005); such improvement is expected to occur in the future due to the new availability of NIST SRM 1950 and 3950 (certified concentrations for serum PLP by LC-MS/MS).

Serum vitamin B12 is commonly measured by competitive protein-binding assay (Carmel 2011). Research methods for tHcy determination are HPLC with fluorescence detection or coupled to tandem mass spectrometry; clinical methods are based on immunoassay or enzymatic principle (Refsum 2004). MMA is measured by gas chromatography coupled to mass spectrometry (GC-MS) or by LC-MS/MS (Pedersen 2011). The comparability among methods for serum vitamin B12, plasma Hcy, and MMA is superior to that for folate. The following international reference materials are available: NIBSC 03/178 for serum vitamin B12 (consensus value); and NIST SRM 1955 and 1950 for plasma tHcy (certified concentration by LC-MS/MS or GC-MS).

Data in NHANES. Folate and vitamin B12 data presented in this report were generated by use of the commercial BioRad Quantaphase II radio-protein-binding assay kit. This is the same method used during the first four years of the continuous NHANES survey (1999-2002) and during NHANES III (1988-1994) (Yetley 2011). The BioRad assay measures approximately 35% lower than the traditional microbiologic assay (Life Sciences Research Office 1994). As a result, the conventional cutoff values of less than 3 ng/mL for low serum folate concentrations, representing a negative folate balance at the time the blood sample was drawn, and less than 140 ng/mL for low RBC folate concentrations (Life Sciences Research Office 1984) should be adjusted to less than 2 ng/mL and less than 95 ng/mL, respectively (Wright 1998). A 2005 WHO Technical Consultation on folate and vitamin B12 deficiencies estimated blood folate and vitamin B12 concentrations below which plasma metabolite concentrations (tHcy for folate and MMA for vitamin B12) became elevated. It arrived at the following consensus cutoff values: 4 ng/mL (10 nmol/L) for serum folate, 151 ng/mL (340 nmol/L) for RBC folate, and 203 pg/mL (150 pmol/L) for serum vitamin B12 (de Benoist 2008). Because the folate data used to derive these cutoff values were generated with the microbiologic assay, the cutoff values are not directly applicable to data generated with the BioRad radio-protein-binding assay. For this report, we used cutoff values of 2 ng/mL and 95 ng/mL, respectively, to estimate the prevalence of low serum and RBC folate concentrations. To estimate the prevalence of low serum vitamin B12 concentrations, we used a cutoff value of 200 pg/mL. This cutoff value is very close to the WHO consensus cutoff value and has been widely used in previous studies (Carmel 2011).

Vitamin B6 data presented in this report include serum PLP and 4PA. They were generated by use of HPLC with post-column derivatization and fluorometric detection (Rybak 2004; Rybak 2009). We used a cutoff value of 20 nmol/L to indicate low serum PLP concentrations. This cutoff value was used by the Institute of Medicine as the basis for the Estimated Average Requirement (EAR) (1998); it may overestimate the vitamin B6 requirement for health maintenance of more than half the group.



tHcy data presented in this report were generated by use of the commercial Abbott fluorescence polarization immunoassay kit. MMA data were generated through a GC-MS method. Frequently used cutoff values for elevated concentrations of plasma tHcy and MMA are 13 $\mu\text{mol/L}$ (Jacques 1999) and 271 nmol/L (Allen 1990), respectively.

Monitoring the folate status of the U.S. population over time has been a priority (Yetley 2011). It has been so first because serum and RBC folate results from NHANES II (1976–1980) (Senti 1985) and NHANES III (1988–1994) (Wright 1998) suggested that the folate status of some population groups might be of public health concern; a second reason was to assess the impact of folic acid fortification (Pfeiffer 2007). Vitamin B12 status of the U.S. population has been monitored during the second phase of NHANES III (1991–1994) (Wright 1998) and during eight years of the continuous survey (1999–2006). Plasma metabolite concentrations have also been monitored during several years of the continuous survey (tHcy 1999–2006; MMA 1999–2004).

Pfeiffer et al. (2007) showed that the introduction of folic acid fortification has substantially increased serum and RBC folate concentrations in each age group. Serum vitamin B12 concentrations, however, did not change appreciably. Circulating tHcy concentrations from prefortification to postfortification decreased by approximately 10% in a national sample of the U.S. population (Pfeiffer 2008).

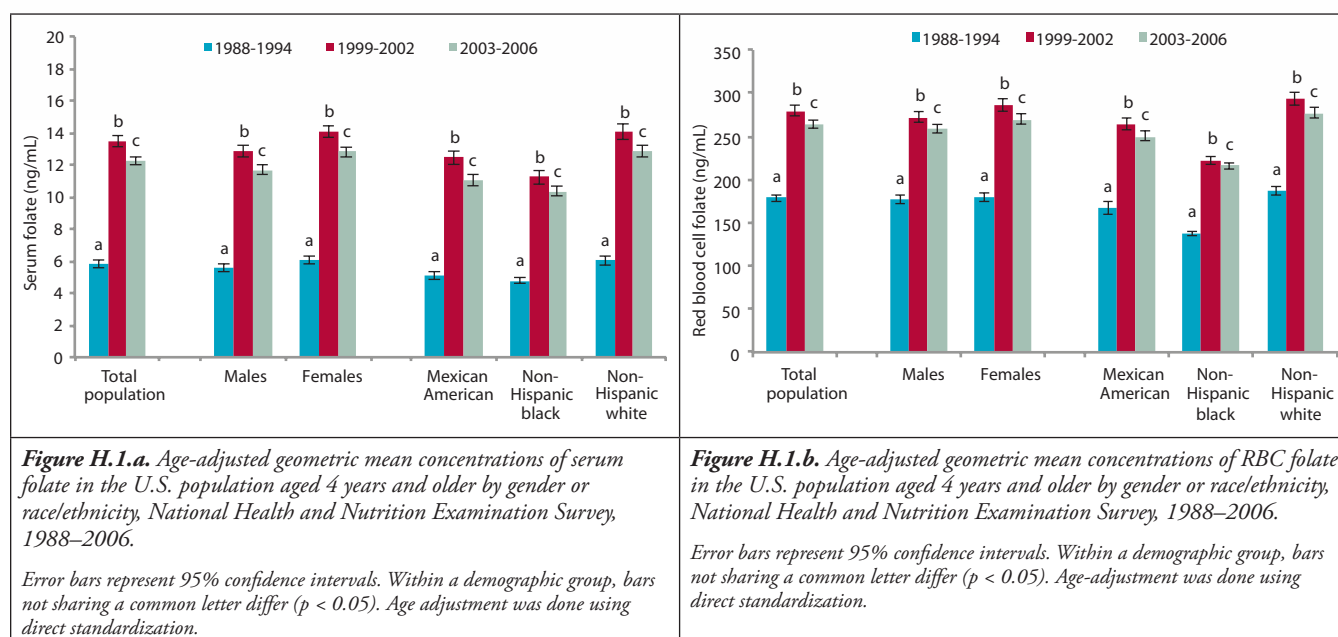
For more information on B vitamins and related biochemical indicators, see the Institute of Medicine’s Dietary Reference Intake reports (Institute of Medicine 1998) and fact sheets from the National Institutes of Health (NIH), Office of Dietary Supplements (http://ods.od.nih.gov/Health_Information/Information_About_Individual_Dietary_Supplements.aspx).

Highlights

Blood concentrations of water-soluble B vitamins (folate, vitamins B6 and B12) in the U.S. population showed the following demographic patterns and characteristics:

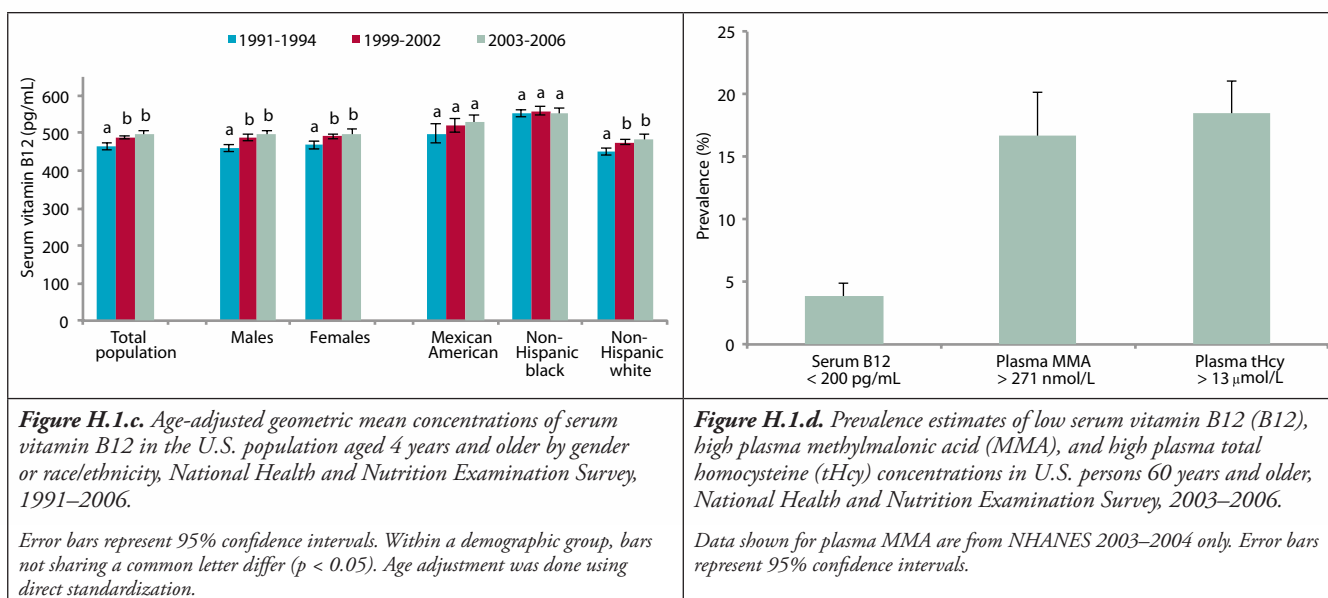
- The highest concentrations were generally found in the youngest age group, except for RBC folate and the vitamin B6 catabolite 4-pyridoxic acid where the highest concentrations were found in the oldest age group.
- No consistent pattern was observed with regard to gender.
- A specific race/ethnic pattern was observed: non-Hispanic blacks had the lowest folate and the highest vitamin B12 status, non-Hispanic whites had the highest folate and the lowest vitamin B12 status, and Mexican Americans had intermediate folate and vitamin B12 status.
- In the era of folic acid fortification, the prevalence of folate deficiency was very low throughout the population.
- The likelihood of being vitamin B6 and B12 deficient was higher in persons 40 years and older compared to younger persons.

Monitoring the continued effect of the U.S. folic acid fortification program of enriched grains and cereal products on serum and RBC folate concentrations is of great public health interest. Serum folate concentrations more than doubled and RBC folate concentrations increased by approximately 50% after the introduction of fortification in 1998. Regardless of gender or race/ethnicity, we observed small decreases (< 10%) in serum and RBC folate concentrations from the earlier (1999–2002) to the later (2003–2006) post-fortification period (Figures H.1.a and H.1.b). However, during the first eight years post-fortification covered in this report (1999–2006), the prevalence of low serum (< 2 ng/mL) and RBC folate (< 95 ng/mL) concentrations was less than 1% in the U.S. population, including women of childbearing age, regardless of race/ethnicity (data not shown). Folate deficiency was virtually non-existent in the general population, and it may be limited to persons with malabsorption, alcohol abusers, or consumers of certain drugs.



Because of the close relationship of folate and vitamin B12 in one-carbon metabolism, it is of interest to see whether serum vitamin B12 concentrations changed since the introduction of folic acid fortification and whether there are differences among race/ethnic groups. We observed a small increase in serum vitamin B12 concentrations from pre- (1991–1994) to post-fortification (1999–2002). We then found similar concentrations during 2003–2006 for the total population and for males and females (Figure H.1.c). The increase from pre- to post-fortification was observed for non-Hispanic whites, but not for non-Hispanic blacks and Mexican Americans; the latter two groups had higher serum vitamin B12 concentrations than non-Hispanic whites during both pre- and post-fortification.

Assessing the extent of inadequate vitamin B12 status in the older U.S. population is challenging because serum vitamin B12 is not sensitive enough, plasma tHcy is not specific, and both plasma MMA and tHcy are artificially elevated when renal function is impaired, which is common in older persons. As expected, we found a higher prevalence of elevated plasma MMA (17%) or tHcy (19%) concentrations, potentially indicating suboptimal vitamin B12 status, than we found in the prevalence of low serum vitamin B12 concentrations (4%) in older persons (Figure H.1.d). Defining better cutoff values for vitamin B12 status biomarkers remains a continued area of research (Bailey 2011).



Detailed Observations

The selected observations mentioned below are derived from the tables and figures presented next. 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, gender, race/ethnicity) or other blood concentration determinants (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 not statistically significant 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 G](#).

Geometric mean concentrations (NHANES 2003–2006):

- Serum and RBC folate concentrations followed a U-shaped age pattern, with the lowest concentrations seen in adolescents and young adults, respectively (Tables 1.1.a.1 and 1.2.a.1; Figures 1.1.a and 1.2.a).
- Serum PLP concentrations declined from childhood to adolescence, then stabilized in older age groups (Table 1.3.a.1 and Figure 1.3.a). Serum 4PA concentrations were lowest in adolescence and increased steadily through the oldest age group (Table 1.4.a.1 and Figure 1.4.a).
- Serum vitamin B12 concentrations declined from childhood to adolescence and then stabilized in older age groups (Table 1.5.a.1), while plasma MMA concentrations were relatively stable through young adulthood, and then increased with age (Table 1.7.a.1 and Figure 1.7.a).
- Plasma tHcy concentrations in adults increased with age (Table 1.6.a.1 and Figure 1.6.a).
- Females had higher serum and RBC folate concentrations than males (Tables 1.1.a.1 and 1.2.a.1); males had higher serum PLP and plasma tHcy concentrations than females (Tables 1.3.a.1 and 1.6.a.1); males and females had similar serum 4PA (Table 1.4.a.1),

vitamin B12 (Table 1.5.a.1) and plasma MMA (Table 1.7.a.1) concentrations.

- Non-Hispanic whites had the highest concentrations of serum and RBC folate (Tables 1.1.a.1 and 1.2.a.1), serum 4PA (Table 1.4.a.1), and plasma MMA (Table 1.7.a.1). They also had the lowest concentrations of serum vitamin B12 (Table 1.5.a.1). Non-Hispanic blacks had the lowest concentrations of RBC folate (Table 1.2.a.1) and serum PLP (Table 1.3.a.1). Mexican Americans had the lowest concentrations of plasma tHcy (Table 1.6.a.1).

Changes in geometric mean concentrations across survey cycles:

- Serum folate concentrations decreased slightly (< 10%) between the 1999–2000 and 2001–2002 survey cycles; however, concentrations stabilized over the next two survey cycles (Table 1.1.b).
- RBC folate concentrations were similar across all survey cycles except for a < 10% decrease between the 2001–2002 and 2003–2004 survey cycles (Table 1.2.b).
- We observed no changes in serum vitamin B12 (Table 1.5.b), plasma tHcy (Table 1.6.b), or plasma MMA (Table 1.7.b) concentrations over time.

Prevalence estimates of low or high biochemical indicator concentrations:

- In 2003–2006, less than 1% of the population aged 1 year and older had RBC folate concentrations < 95 ng/mL (Table 1.2.c). Similarly, less than 1% of the population had low serum folate concentrations < 2 ng/mL; however, the estimates had large variances and we do not present a prevalence table for this indicator.
- Of the population aged 1 year and older, approximately 11% had serum PLP concentrations < 20 nmol/L in 2005–2006 (Table 1.3.c). Compared to the prevalence of low PLP concentrations in persons 20–39 years of age, the prevalence of low PLP concentrations was lower in all younger age groups and higher in all older age groups.
- Approximately 2% of the population aged 1 year and older and 4% of persons 60 years and older had serum vitamin B12 concentrations < 200 pg/mL in 2003–2006 (Table 1.5.c).
- We found elevated plasma tHcy concentrations (> 13 μ mol/L) in 2003–2006 in approximately 8% of the population aged 20 years and older and in 19% of persons 60 years and older (Table 1.6.c).
- Approximately 7% of the population aged 3 years and older and 17% of persons 60 years and older had plasma MMA concentrations > 271 nmol/L in 2003–2004 (Table 1.7.c).
- Between 1999 and 2006 (2004 for MMA), we did not observe any change in the prevalence of low RBC folate (Table 1.2.d), low serum vitamin B12 (Table 1.5.d), high plasma tHcy (Table 1.6.d), and high plasma MMA (Table 1.7.d) concentrations.

Table 1.1.a.1. Serum folate: Concentrations

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)		Selected percentiles (95% conf. interval)					Sample size
	2.5th	5th	50th	95th	97.5th			
Total, 1 year and older	4.51 (4.36–4.61)	5.46 (5.26–5.66)	12.2 (11.9–12.5)	28.5 (27.5–29.5)	34.0 (32.5–36.0)	16,411		
Age group								
1–5 years	6.29 (5.51–6.93)	7.61 (6.92–8.24)	16.0 (15.5–16.5)	36.0 (32.0–41.9)	50.8 (37.7–77.7)	1,690		
6–11 years	8.21 (7.82–8.58)	9.04 (8.63–9.58)	15.7 (15.3–16.2)	29.9 (27.5–35.0)	35.9 (32.3–46.3)	1,749		
12–19 years	4.86 (4.57–5.11)	5.62 (5.45–5.83)	11.3 (10.9–11.6)	20.9 (19.9–21.8)	24.6 (23.4–25.8)	4,028		
20–39 years	4.24 (4.08–4.46)	4.93 (4.75–5.09)	10.5 (10.1–10.9)	20.5 (19.5–22.9)	26.1 (23.1–29.9)	3,242		
40–59 years	4.23 (3.70–4.40)	5.09 (4.57–5.42)	11.6 (11.3–11.9)	25.2 (24.1–28.1)	32.8 (29.2–37.1)	2,649		
60 years and older	5.31 (4.83–5.57)	6.32 (5.95–6.61)	15.8 (15.2–16.3)	35.7 (34.2–37.7)	45.7 (42.1–49.6)	3,053		
Gender								
Males	4.39 (4.29–4.60)	5.32 (5.00–5.55)	11.6 (11.3–11.9)	26.4 (25.6–27.8)	32.2 (30.6–34.8)	8,050		
Females	4.56 (4.41–4.81)	5.61 (5.33–5.91)	12.9 (12.5–13.2)	29.7 (28.8–31.2)	35.6 (33.6–37.8)	8,361		
Race/ethnicity								
Mexican Americans	4.67 (4.52–4.92)	5.49 (5.17–5.68)	11.1 (10.8–11.4)	22.2 (20.8–23.4)	25.9 (24.3–28.8)	4,212		
Non-Hispanic Blacks	4.19 (4.01–4.36)	4.83 (4.56–5.07)	10.3 (9.94–10.8)	22.6 (21.4–23.5)	27.0 (25.6–29.3)	4,297		
Non-Hispanic Whites	4.58 (4.40–4.81)	5.72 (5.36–5.98)	12.9 (12.5–13.3)	30.1 (29.2–31.5)	36.0 (34.2–38.5)	6,633		

Figure 1.1.a. Serum folate: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2006

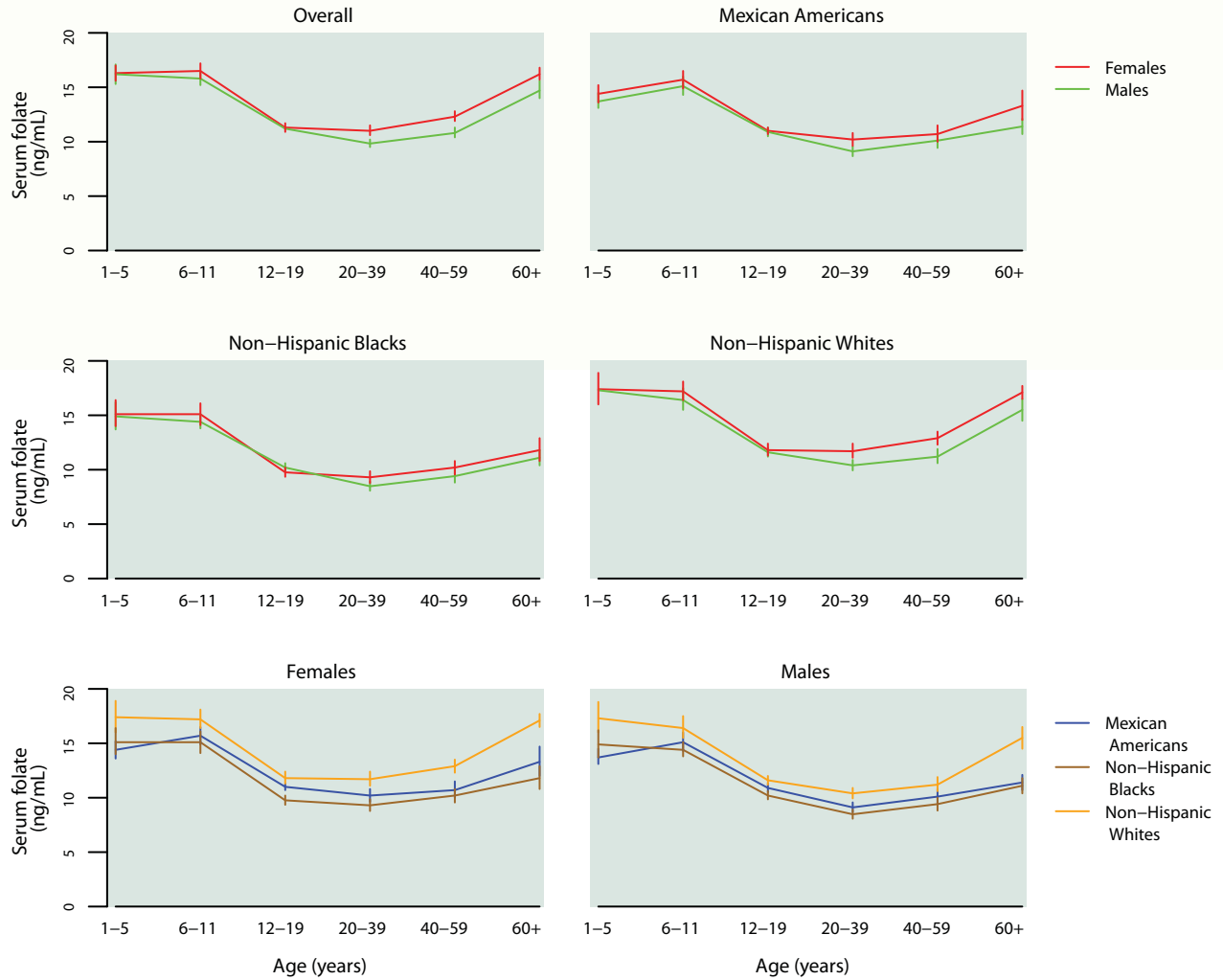


Table 1.1.a.2. Serum folate: Total population

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean		Selected percentiles (95% conf. interval)			Sample size			
	(95% conf. interval)		5th	50th	95th				
Males and Females									
Total, 1 year and older	12.3	(12.0 – 12.6)	5.46	(5.26 – 5.66)	12.2	(11.9 – 12.5)	28.5	(27.5 – 29.5)	16,411
1–5 years	16.2	(15.5 – 16.9)	7.61	(6.92 – 8.24)	16.0	(15.5 – 16.5)	36.0	(32.0 – 41.9)	1,690
6–11 years	16.1	(15.6 – 16.6)	9.04	(8.63 – 9.58)	15.7	(15.3 – 16.2)	29.9	(27.5 – 35.0)	1,749
12–19 years	11.2	(11.0 – 11.5)	5.62	(5.45 – 5.83)	11.3	(10.9 – 11.6)	20.9	(19.9 – 21.8)	4,028
20–39 years	10.4	(10.1 – 10.7)	4.93	(4.75 – 5.09)	10.5	(10.1 – 10.9)	20.5	(19.5 – 22.9)	3,242
40–59 years	11.6	(11.2 – 12.0)	5.09	(4.57 – 5.42)	11.6	(11.3 – 11.9)	25.2	(24.1 – 28.1)	2,649
60 years and older	15.6	(15.0 – 16.1)	6.32	(5.95 – 6.61)	15.8	(15.2 – 16.3)	35.7	(34.2 – 37.7)	3,053
Males									
Total, 1 year and older	11.7	(11.4 – 12.0)	5.32	(5.00 – 5.55)	11.6	(11.3 – 11.9)	26.4	(25.6 – 27.8)	8,050
1–5 years	16.2	(15.3 – 17.1)	7.56	(6.40 – 8.53)	15.8	(15.2 – 16.3)	36.2	(32.0 – 46.5)	854
6–11 years	15.8	(15.2 – 16.4)	9.10	(8.37 – 9.77)	15.3	(14.8 – 16.0)	29.1	(26.2 – 34.9)	854
12–19 years	11.2	(10.9 – 11.5)	5.45	(4.94 – 5.82)	11.3	(10.9 – 11.6)	20.5	(19.8 – 21.9)	2,041
20–39 years	9.83	(9.51 – 10.2)	4.84	(4.66 – 5.03)	9.89	(9.53 – 10.3)	18.3	(17.6 – 20.0)	1,462
40–59 years	10.8	(10.4 – 11.3)	4.84	(4.39 – 5.26)	11.0	(10.4 – 11.4)	22.7	(20.5 – 25.8)	1,305
60 years and older	14.7	(14.0 – 15.6)	6.12	(5.81 – 6.42)	14.7	(13.7 – 15.7)	34.9	(32.5 – 41.9)	1,534
Females									
Total, 1 year and older	12.9	(12.5 – 13.3)	5.61	(5.33 – 5.91)	12.9	(12.5 – 13.2)	29.7	(28.8 – 31.2)	8,361
1–5 years	16.3	(15.6 – 17.0)	7.65	(6.80 – 8.30)	16.3	(15.8 – 17.0)	34.6	(30.2 – 46.5)	836
6–11 years	16.5	(15.8 – 17.2)	9.01	(8.62 – 9.59)	16.2	(15.5 – 16.9)	30.8	(28.2 – 36.6)	895
12–19 years	11.3	(10.9 – 11.7)	5.76	(5.57 – 6.04)	11.2	(10.9 – 11.7)	21.3	(19.6 – 23.4)	1,987
20–39 years	11.0	(10.6 – 11.5)	5.05	(4.63 – 5.27)	11.1	(10.7 – 11.6)	23.1	(21.1 – 26.1)	1,780
40–59 years	12.3	(11.9 – 12.8)	5.37	(4.56 – 5.96)	12.4	(11.9 – 12.9)	27.6	(25.2 – 32.1)	1,344
60 years and older	16.2	(15.7 – 16.8)	6.57	(6.05 – 6.92)	16.5	(15.9 – 17.2)	36.1	(34.4 – 38.5)	1,519

Table 1.1.a.3. Serum folate: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for Mexican Americans in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean		Selected percentiles (95% conf. interval)			Sample size			
	(95% conf. interval)		5th	50th	95th				
Males and Females									
Total, 1 year and older	11.1	(10.7 – 11.4)	5.49	(5.17 – 5.68)	11.1	(10.8 – 11.4)	22.2	(20.8 – 23.4)	4,212
1–5 years	14.1	(13.4 – 14.7)	7.56	(6.85 – 8.17)	14.0	(13.3 – 14.8)	26.2	(23.8 – 29.4)	542
6–11 years	15.4	(14.7 – 16.2)	9.03	(8.32 – 9.67)	15.2	(14.2 – 16.0)	28.2	(26.2 – 32.2)	586
12–19 years	10.9	(10.6 – 11.2)	5.89	(5.43 – 6.28)	11.1	(10.8 – 11.5)	19.1	(18.2 – 19.8)	1,281
20–39 years	9.60	(9.24 – 9.96)	5.04	(4.70 – 5.19)	9.62	(9.07 – 10.2)	18.1	(16.8 – 19.6)	781
40–59 years	10.4	(9.76 – 11.1)	5.13	(4.59 – 5.67)	10.1	(9.51 – 11.0)	21.0	(18.7 – 23.7)	469
60 years and older	12.4	(11.6 – 13.2)	5.36	(4.61 – 6.41)	12.1	(11.6 – 12.6)	27.1	(24.6 – 37.1)	553
Males									
Total, 1 year and older	10.6	(10.3 – 11.0)	5.35	(4.99 – 5.65)	10.7	(10.3 – 11.0)	20.2	(19.5 – 22.4)	2,042
1–5 years	13.7	(13.1 – 14.5)	8.03	(6.22 – 8.33)	13.5	(12.7 – 14.5)	23.9	(21.2 – 31.4)	263
6–11 years	15.1	(14.3 – 16.0)	8.68	(7.46 – 9.86)	14.9	(13.7 – 16.0)	28.3	(25.4 – 32.3)	285
12–19 years	10.9	(10.5 – 11.3)	5.62	(4.99 – 5.94)	11.1	(10.6 – 11.4)	19.1	(17.7 – 20.6)	638
20–39 years	9.11	(8.67 – 9.57)	4.90	(4.47 – 5.37)	9.09	(8.68 – 9.70)	15.6	(14.7 – 18.7)	347
40–59 years	10.1	(9.43 – 10.8)	5.11	(4.48 – 5.91)	10.0	(9.19 – 10.7)	19.1	(18.1 – 22.5)	237
60 years and older	11.4	(10.7 – 12.1)	5.27	(4.61 – 6.23)	10.5	(9.85 – 12.1)	26.0	(22.9 – 36.9)	272
Females									
Total, 1 year and older	11.5	(11.1 – 12.0)	5.64	(5.15 – 5.87)	11.6	(11.3 – 11.8)	23.3	(21.8 – 25.6)	2,170
1–5 years	14.4	(13.6 – 15.2)	7.34	(6.41 – 8.10)	14.4	(13.7 – 15.9)	26.5	(24.5 – 31.9)	279
6–11 years	15.7	(14.9 – 16.5)	9.13	(8.01 – 10.2)	15.5	(14.8 – 16.3)	27.8	(25.9 – 34.2)	301
12–19 years	11.0	(10.7 – 11.3)	6.23	(5.78 – 6.54)	11.2	(10.8 – 11.6)	19.0	(18.2 – 21.0)	643
20–39 years	10.2	(9.62 – 10.8)	5.11	(4.74 – 5.38)	10.4	(9.53 – 11.0)	19.3	(18.1 – 21.8)	434
40–59 years	10.7	(10.0 – 11.5)	5.16	(3.80 – 5.85)	10.4	(9.57 – 11.4)	22.4	(19.1 – 40.0)	232
60 years and older	13.3	(12.0 – 14.7)	5.62	(4.00 – 6.65)	13.0	(12.1 – 13.7)	29.7	(25.3 – 64.8)	281

Table 1.1.a.4. Serum folate: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for non-Hispanic blacks in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	10.4 (10.1 – 10.7)	4.83 (4.56 – 5.07)	10.3 (9.94 – 10.8)	22.6 (21.4 – 23.5)	4,297
1–5 years	15.0 (14.0 – 16.0)	7.08 (5.99 – 7.80)	14.9 (14.3 – 15.6)	32.9 (28.0 – 40.7)	481
6–11 years	14.8 (14.2 – 15.3)	8.62 (7.91 – 9.03)	14.6 (14.0 – 15.2)	25.3 (23.9 – 29.4)	554
12–19 years	9.98 (9.63 – 10.4)	5.19 (4.98 – 5.39)	9.91 (9.59 – 10.3)	18.3 (17.7 – 19.1)	1,417
20–39 years	8.92 (8.56 – 9.29)	4.56 (4.26 – 4.81)	8.73 (8.34 – 9.23)	17.7 (16.7 – 19.1)	711
40–59 years	9.81 (9.28 – 10.4)	4.34 (3.93 – 4.99)	9.75 (9.04 – 10.3)	20.0 (18.8 – 26.0)	621
60 years and older	11.5 (10.8 – 12.3)	4.88 (4.48 – 5.29)	11.3 (10.7 – 11.9)	27.2 (24.5 – 36.0)	513
Males					
Total, 1 year and older	10.1 (9.84 – 10.4)	4.67 (4.34 – 4.94)	10.1 (9.76 – 10.5)	21.1 (19.7 – 23.2)	2,141
1–5 years	14.9 (13.7 – 16.2)	6.69 (5.91 – 7.81)	14.7 (13.9 – 15.5)	36.5 (29.0 – 51.9)	238
6–11 years	14.4 (13.8 – 15.1)	8.87 (8.20 – 9.55)	14.3 (13.6 – 14.9)	24.3 (21.2 – 30.8)	273
12–19 years	10.2 (9.85 – 10.6)	5.02 (4.75 – 5.19)	10.3 (9.82 – 10.8)	19.0 (17.9 – 19.8)	742
20–39 years	8.48 (8.07 – 8.91)	4.33 (4.01 – 4.81)	8.35 (7.82 – 8.89)	15.4 (14.5 – 17.7)	339
40–59 years	9.41 (8.82 – 10.0)	4.11 (3.42 – 4.99)	9.38 (8.49 – 10.1)	18.7 (17.3 – 32.9)	291
60 years and older	11.1 (10.4 – 11.8)	4.73 (3.87 – 5.82)	10.7 (9.77 – 11.3)	29.0 (23.9 – 32.7)	258
Females					
Total, 1 year and older	10.6 (10.2 – 11.0)	5.00 (4.62 – 5.23)	10.5 (10.0 – 11.1)	23.3 (22.0 – 24.9)	2,156
1–5 years	15.1 (14.0 – 16.4)	7.33 (5.00 – 8.42)	15.1 (14.2 – 16.3)	28.8 (26.7 – 40.8)	243
6–11 years	15.1 (14.1 – 16.1)	8.03 (7.24 – 8.98)	14.9 (14.0 – 15.9)	26.0 (24.3 – 33.6)	281
12–19 years	9.76 (9.35 – 10.2)	5.42 (4.98 – 5.57)	9.67 (9.21 – 10.0)	17.7 (16.9 – 18.4)	675
20–39 years	9.30 (8.78 – 9.86)	4.68 (4.44 – 5.01)	9.00 (8.52 – 9.59)	19.1 (17.8 – 20.8)	372
40–59 years	10.2 (9.56 – 10.8)	4.48 (4.07 – 5.18)	10.1 (9.24 – 10.7)	22.1 (19.2 – 27.7)	330
60 years and older	11.8 (10.8 – 12.9)	4.95 (4.26 – 5.65)	11.6 (11.0 – 12.8)	26.8 (23.9 – 45.8)	255

Table 1.1.a.5. Serum folate: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for non-Hispanic whites in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	13.0 (12.5 – 13.4)	5.72 (5.36 – 5.98)	12.9 (12.5 – 13.3)	30.1 (29.2 – 31.5)	6,633
1–5 years	17.4 (16.2 – 18.6)	7.94 (6.77 – 8.99)	17.0 (16.0 – 17.8)	37.9 (34.7 – 56.0)	478
6–11 years	16.8 (16.1 – 17.5)	9.54 (8.59 – 10.0)	16.5 (15.9 – 17.2)	31.7 (28.0 – 37.6)	449
12–19 years	11.7 (11.3 – 12.1)	5.83 (5.57 – 6.19)	11.6 (11.3 – 12.2)	22.1 (21.2 – 23.4)	1,048
20–39 years	11.0 (10.6 – 11.5)	5.22 (4.82 – 5.54)	11.1 (10.7 – 11.5)	22.9 (20.6 – 26.2)	1,453
40–59 years	12.0 (11.5 – 12.6)	5.14 (4.55 – 5.61)	12.1 (11.7 – 12.6)	26.1 (24.3 – 31.7)	1,357
60 years and older	16.3 (15.7 – 17.0)	6.55 (6.19 – 6.92)	16.7 (16.1 – 17.2)	36.8 (34.9 – 39.4)	1,848
Males					
Total, 1 year and older	12.3 (11.8 – 12.7)	5.56 (5.04 – 5.93)	12.1 (11.7 – 12.6)	28.0 (26.4 – 29.8)	3,268
1–5 years	17.3 (16.0 – 18.8)	8.02 (5.84 – 9.82)	16.5 (15.7 – 17.9)	36.3 (32.6 – 55.8)	259
6–11 years	16.4 (15.5 – 17.5)	8.91† (7.81 – 10.0)	16.2 (15.1 – 16.9)	30.4† (26.1 – 52.6)	216
12–19 years	11.6 (11.2 – 12.0)	5.58 (4.93 – 6.17)	11.6 (11.2 – 12.1)	21.8 (20.4 – 23.3)	528
20–39 years	10.4 (9.94 – 10.9)	5.30 (4.75 – 5.82)	10.5 (9.93 – 11.0)	19.5 (18.1 – 22.9)	638
40–59 years	11.2 (10.6 – 11.9)	4.95 (4.36 – 5.35)	11.5 (10.9 – 12.1)	22.9 (20.9 – 26.8)	689
60 years and older	15.5 (14.5 – 16.5)	6.35 (5.91 – 6.72)	15.6 (14.5 – 16.6)	37.0 (32.7 – 45.3)	938
Females					
Total, 1 year and older	13.7 (13.2 – 14.1)	5.88 (5.45 – 6.20)	13.7 (13.2 – 14.2)	31.6 (30.3 – 32.9)	3,365
1–5 years	17.4 (16.0 – 18.9)	7.79† (6.32 – 8.79)	17.1 (15.9 – 18.0)	42.7† (30.9 – 73.2)	219
6–11 years	17.2 (16.4 – 18.1)	9.71 (8.72 – 10.2)	17.0 (15.9 – 17.7)	31.7 (28.3 – 38.2)	233
12–19 years	11.8 (11.3 – 12.4)	5.90 (5.64 – 6.67)	11.8 (11.1 – 12.5)	22.2 (20.5 – 25.1)	520
20–39 years	11.7 (11.1 – 12.4)	5.19 (4.54 – 5.60)	11.8 (11.1 – 12.5)	25.7 (22.8 – 30.7)	815
40–59 years	12.9 (12.3 – 13.5)	5.40 (4.54 – 6.22)	13.1 (12.3 – 13.7)	30.9 (25.5 – 34.0)	668
60 years and older	17.1 (16.5 – 17.7)	6.85 (6.21 – 7.22)	17.6 (16.8 – 18.4)	36.6 (34.9 – 39.7)	910

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

Table 1.1.b. Serum folate: Concentrations by survey cycle

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Geometric mean (95% conf. interval)		Selected percentiles (95% conf. interval)			Sample size			
			5th	50th	95th				
Total, 3 years and older									
1999–2000	14.0	(13.4 – 14.8)	5.74	(5.35 – 6.10)	14.2	(13.4 – 15.0)	33.1	(31.6 – 34.9)	7,526
2001–2002	12.9	(12.5 – 13.3)	5.73	(5.36 – 6.05)	13.0	(12.7 – 13.4)	27.2	(26.4 – 28.5)	8,386
2003–2004	12.1	(11.7 – 12.6)	5.40	(5.12 – 5.69)	11.9	(11.5 – 12.4)	28.2	(27.1 – 29.7)	7,836
2005–2006	12.4	(11.9 – 12.9)	5.47	(5.10 – 5.80)	12.3	(11.9 – 12.7)	28.5	(26.5 – 30.2)	7,774
Age group									
3–5 years									
1999–2000	20.1	(18.8 – 21.4)	10.5	(7.89 – 12.2)	19.1	(17.9 – 21.6)	38.2	(34.0 – 45.1)	361
2001–2002	17.3	(16.3 – 18.4)	9.44	(7.08 – 10.6)	17.1	(16.1 – 18.3)	31.9	(29.5 – 38.5)	438
2003–2004	16.6	(15.1 – 18.2)	8.59	(5.22 – 9.61)	16.2	(15.2 – 17.0)	34.5	(29.4 – 57.9)	448
2005–2006	17.6	(16.5 – 18.8)	9.56	(8.34 – 10.3)	16.7	(16.1 – 17.9)	37.6	(31.3 – 77.2)	441
6–11 years									
1999–2000	19.3	(18.4 – 20.3)	11.0	(10.6 – 11.4)	19.3	(18.4 – 19.9)	33.4	(31.6 – 36.3)	885
2001–2002	17.2	(16.6 – 17.9)	9.31	(8.75 – 9.78)	17.1	(16.3 – 17.8)	32.7	(29.9 – 37.9)	1,023
2003–2004	15.6	(14.9 – 16.3)	9.39	(8.66 – 9.85)	15.2	(14.7 – 16.0)	27.4	(24.4 – 34.0)	843
2005–2006	16.7	(15.9 – 17.5)	8.77	(8.26 – 9.60)	16.3	(15.5 – 17.1)	32.4	(29.5 – 36.9)	906
12–19 years									
1999–2000	13.3	(12.6 – 14.0)	6.26	(5.72 – 6.61)	13.3	(12.7 – 14.0)	27.6	(25.6 – 31.3)	2,124
2001–2002	12.2	(11.6 – 12.8)	5.91	(5.29 – 6.28)	12.5	(11.9 – 13.3)	22.1	(21.2 – 23.4)	2,208
2003–2004	11.0	(10.5 – 11.5)	5.56	(5.20 – 6.02)	11.0	(10.5 – 11.4)	19.7	(19.1 – 22.1)	2,058
2005–2006	11.5	(11.2 – 11.8)	5.65	(5.39 – 5.90)	11.6	(11.1 – 12.1)	21.8	(21.1 – 22.6)	1,970
20–39 years									
1999–2000	11.8	(11.0 – 12.7)	5.15	(4.40 – 5.55)	11.6	(10.6 – 12.8)	28.6	(25.6 – 30.8)	1,470
2001–2002	11.1	(10.6 – 11.6)	5.27	(4.78 – 5.59)	11.1	(10.6 – 11.6)	22.6	(20.6 – 24.3)	1,714
2003–2004	10.2	(9.78 – 10.6)	4.83	(4.62 – 5.01)	10.2	(9.59 – 10.8)	20.0	(19.1 – 22.9)	1,555
2005–2006	10.6	(10.2 – 11.1)	5.07	(4.76 – 5.33)	10.8	(10.3 – 11.2)	21.1	(19.2 – 25.9)	1,687
40–59 years									
1999–2000	13.6	(12.7 – 14.5)	5.37	(4.37 – 6.08)	13.6	(12.7 – 14.7)	31.6	(30.0 – 35.4)	1,199
2001–2002	12.2	(11.7 – 12.7)	5.63	(4.86 – 6.06)	12.5	(11.9 – 13.1)	24.0	(22.4 – 25.3)	1,475
2003–2004	11.6	(11.0 – 12.3)	5.20	(4.57 – 5.60)	11.6	(11.1 – 11.9)	26.0	(23.8 – 32.8)	1,276
2005–2006	11.6	(11.0 – 12.2)	4.85	(4.39 – 5.57)	11.7	(11.1 – 12.1)	24.4	(22.8 – 29.0)	1,373
60 years and older									
1999–2000	17.4	(16.7 – 18.1)	7.09	(6.48 – 7.51)	17.4	(16.5 – 18.2)	42.3	(39.2 – 44.8)	1,487
2001–2002	16.1	(15.4 – 16.8)	6.50	(5.75 – 7.09)	16.6	(15.4 – 17.5)	37.3	(34.2 – 40.7)	1,528
2003–2004	15.7	(15.1 – 16.4)	6.53	(6.13 – 7.00)	15.6	(14.8 – 16.4)	34.9	(32.9 – 37.7)	1,656
2005–2006	15.4	(14.5 – 16.4)	6.06	(5.40 – 6.58)	15.8	(15.0 – 16.8)	36.4	(34.4 – 41.9)	1,397
Gender									
Males									
1999–2000	13.3	(12.7 – 14.0)	5.53	(4.73 – 6.13)	13.4	(12.7 – 14.2)	30.6	(29.0 – 32.2)	3,684
2001–2002	12.3	(11.8 – 12.8)	5.64	(5.17 – 6.00)	12.5	(12.1 – 13.0)	25.0	(23.7 – 27.0)	4,063
2003–2004	11.6	(11.1 – 12.1)	5.31	(4.93 – 5.69)	11.5	(11.1 – 11.9)	26.2	(24.7 – 28.1)	3,871
2005–2006	11.7	(11.2 – 12.1)	5.24	(4.74 – 5.59)	11.6	(11.2 – 12.0)	26.2	(25.2 – 28.5)	3,780
Females									
1999–2000	14.8	(14.0 – 15.6)	5.94	(5.60 – 6.18)	14.8	(14.1 – 16.0)	35.3	(33.7 – 37.5)	3,842
2001–2002	13.5	(13.1 – 13.9)	5.80	(5.39 – 6.35)	13.6	(13.2 – 14.0)	29.3	(27.3 – 31.6)	4,323
2003–2004	12.6	(12.1 – 13.1)	5.51	(5.12 – 5.84)	12.5	(12.0 – 13.0)	29.5	(28.3 – 31.6)	3,965
2005–2006	13.1	(12.5 – 13.7)	5.66	(5.25 – 6.14)	13.2	(12.6 – 13.8)	29.9	(28.2 – 32.2)	3,994
Race/ethnicity									
Mexican Americans									
1999–2000	13.2	(12.8 – 13.7)	6.10	(5.49 – 6.51)	13.5	(12.9 – 14.0)	28.4	(27.1 – 30.2)	2,571
2001–2002	11.6	(10.9 – 12.4)	5.48	(4.66 – 6.08)	11.8	(11.1 – 12.5)	22.5	(20.0 – 26.1)	2,124
2003–2004	10.9	(10.4 – 11.5)	5.20	(5.09 – 5.50)	11.1	(10.7 – 11.6)	20.9	(19.2 – 23.4)	1,919
2005–2006	11.1	(10.7 – 11.5)	5.56	(5.18 – 5.79)	11.0	(10.6 – 11.5)	23.1	(21.6 – 25.0)	2,012
Non-Hispanic Blacks									
1999–2000	11.7	(11.1 – 12.4)	5.15	(4.67 – 5.42)	11.6	(10.9 – 12.4)	27.3	(24.9 – 31.5)	1,712
2001–2002	10.9	(10.2 – 11.6)	5.06	(4.47 – 5.39)	10.7	(10.1 – 11.4)	23.6	(21.7 – 25.2)	2,004
2003–2004	10.1	(9.66 – 10.6)	4.65	(4.28 – 5.11)	10.1	(9.37 – 10.8)	21.9	(19.9 – 23.7)	2,057
2005–2006	10.6	(10.1 – 11.1)	4.95	(4.68 – 5.15)	10.5	(9.92 – 11.2)	22.9	(21.4 – 24.0)	2,040
Non-Hispanic Whites									
1999–2000	14.8	(13.8 – 15.8)	6.11	(5.52 – 6.55)	15.0	(13.9 – 16.2)	34.2	(32.6 – 36.0)	2,557
2001–2002	13.4	(13.0 – 13.9)	5.90	(5.62 – 6.21)	13.6	(13.2 – 14.1)	28.4	(27.2 – 29.9)	3,590
2003–2004	12.9	(12.2 – 13.5)	5.76	(5.31 – 6.08)	12.7	(12.1 – 13.3)	30.0	(28.5 – 32.1)	3,272
2005–2006	13.0	(12.4 – 13.6)	5.62	(4.96 – 6.04)	12.9	(12.4 – 13.5)	29.9	(28.3 – 32.2)	3,120

Figure 1.1.b. Serum folate: Concentrations by survey cycle

Selected percentiles in ng/mL (95% confidence intervals), National Health and Nutrition Examination Survey, 1999–2006

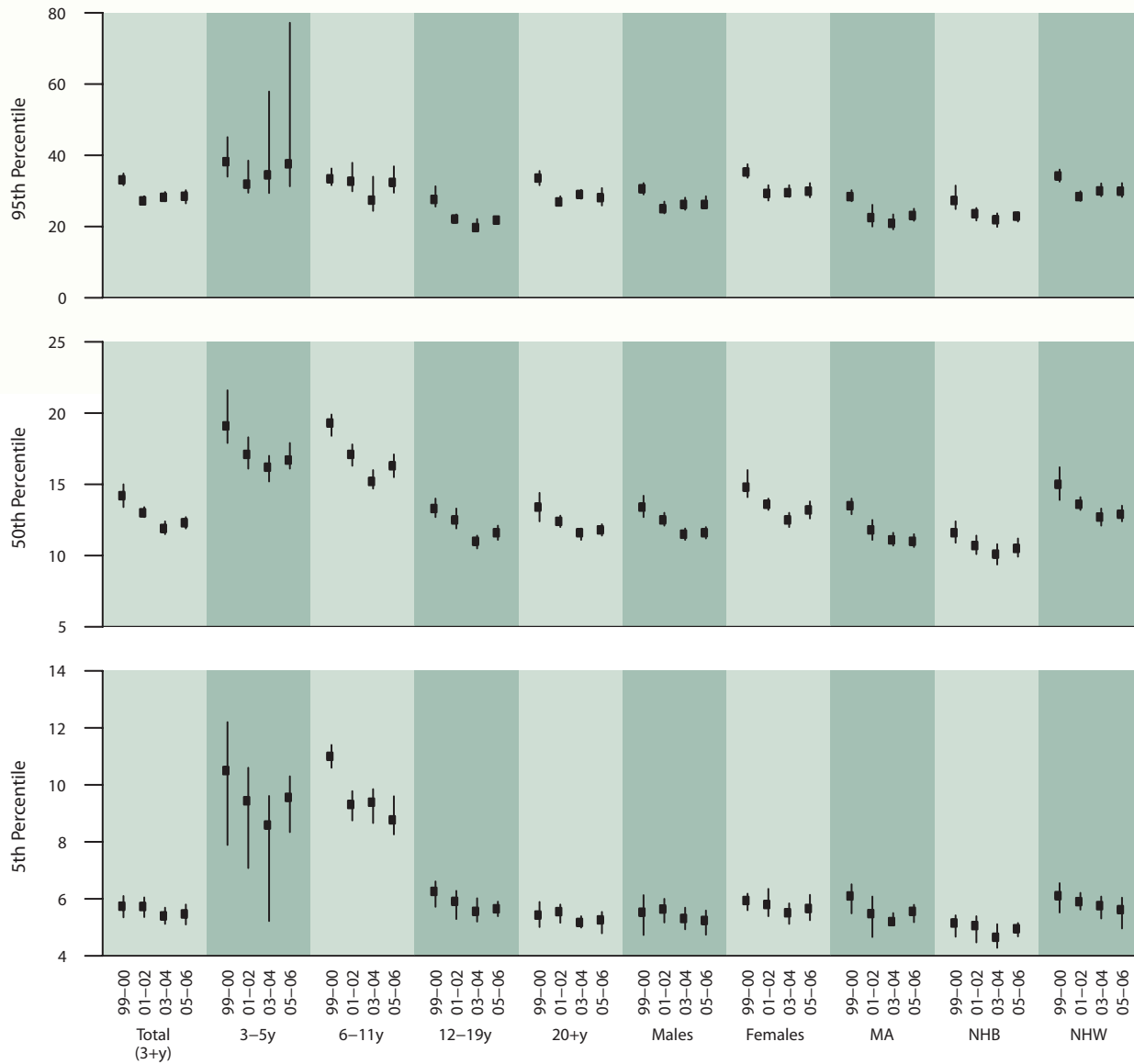


Table 1.2.a.1. Red blood cell folate: Concentrations

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)					Sample size
		2.5th	5th	50th	95th	97.5th	
Total, 1 year and older	265 (261 – 270)	133 (129 – 136)	149 (146 – 152)	261 (256 – 265)	501 (487 – 515)	581 (566 – 604)	16,670
Age group							
1–5 years	272 (265 – 279)	152 (149 – 160)	174 (169 – 178)	266 (261 – 272)	483 (436 – 531)	560 (521 – 668)	1,861
6–11 years	263 (258 – 268)	164 (152 – 171)	180 (172 – 184)	259 (254 – 264)	430 (400 – 456)	470 (457 – 511)	1,779
12–19 years	229 (225 – 234)	126 (123 – 130)	140 (134 – 146)	229 (224 – 233)	370 (355 – 390)	436 (398 – 471)	4,050
20–39 years	244 (238 – 250)	126 (119 – 131)	140 (136 – 144)	241 (235 – 247)	449 (421 – 480)	512 (483 – 547)	3,262
40–59 years	270 (264 – 276)	132 (126 – 137)	149 (143 – 154)	273 (266 – 279)	481 (461 – 510)	554 (519 – 605)	2,649
60 years and older	324 (317 – 332)	147 (140 – 151)	161 (157 – 166)	327 (315 – 338)	656 (622 – 705)	768 (724 – 860)	3,069
Gender							
Males	259 (253 – 264)	133 (128 – 138)	149 (144 – 153)	255 (250 – 259)	469 (453 – 489)	551 (529 – 588)	8,172
Females	272 (267 – 277)	132 (127 – 136)	149 (146 – 153)	268 (262 – 273)	522 (508 – 535)	604 (576 – 642)	8,498
Race/ethnicity							
Mexican Americans	247 (242 – 252)	133 (125 – 138)	149 (138 – 155)	241 (237 – 246)	452 (434 – 465)	529 (506 – 558)	4,304
Non-Hispanic Blacks	214 (210 – 218)	112 (107 – 116)	125 (120 – 130)	213 (210 – 216)	382 (367 – 398)	428 (419 – 449)	4,404
Non-Hispanic Whites	281 (274 – 288)	144 (137 – 149)	160 (154 – 165)	276 (269 – 282)	529 (510 – 537)	617 (594 – 653)	6,675

Figure 1.2.a. Red blood cell folate: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2006

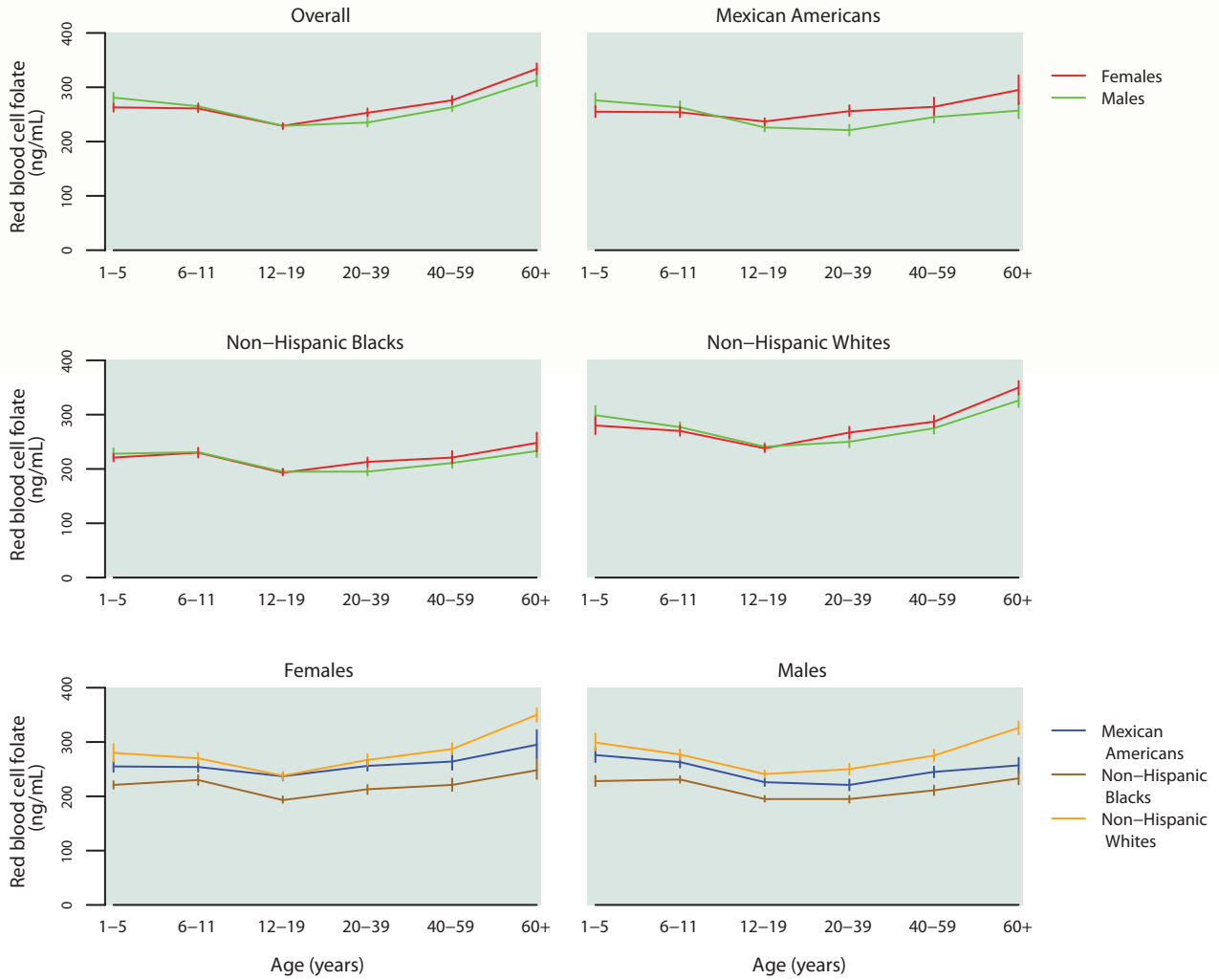


Table 1.2.a.2. Red blood cell folate: Total population

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	265 (261 – 270)	149 (146 – 152)	261 (256 – 265)	501 (487 – 515)	16,670
1–5 years	272 (265 – 279)	174 (169 – 178)	266 (261 – 272)	483 (436 – 531)	1,861
6–11 years	263 (258 – 268)	180 (172 – 184)	259 (254 – 264)	430 (400 – 456)	1,779
12–19 years	229 (225 – 234)	140 (134 – 146)	229 (224 – 233)	370 (355 – 390)	4,050
20–39 years	244 (238 – 250)	140 (136 – 144)	241 (235 – 247)	449 (421 – 480)	3,262
40–59 years	270 (264 – 276)	149 (143 – 154)	273 (266 – 279)	481 (461 – 510)	2,649
60 years and older	324 (317 – 332)	161 (157 – 166)	327 (315 – 338)	656 (622 – 705)	3,069
Males					
Total, 1 year and older	259 (253 – 264)	149 (144 – 153)	255 (250 – 259)	469 (453 – 489)	8,172
1–5 years	281 (271 – 290)	176 (170 – 185)	271 (264 – 281)	507 (460 – 560)	941
6–11 years	265 (259 – 271)	182 (173 – 188)	257 (251 – 264)	439 (414 – 468)	867
12–19 years	229 (225 – 234)	142 (135 – 148)	229 (223 – 233)	361 (353 – 385)	2,051
20–39 years	235 (228 – 242)	140 (131 – 148)	235 (226 – 244)	397 (379 – 429)	1,467
40–59 years	263 (256 – 271)	149 (140 – 154)	265 (256 – 275)	463 (431 – 513)	1,309
60 years and older	313 (302 – 324)	159 (154 – 163)	311 (297 – 328)	651 (595 – 709)	1,537
Females					
Total, 1 year and older	272 (267 – 277)	149 (146 – 153)	268 (262 – 273)	522 (508 – 535)	8,498
1–5 years	263 (255 – 270)	173 (161 – 177)	262 (254 – 267)	436 (395 – 531)	920
6–11 years	261 (254 – 269)	176 (162 – 183)	260 (253 – 267)	402 (379 – 459)	912
12–19 years	229 (223 – 234)	138 (130 – 146)	229 (223 – 234)	373 (354 – 398)	1,999
20–39 years	253 (246 – 261)	139 (134 – 145)	248 (239 – 258)	486 (461 – 529)	1,795
40–59 years	276 (269 – 284)	149 (139 – 157)	278 (271 – 288)	501 (467 – 536)	1,340
60 years and older	334 (324 – 344)	162 (157 – 172)	338 (325 – 352)	661 (616 – 744)	1,532

Table 1.2.a.3. Red blood cell folate: Mexican Americans

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for Mexican Americans in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	247 (242 – 252)	149 (138 – 155)	241 (237 – 246)	452 (434 – 465)	4,304
1–5 years	266 (257 – 275)	170 (152 – 177)	258 (249 – 266)	477 (441 – 507)	610
6–11 years	259 (252 – 266)	170 (156 – 183)	256 (249 – 262)	443 (396 – 483)	595
12–19 years	231 (225 – 237)	144 (136 – 154)	225 (221 – 232)	402 (386 – 423)	1,288
20–39 years	237 (228 – 246)	139 (125 – 154)	232 (223 – 241)	437 (402 – 463)	787
40–59 years	254 (245 – 264)	149 (132 – 157)	249 (235 – 264)	451 (415 – 520)	471
60 years and older	277 (263 – 292)	147 (130 – 156)	271 (258 – 290)	565 (483 – 646)	553
Males					
Total, 1 year and older	238 (231 – 245)	146 (133 – 153)	234 (230 – 239)	413 (388 – 445)	2,087
1–5 years	276 (263 – 289)	171 (151 – 189)	267 (260 – 275)	481 (445 – 553)	298
6–11 years	263 (253 – 274)	171 (151 – 189)	258 (249 – 265)	466 (422 – 523)	289
12–19 years	226 (219 – 233)	139 (134 – 147)	223 (214 – 230)	378 (340 – 455)	639
20–39 years	221 (211 – 231)	136 (106 – 153)	220 (211 – 231)	367 (333 – 406)	350
40–59 years	245 (235 – 255)	149 (122 – 158)	234 (226 – 250)	429 (373 – 538)	238
60 years and older	257 (243 – 271)	146 (121 – 150)	248 (234 – 268)	478 (438 – 542)	273
Females					
Total, 1 year and older	257 (252 – 263)	154 (140 – 161)	250 (246 – 256)	477 (460 – 505)	2,217
1–5 years	255 (245 – 265)	165 (139 – 177)	248 (240 – 258)	445 (398 – 506)	312
6–11 years	254 (245 – 263)	170 (153 – 180)	253 (246 – 261)	405 (358 – 477)	306
12–19 years	237 (230 – 243)	153 (135 – 158)	230 (224 – 237)	420 (398 – 450)	649
20–39 years	256 (247 – 267)	149 (135 – 161)	250 (236 – 267)	490 (458 – 587)	437
40–59 years	264 (249 – 281)	144 (110 – 159)	263 (244 – 287)	486 (424 – 746)	233
60 years and older	295 (269 – 322)	148 (91.6 – 168)	306 (267 – 329)	587 (550 – 682)	280

Table 1.2.a.4. Red blood cell folate: Non-Hispanic blacks

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for non-Hispanic blacks in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	214 (210 – 218)	125 (120 – 130)	213 (210 – 216)	382 (367 – 398)	4,404
1–5 years	225 (218 – 232)	143 (132 – 152)	226 (221 – 231)	350 (330 – 371)	525
6–11 years	230 (225 – 235)	156 (146 – 165)	231 (224 – 238)	336 (321 – 370)	572
12–19 years	194 (190 – 199)	118 (111 – 124)	195 (191 – 200)	312 (299 – 319)	1,432
20–39 years	204 (199 – 210)	119 (115 – 122)	203 (193 – 209)	370 (350 – 406)	717
40–59 years	216 (208 – 225)	124 (107 – 132)	215 (209 – 221)	386 (359 – 436)	630
60 years and older	242 (231 – 254)	131 (125 – 137)	237 (221 – 252)	449 (423 – 508)	528
Males					
Total, 1 year and older	209 (205 – 213)	122 (119 – 129)	208 (204 – 213)	355 (344 – 375)	2,189
1–5 years	228 (219 – 238)	143 (122 – 152)	227 (220 – 235)	359 (333 – 418)	259
6–11 years	231 (225 – 237)	164 (146 – 170)	231 (222 – 239)	337 (319 – 386)	282
12–19 years	195 (190 – 201)	123 (110 – 131)	198 (190 – 204)	305 (289 – 320)	750
20–39 years	195 (188 – 201)	116 (113 – 121)	192 (184 – 204)	309 (298 – 337)	339
40–59 years	211 (202 – 220)	120 (95.7 – 133)	209 (201 – 218)	375 (355 – 435)	295
60 years and older	233 (222 – 245)	128 (123 – 134)	224 (211 – 240)	461 (413 – 541)	264
Females					
Total, 1 year and older	219 (214 – 224)	127 (119 – 131)	216 (212 – 221)	397 (374 – 416)	2,215
1–5 years	221 (214 – 228)	146 (124 – 158)	224 (218 – 232)	334 (301 – 361)	266
6–11 years	230 (221 – 239)	149 (142 – 161)	230 (219 – 242)	334 (314 – 388)	290
12–19 years	193 (188 – 200)	113 (109 – 119)	194 (190 – 200)	314 (299 – 341)	682
20–39 years	213 (204 – 221)	121 (108 – 132)	210 (199 – 219)	406 (371 – 428)	378
40–59 years	221 (210 – 233)	128 (99.8 – 133)	219 (211 – 232)	389 (353 – 494)	335
60 years and older	248 (232 – 267)	135 (104 – 150)	245 (220 – 275)	445 (421 – 521)	264

Table 1.2.a.5. Red blood cell folate: Non-Hispanic whites

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for non-Hispanic whites in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	281 (274 – 288)	160 (154 – 165)	276 (269 – 282)	529 (510 – 537)	6,675
1–5 years	290 (277 – 304)	191 (179 – 201)	278 (267 – 293)	528 (484 – 598)	523
6–11 years	274 (267 – 281)	191 (187 – 197)	268 (261 – 275)	439 (411 – 464)	454
12–19 years	239 (233 – 246)	152 (145 – 158)	238 (231 – 246)	376 (356 – 407)	1,046
20–39 years	258 (250 – 267)	152 (143 – 159)	254 (246 – 262)	464 (435 – 504)	1,460
40–59 years	281 (273 – 290)	159 (150 – 165)	285 (275 – 293)	494 (466 – 532)	1,346
60 years and older	339 (330 – 348)	173 (162 – 183)	340 (328 – 350)	673 (645 – 732)	1,846
Males					
Total, 1 year and older	274 (267 – 281)	161 (153 – 167)	269 (262 – 278)	493 (473 – 524)	3,294
1–5 years	299 (284 – 316)	200 (173 – 208)	283 (268 – 312)	537 (498 – 659)	286
6–11 years	277 (268 – 286)	193† (188 – 202)	269 (258 – 278)	447† (425 – 517)	218
12–19 years	241 (234 – 248)	152 (139 – 158)	238 (231 – 249)	374 (355 – 437)	527
20–39 years	250 (240 – 260)	154 (141 – 165)	248 (238 – 258)	414 (395 – 447)	641
40–59 years	275 (265 – 286)	160 (148 – 165)	280 (266 – 292)	474 (433 – 534)	688
60 years and older	326 (314 – 338)	170 (161 – 184)	322 (306 – 340)	660 (609 – 716)	934
Females					
Total, 1 year and older	288 (280 – 296)	158 (153 – 164)	282 (273 – 290)	546 (531 – 569)	3,381
1–5 years	280 (264 – 296)	183 (152 – 196)	272 (263 – 286)	486 (428 – 584)	237
6–11 years	270 (261 – 280)	188 (170 – 198)	267 (259 – 276)	390 (373 – 456)	236
12–19 years	238 (231 – 245)	149 (136 – 160)	237 (230 – 244)	381 (350 – 447)	519
20–39 years	267 (257 – 278)	149 (139 – 155)	263 (251 – 272)	502 (473 – 557)	819
40–59 years	287 (277 – 298)	158 (148 – 167)	289 (276 – 302)	506 (477 – 545)	658
60 years and older	350 (337 – 362)	177 (158 – 186)	352 (338 – 370)	689 (630 – 796)	912

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

Table 1.2.b. Red blood cell folate: Concentrations by survey cycle

Geometric mean and selected percentiles of red blood cell concentrations (in ng/mL) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 3 years and older					
1999–2000	281 (269 – 293)	153 (144 – 162)	277 (266 – 288)	522 (499 – 556)	7,614
2001–2002	277 (269 – 285)	155 (148 – 160)	274 (265 – 282)	519 (500 – 540)	8,488
2003–2004	258 (251 – 266)	146 (139 – 151)	254 (246 – 262)	483 (464 – 506)	7,849
2005–2006	272 (267 – 277)	152 (148 – 155)	267 (263 – 270)	517 (497 – 534)	7,906
Age group					
3–5 years					
1999–2000	293 (282 – 306)	198 (182 – 206)	290 (283 – 301)	446 (397 – 608)	380
2001–2002	284 (273 – 296)	188 (163 – 201)	283 (270 – 296)	468 (394 – 522)	460
2003–2004	263 (253 – 273)	181 (172 – 187)	258 (245 – 268)	385 (364 – 583)	453
2005–2006	282 (269 – 295)	191 (181 – 197)	271 (265 – 281)	463 (432 – 598)	493
6–11 years					
1999–2000	284 (275 – 293)	190 (177 – 202)	282 (274 – 292)	423 (389 – 502)	898
2001–2002	276 (266 – 287)	183 (171 – 189)	272 (260 – 283)	444 (422 – 512)	1,040
2003–2004	258 (251 – 265)	176 (170 – 183)	255 (246 – 264)	414 (372 – 447)	849
2005–2006	269 (260 – 277)	182 (173 – 189)	263 (257 – 271)	434 (396 – 494)	930
12–19 years					
1999–2000	247 (237 – 256)	152 (146 – 158)	244 (238 – 255)	415 (391 – 456)	2,136
2001–2002	242 (231 – 253)	148 (138 – 157)	238 (228 – 249)	406 (381 – 446)	2,226
2003–2004	223 (217 – 230)	137 (129 – 145)	223 (215 – 230)	356 (338 – 386)	2,063
2005–2006	235 (229 – 241)	145 (133 – 151)	234 (228 – 240)	380 (358 – 414)	1,987
20–39 years					
1999–2000	256 (244 – 268)	141 (130 – 150)	254 (237 – 270)	460 (439 – 515)	1,474
2001–2002	254 (246 – 263)	144 (134 – 152)	251 (240 – 262)	448 (432 – 471)	1,721
2003–2004	236 (228 – 245)	138 (131 – 143)	234 (221 – 245)	426 (403 – 461)	1,555
2005–2006	252 (244 – 261)	143 (138 – 150)	249 (242 – 256)	462 (428 – 525)	1,707
40–59 years					
1999–2000	294 (279 – 311)	156 (144 – 167)	292 (274 – 309)	538 (502 – 613)	1,213
2001–2002	289 (280 – 298)	163 (155 – 170)	287 (281 – 295)	526 (484 – 585)	1,496
2003–2004	264 (253 – 275)	148 (137 – 156)	270 (258 – 279)	465 (430 – 514)	1,273
2005–2006	276 (270 – 282)	150 (145 – 155)	277 (270 – 284)	495 (465 – 544)	1,376
60 years and older					
1999–2000	340 (328 – 352)	169 (154 – 182)	343 (323 – 363)	667 (629 – 701)	1,513
2001–2002	334 (323 – 345)	167 (158 – 178)	336 (325 – 349)	654 (608 – 721)	1,545
2003–2004	320 (310 – 329)	162 (154 – 171)	321 (310 – 337)	642 (589 – 725)	1,656
2005–2006	329 (316 – 342)	161 (155 – 168)	332 (312 – 347)	662 (618 – 733)	1,413
Gender					
Males					
1999–2000	274 (262 – 286)	153 (144 – 161)	270 (259 – 280)	499 (478 – 526)	3,721
2001–2002	269 (259 – 278)	155 (147 – 160)	265 (254 – 276)	485 (465 – 520)	4,106
2003–2004	252 (244 – 260)	147 (138 – 153)	248 (239 – 257)	452 (431 – 485)	3,874
2005–2006	264 (257 – 271)	151 (144 – 157)	259 (255 – 264)	481 (459 – 508)	3,845
Females					
1999–2000	288 (275 – 301)	154 (142 – 164)	286 (272 – 298)	549 (515 – 590)	3,893
2001–2002	285 (276 – 294)	155 (148 – 159)	282 (274 – 291)	540 (518 – 575)	4,382
2003–2004	264 (256 – 273)	146 (138 – 151)	261 (251 – 271)	502 (483 – 530)	3,975
2005–2006	280 (273 – 287)	153 (148 – 157)	274 (267 – 282)	538 (528 – 557)	4,061
Race/ethnicity					
Mexican Americans					
1999–2000	261 (253 – 268)	159 (151 – 166)	256 (251 – 262)	452 (429 – 465)	2,592
2001–2002	256 (244 – 268)	146 (132 – 161)	252 (241 – 265)	458 (434 – 497)	2,134
2003–2004	242 (234 – 251)	149 (136 – 157)	236 (231 – 244)	414 (398 – 462)	1,919
2005–2006	250 (244 – 256)	148 (129 – 158)	244 (239 – 249)	461 (452 – 482)	2,057
Non-Hispanic Blacks					
1999–2000	225 (218 – 233)	125 (113 – 135)	226 (221 – 234)	386 (366 – 427)	1,738
2001–2002	216 (210 – 222)	122 (119 – 124)	214 (208 – 220)	376 (355 – 412)	2,045
2003–2004	209 (203 – 214)	119 (114 – 127)	209 (204 – 214)	366 (349 – 389)	2,091
2005–2006	220 (215 – 224)	131 (124 – 136)	217 (212 – 221)	402 (376 – 422)	2,084
Non-Hispanic Whites					
1999–2000	298 (281 – 315)	165 (147 – 175)	293 (275 – 309)	555 (527 – 592)	2,585
2001–2002	293 (286 – 300)	166 (160 – 172)	289 (283 – 295)	542 (524 – 566)	3,625
2003–2004	273 (262 – 285)	158 (146 – 166)	269 (258 – 280)	504 (485 – 531)	3,256
2005–2006	288 (281 – 295)	162 (155 – 167)	282 (276 – 289)	539 (527 – 567)	3,149

Figure 1.2.b. Red blood cell folate: Concentrations by survey cycle

Selected percentiles in ng/mL (95% confidence intervals), National Health and Nutrition Examination Survey, 1999–2006

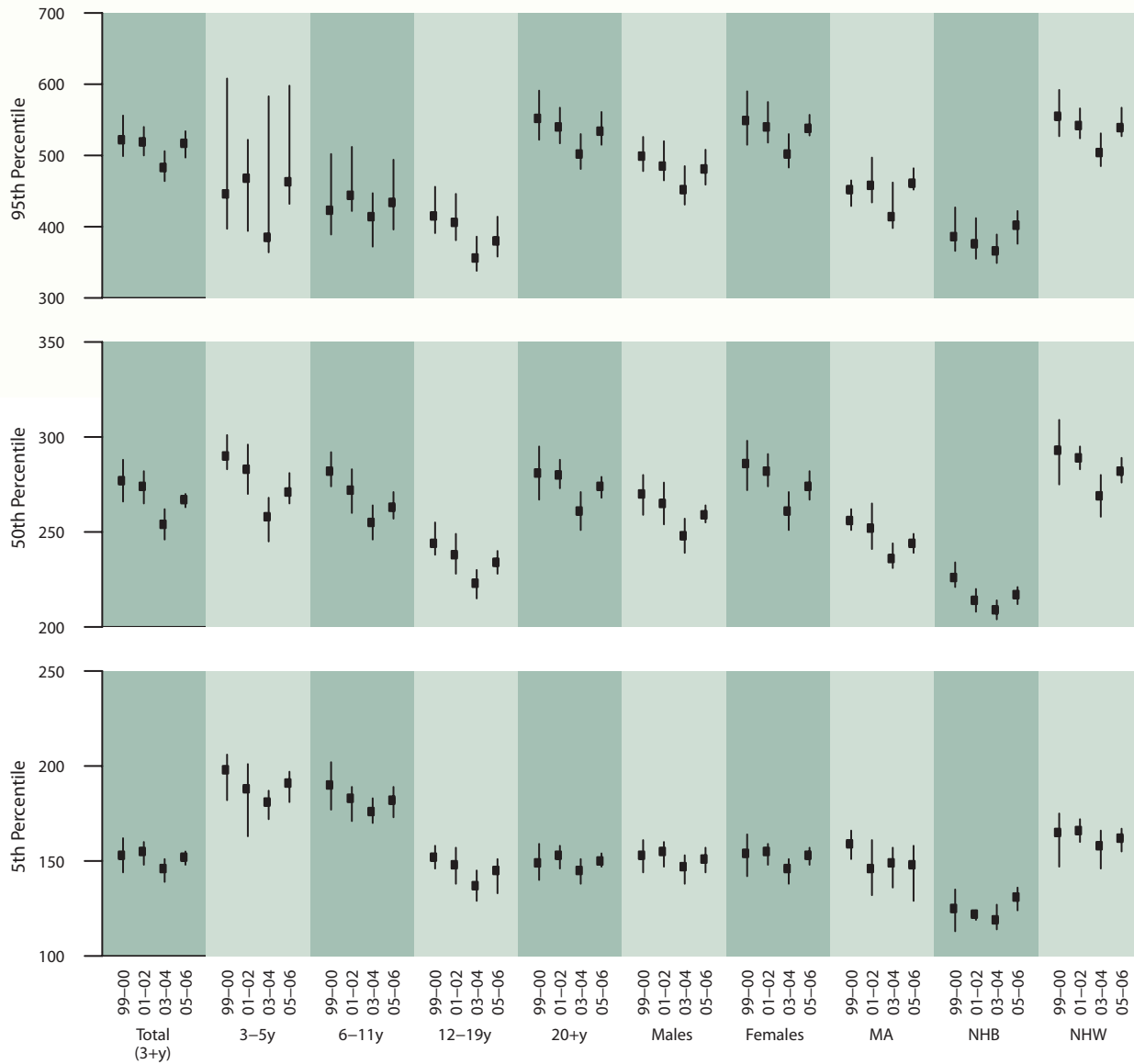


Table 1.2.c. Red blood cell folate: Prevalence

Prevalence (in percent) of low red blood cell folate concentration (< 95 ng/mL) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 1 year and older	16,670	0.2 (0.2 – 0.4)	704,000
Age group			
1–5 years	1,861	§	§
6–11 years	1,779	§	§
12–19 years	4,050	0.2 (0.1 – 0.4)	76,000
20–39 years	3,262	§	§
40–59 years	2,649	0.4 (0.2 – 0.7)	331,000
60 years and older	3,069	§	§
Gender			
Males	8,172	0.2 (0.1 – 0.4)	301,000
Females	8,498	0.3 (0.2 – 0.5)	404,000
Race/ethnicity			
Mexican Americans	4,304	0.3‡ (0.1 – 0.6)	72,000‡
Non-Hispanic Blacks	4,404	0.9 (0.6 – 1.5)	313,000
Non-Hispanic Whites	6,675	§	§

‡ Estimate flagged: $30\% \leq RSE < 40\%$ for the prevalence estimate.

§ Estimate suppressed: $RSE \geq 40\%$ for the prevalence estimate.

Table 1.2.d. Red blood cell folate: Prevalence by survey cycle

Prevalence (in percent) of low red blood cell folate concentration (< 95 ng/mL) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 3 years and older			
1999–2000	7,614	§	§
2001–2002	8,488	0.2‡ (0.1 – 0.4)	562,000‡
2003–2004	7,849	0.3 (0.2 – 0.6)	947,000
2005–2006	7,906	0.2 (0.1 – 0.3)	434,000
Age group			
3–5 years			
1999–2000	380	§	§
2001–2002	460	§	§
2003–2004	453	§	§
2005–2006	493	§	§
6–11 years			
1999–2000	898	§	§
2001–2002	1,040	§	§
2003–2004	849	§	§
2005–2006	930	§	§
12–19 years			
1999–2000	2,136	§	§
2001–2002	2,226	§	§
2003–2004	2,063	0.3‡ (0.1 – 0.5)	88,000‡
2005–2006	1,987	0.2‡ (0.1 – 0.4)	64,000‡
20–39 years			
1999–2000	1,474	§	§
2001–2002	1,721	§	§
2003–2004	1,555	§	§
2005–2006	1,707	§	§
40–59 years			
1999–2000	1,213	§	§
2001–2002	1,496	§	§
2003–2004	1,273	0.7‡ (0.3 – 1.5)	555,000‡
2005–2006	1,376	0.1‡ (0.1 – 0.3)	118,000‡
60 years and older			
1999–2000	1,513	§	§
2001–2002	1,545	0.3‡ (0.1 – 0.7)	147,000‡
2003–2004	1,656	§	§
2005–2006	1,413	§	§
Gender			
Males			
1999–2000	3,721	0.2‡ (0.1 – 0.4)	217,000‡
2001–2002	4,106	§	§
2003–2004	3,874	0.3‡ (0.1 – 0.6)	378,000‡
2005–2006	3,845	0.1 (0.1 – 0.2)	201,000
Females			
1999–2000	3,893	§	§
2001–2002	4,382	0.1‡ (0.1 – 0.3)	161,000‡
2003–2004	3,975	0.4‡ (0.2 – 0.9)	570,000‡
2005–2006	4,061	§	§
Race/ethnicity			
Mexican Americans			
1999–2000	2,592	§	§
2001–2002	2,134	§	§
2003–2004	1,919	§	§
2005–2006	2,057	§	§
Non-Hispanic Blacks			
1999–2000	1,738	1.0 (0.5 – 1.7)	318,000
2001–2002	2,045	0.7‡ (0.3 – 1.5)	238,000‡
2003–2004	2,091	1.0 (0.5 – 1.9)	333,000
2005–2006	2,084	0.8‡ (0.3 – 1.8)	261,000‡
Non-Hispanic Whites			
1999–2000	2,585	§	§
2001–2002	3,625	§	§
2003–2004	3,256	§	§
2005–2006	3,149	0.0 (0.0 – 0.1)	85,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.
 § Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

Table 1.3.a.1. Serum pyridoxal-5'-phosphate: Concentrations

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)		Selected percentiles (95% conf. interval)					Sample size
	2.5th	5th	50th	95th	97.5th			
Total, 1 year and older	11.3 (10.0–12.5)	14.3 (13.3–15.3)	49.3 (46.9–51.2)	214 (199–245)	302 (279–330)	8,311		
Age group								
1–5 years	20.7 (18.2–23.6)	25.4 (21.3–29.9)	66.1 (63.1–70.4)	160 (148–182)	185 (176–202)	915		
6–11 years	22.9 (20.0–24.1)	25.5 (23.3–28.2)	60.0 (55.3–65.5)	157 (137–185)	188 (169–223)	922		
12–19 years	17.4 (16.4–18.4)	20.7 (19.2–21.6)	47.8 (44.9–51.0)	127 (118–150)	174 (140–206)	1,985		
20–39 years	11.8 (10.3–13.7)	15.6 (13.6–17.0)	47.3 (43.9–50.5)	219 (194–273)	322 (279–379)	1,699		
40–59 years	9.84 (8.61–11.3)	12.8 (11.2–13.8)	45.6 (41.5–50.3)	262 (212–302)	342 (297–399)	1,381		
60 years and older	9.13 (8.70–9.95)	11.6 (9.96–12.9)	46.9 (41.9–53.5)	262 (217–311)	324 (281–385)	1,409		
Gender								
Males	13.3 (11.7–14.5)	17.1 (15.2–18.9)	53.9 (52.0–56.0)	209 (191–254)	320 (282–352)	4,055		
Females	10.2 (9.46–11.2)	12.9 (11.7–13.9)	44.1 (40.8–47.0)	222 (210–249)	291 (266–323)	4,256		
Race/ethnicity								
Mexican Americans	12.9 (10.8–14.7)	17.5 (14.5–19.5)	46.4 (44.9–48.3)	157 (147–174)	212 (190–262)	2,212		
Non-Hispanic Blacks	9.41 (8.45–10.5)	12.7 (11.3–13.2)	39.0 (35.9–41.7)	155 (129–212)	238 (183–302)	2,157		
Non-Hispanic Whites	11.3 (9.84–12.8)	14.1 (12.9–15.3)	51.7 (49.5–54.6)	234 (212–269)	319 (289–344)	3,285		

Figure 1.3.a. Serum pyridoxal–5'–phosphate: Concentrations by age group
 Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2005–2006

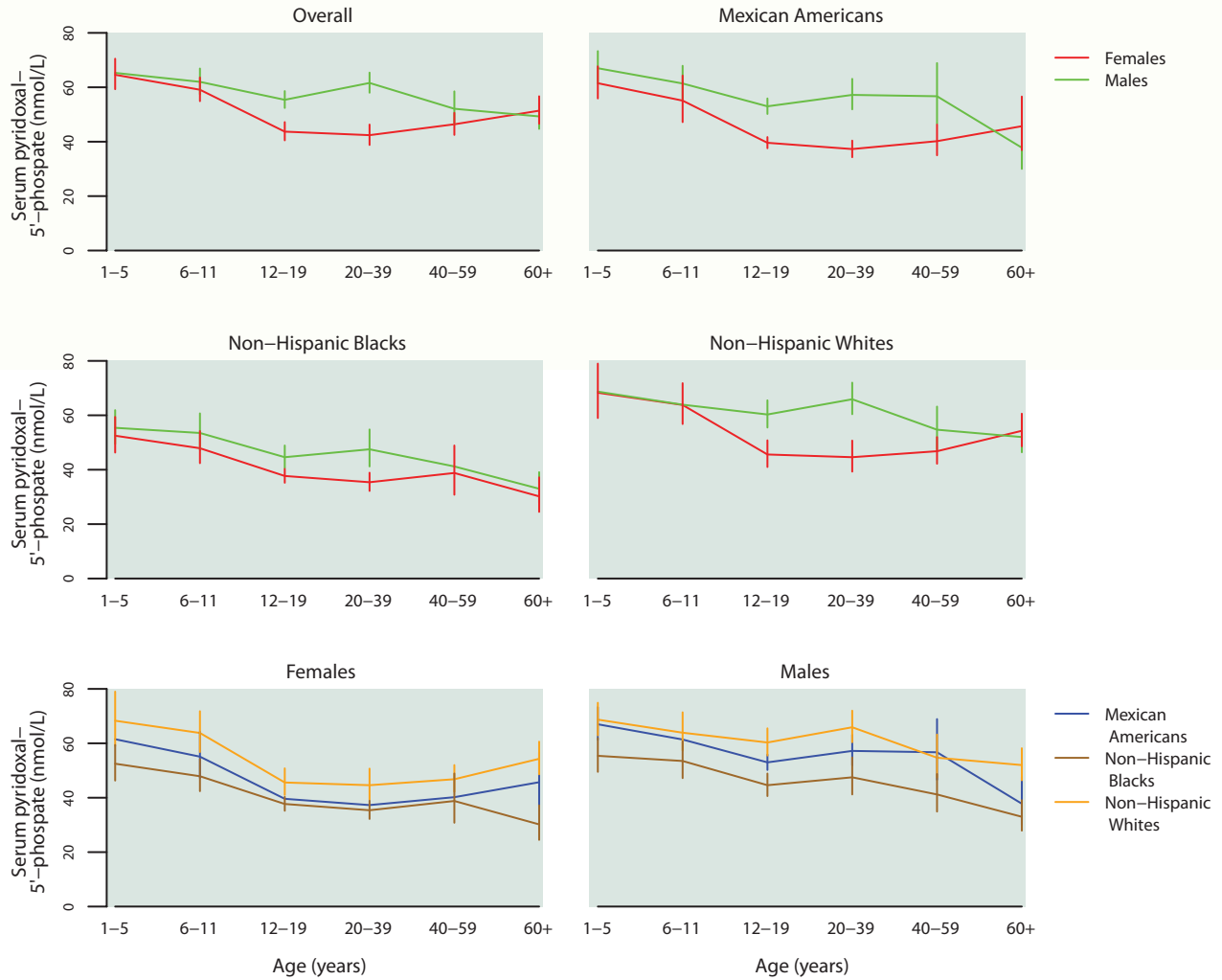


Table 1.3.a.2. Serum pyridoxal-5'-phosphate: Total population

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	51.4 (49.1 – 53.8)	19.5 (18.2 – 20.6)	49.3 (46.9 – 51.2)	154 (139 – 162)	8,311
1–5 years	65.0 (61.2 – 69.0)	31.7 (29.2 – 35.0)	66.1 (63.1 – 70.4)	126 (116 – 140)	915
6–11 years	60.5 (56.9 – 64.4)	30.7 (28.0 – 33.5)	60.0 (55.3 – 65.5)	126 (110 – 138)	922
12–19 years	49.4 (46.7 – 52.3)	24.8 (23.3 – 26.3)	47.8 (44.9 – 51.0)	105 (92.9 – 114)	1,985
20–39 years	51.0 (47.7 – 54.6)	20.0 (18.0 – 21.6)	47.3 (43.9 – 50.5)	153 (130 – 183)	1,699
40–59 years	49.0 (45.1 – 53.3)	16.5 (14.3 – 19.0)	45.6 (41.5 – 50.3)	166 (147 – 192)	1,381
60 years and older	50.4 (46.7 – 54.5)	15.1 (13.0 – 17.5)	46.9 (41.9 – 53.5)	187 (173 – 209)	1,409
Males					
Total, 1 year and older	56.0 (53.6 – 58.5)	22.6 (20.3 – 24.6)	53.9 (52.0 – 56.0)	149 (136 – 162)	4,055
1–5 years	65.3 (61.2 – 69.6)	31.6 (26.3 – 35.2)	66.8 (63.2 – 71.9)	127 (117 – 135)	455
6–11 years	62.0 (57.4 – 66.9)	31.6 (30.5 – 33.4)	60.8 (54.8 – 68.4)	130 (113 – 143)	454
12–19 years	55.4 (52.4 – 58.6)	28.9 (27.0 – 30.6)	54.8 (51.3 – 57.9)	110 (101 – 122)	991
20–39 years	61.6 (58.0 – 65.4)	26.8 (24.8 – 28.8)	55.3 (52.7 – 58.3)	165 (139 – 202)	741
40–59 years	52.1 (46.4 – 58.5)	19.1 (14.8 – 22.6)	51.0 (43.7 – 56.9)	158 (125 – 188)	680
60 years and older	49.3 (44.7 – 54.3)	16.1 (13.5 – 19.3)	45.9 (40.0 – 54.4)	171 (156 – 196)	734
Females					
Total, 1 year and older	47.4 (44.7 – 50.3)	17.2 (15.2 – 18.8)	44.1 (40.8 – 47.0)	156 (141 – 165)	4,256
1–5 years	64.6 (59.3 – 70.5)	32.1 (28.5 – 36.1)	65.2 (60.9 – 71.1)	124 (106 – 156)	460
6–11 years	59.1 (54.9 – 63.6)	29.7 (25.3 – 33.6)	58.3 (52.0 – 64.0)	118 (104 – 156)	468
12–19 years	43.7 (40.5 – 47.2)	21.8 (21.0 – 22.8)	41.4 (39.0 – 45.1)	90.6 (78.4 – 111)	994
20–39 years	42.4 (38.8 – 46.3)	16.5 (14.6 – 18.4)	37.6 (35.1 – 41.8)	132 (111 – 166)	958
40–59 years	46.4 (42.5 – 50.6)	14.4 (13.0 – 17.6)	41.6 (36.3 – 46.6)	172 (161 – 207)	701
60 years and older	51.4 (46.6 – 56.7)	14.1 (12.7 – 16.2)	47.6 (39.8 – 57.1)	206 (176 – 246)	675

Table 1.3.a.3. Serum pyridoxal-5'-phosphate: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for Mexican Americans in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	49.3 (47.2 – 51.4)	22.3 (19.8 – 23.9)	46.4 (44.9 – 48.3)	121 (105 – 136)	2,212
1–5 years	64.2 (60.1 – 68.7)	32.4 (28.0 – 34.2)	65.0 (59.0 – 71.1)	126 (115 – 142)	322
6–11 years	58.3 (52.5 – 64.6)	30.3 (24.0 – 34.9)	56.4 (50.8 – 65.8)	116 (98.9 – 137)	321
12–19 years	46.0 (44.4 – 47.6)	24.7 (23.0 – 26.6)	44.4 (42.5 – 47.6)	91.1 (83.7 – 100)	657
20–39 years	47.1 (44.1 – 50.4)	20.4 (15.7 – 24.8)	42.9 (40.1 – 45.6)	127 (97.0 – 143)	453
40–59 years	47.9 (42.4 – 54.1)	20.2 (14.5 – 23.3)	42.2 (38.5 – 49.4)	141 (115 – 170)	249
60 years and older	42.0 (34.9 – 50.5)	15.0 (13.1 – 17.2)	38.6 (30.2 – 50.1)	142 (101 – 184)	210
Males					
Total, 1 year and older	56.4 (53.7 – 59.1)	27.9 (23.5 – 30.6)	53.7 (51.2 – 55.8)	124 (108 – 140)	1,056
1–5 years	67.0 (61.3 – 73.3)	30.4 (22.2 – 38.5)	67.7 (60.0 – 76.3)	129 (108 – 180)	153
6–11 years	61.4 (55.5 – 67.9)	32.0 (27.9 – 35.2)	57.5 (52.4 – 65.7)	126 (97.0 – 151)	157
12–19 years	53.0 (50.2 – 55.9)	28.2 (26.7 – 32.3)	51.6 (47.7 – 55.8)	104 (87.7 – 113)	318
20–39 years	57.2 (51.9 – 63.1)	29.4 (22.0 – 32.5)	51.9 (46.1 – 60.9)	135 (108 – 152)	200
40–59 years	56.7 (46.6 – 68.9)	24.0 (16.0 – 34.1)	53.3 (45.1 – 59.2)	122 (91.1 – 478)	123
60 years and older	37.8 (30.0 – 47.6)	14.7† (10.7 – 18.6)	35.6 (26.8 – 50.9)	95.5† (71.3 – 209)	105
Females					
Total, 1 year and older	42.6 (40.8 – 44.6)	19.1 (16.4 – 20.8)	39.4 (38.2 – 40.3)	111 (96.5 – 130)	1,156
1–5 years	61.5 (55.9 – 67.7)	33.2 (28.9 – 34.9)	61.2 (55.2 – 68.8)	120 (97.3 – 176)	169
6–11 years	55.1 (47.2 – 64.3)	27.6 (17.6 – 34.7)	54.3 (44.6 – 68.7)	105 (87.9 – 133)	164
12–19 years	39.6 (37.6 – 41.7)	20.7 (19.0 – 22.6)	38.8 (37.2 – 39.7)	76.8 (69.9 – 87.9)	339
20–39 years	37.3 (34.3 – 40.4)	17.7 (11.8 – 19.6)	34.1 (31.7 – 36.1)	89.7 (71.6 – 134)	253
40–59 years	40.2 (35.0 – 46.3)	14.9 (10.3 – 18.9)	33.2 (29.7 – 39.1)	155 (110 – 199)	126
60 years and older	45.7 (36.9 – 56.6)	16.6† (12.6 – 19.8)	39.3 (30.7 – 53.3)	160† (106 – 212)	105

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

Table 1.3.a.4. Serum pyridoxal-5'-phosphate: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for non-Hispanic blacks in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	40.5 (37.4 – 44.0)	16.3 (15.4 – 17.2)	39.0 (35.9 – 41.7)	104 (90.5 – 132)	2,157
1–5 years	54.0 (49.4 – 58.9)	25.2 (22.3 – 29.5)	51.2 (46.4 – 58.8)	115 (99.1 – 138)	226
6–11 years	50.6 (45.4 – 56.4)	27.2 (25.0 – 29.8)	46.4 (41.9 – 55.9)	97.1 (90.0 – 123)	254
12–19 years	41.0 (38.1 – 44.1)	21.6 (19.8 – 22.7)	39.5 (37.1 – 43.2)	82.8 (73.6 – 90.9)	676
20–39 years	40.5 (36.8 – 44.5)	16.3 (13.2 – 18.1)	38.5 (35.3 – 43.5)	105 (94.0 – 142)	371
40–59 years	39.9 (33.5 – 47.5)	14.9 (13.2 – 17.4)	36.3 (31.1 – 41.7)	132 (82.8 – 204)	339
60 years and older	31.3 (26.8 – 36.6)	10.7 (8.73 – 12.6)	29.1 (24.5 – 35.7)	104 (79.0 – 152)	291
Males					
Total, 1 year and older	44.3 (40.5 – 48.6)	19.0 (17.3 – 20.1)	43.7 (39.3 – 47.3)	104 (92.0 – 137)	1,071
1–5 years	55.4 (49.5 – 61.9)	24.6† (19.3 – 32.2)	53.6 (46.6 – 60.4)	120† (103 – 147)	109
6–11 years	53.5 (47.2 – 60.7)	29.6 (26.0 – 31.8)	52.5 (41.9 – 61.7)	100 (92.0 – 124)	133
12–19 years	44.6 (40.6 – 48.9)	22.9 (21.1 – 25.1)	44.5 (38.8 – 49.5)	89.2 (74.9 – 103)	348
20–39 years	47.5 (41.2 – 54.8)	19.7 (14.5 – 23.5)	45.2 (37.7 – 53.5)	130 (95.2 – 185)	170
40–59 years	41.2 (34.9 – 48.7)	16.0 (9.17 – 20.7)	40.7 (31.6 – 46.6)	102 (79.6 – 203)	157
60 years and older	33.0 (27.9 – 39.1)	12.4 (10.2 – 13.4)	27.9 (24.1 – 38.1)	103 (79.1 – 194)	154
Females					
Total, 1 year and older	37.5 (34.2 – 41.1)	14.8 (13.4 – 16.1)	35.6 (32.3 – 39.2)	103 (85.9 – 128)	1,086
1–5 years	52.5 (46.3 – 59.4)	26.0 (11.1 – 30.5)	51.1 (42.8 – 59.8)	109 (88.7 – 149)	117
6–11 years	47.9 (42.4 – 54.2)	25.0 (22.9 – 29.8)	42.9 (38.0 – 52.0)	93.0 (84.6 – 128)	121
12–19 years	37.7 (35.2 – 40.3)	20.7 (18.7 – 21.6)	36.8 (33.7 – 39.1)	73.6 (68.9 – 85.6)	328
20–39 years	35.4 (32.2 – 38.9)	14.4 (9.31 – 16.8)	33.8 (28.4 – 37.9)	99.7 (80.0 – 141)	201
40–59 years	38.8 (30.8 – 48.9)	14.4 (13.0 – 16.1)	33.8 (26.5 – 41.0)	145 (81.3 – 261)	182
60 years and older	30.2 (24.5 – 37.2)	9.48 (8.20 – 11.2)	29.9 (22.4 – 37.0)	95.0 (74.2 – 157)	137

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

Table 1.3.a.5. Serum pyridoxal-5'-phosphate: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for non-Hispanic whites in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	53.8 (50.8 – 57.0)	19.2 (17.7 – 20.7)	51.7 (49.5 – 54.6)	167 (156 – 181)	3,285
1–5 years	68.5 (63.0 – 74.4)	34.0 (30.5 – 37.3)	68.4 (63.3 – 77.5)	130 (114 – 157)	263
6–11 years	63.9 (58.7 – 69.5)	31.6 (29.2 – 34.2)	63.3 (54.9 – 72.7)	133 (117 – 170)	251
12–19 years	52.7 (48.7 – 57.1)	25.7 (23.8 – 27.2)	51.5 (47.4 – 56.8)	109 (96.0 – 127)	505
20–39 years	54.3 (48.9 – 60.3)	20.9 (17.7 – 22.7)	50.6 (44.9 – 55.8)	168 (133 – 211)	718
40–59 years	50.6 (45.6 – 56.1)	16.2 (13.7 – 19.0)	47.9 (42.7 – 52.8)	173 (153 – 199)	691
60 years and older	53.2 (49.0 – 57.9)	15.7 (13.3 – 18.2)	50.6 (44.0 – 57.5)	196 (177 – 215)	857
Males					
Total, 1 year and older	58.8 (55.1 – 62.7)	22.8 (20.2 – 25.5)	57.4 (53.8 – 60.6)	166 (147 – 183)	1,636
1–5 years	68.7 (62.9 – 74.9)	34.9 (30.2 – 37.2)	70.8 (65.3 – 78.3)	126 (115 – 137)	146
6–11 years	63.9 (57.3 – 71.4)	31.6 (29.3 – 33.7)	64.7 (50.1 – 75.8)	135 (106 – 190)	121
12–19 years	60.3 (55.5 – 65.5)	29.5 (27.3 – 33.8)	59.7 (54.7 – 65.2)	117 (105 – 148)	255
20–39 years	65.9 (60.4 – 72.0)	27.9 (25.3 – 30.8)	58.4 (53.9 – 66.8)	183 (152 – 228)	310
40–59 years	54.7 (47.4 – 63.2)	19.1 (14.6 – 22.8)	53.1 (43.6 – 61.7)	173 (140 – 194)	356
60 years and older	52.0 (46.4 – 58.2)	16.7 (13.7 – 20.5)	50.4 (42.2 – 59.3)	174 (157 – 204)	448
Females					
Total, 1 year and older	49.4 (45.8 – 53.2)	16.4 (14.4 – 18.7)	46.4 (42.5 – 50.4)	170 (161 – 182)	1,649
1–5 years	68.3 (59.0 – 79.0)	32.6 (26.5 – 40.3)	66.6 (59.0 – 79.5)	141 (105 – 183)	117
6–11 years	63.8 (56.8 – 71.8)	31.3 (23.7 – 35.9)	62.7 (51.7 – 74.6)	126 (108 – 175)	130
12–19 years	45.6 (41.0 – 50.8)	21.8 (19.7 – 23.9)	42.1 (39.0 – 47.8)	94.0 (80.0 – 126)	250
20–39 years	44.6 (39.3 – 50.7)	16.5 (14.4 – 18.8)	38.4 (34.5 – 45.7)	156 (112 – 216)	408
40–59 years	46.8 (42.2 – 52.0)	13.9 (12.6 – 16.4)	44.4 (35.8 – 48.3)	174 (155 – 221)	335
60 years and older	54.3 (48.6 – 60.6)	14.6 (12.5 – 17.0)	50.6 (41.6 – 62.5)	213 (184 – 254)	409

Table 1.3.c. Serum pyridoxal-5'-phosphate: Prevalence

Prevalence (in percent) of low serum pyridoxal-5'-phosphate concentration (< 20 nmol/L) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 1 year and older	8,311	10.5 (9.1 – 12.0)	30,146,000
Age group			
1–5 years	915	2.1‡ (1.1 – 4.2)	435,000‡
6–11 years	922	1.2‡ (0.5 – 2.7)	280,000‡
12–19 years	1,985	4.6 (3.6 – 5.7)	1,529,000
20–39 years	1,699	9.9 (7.7 – 12.6)	7,877,000
40–59 years	1,381	13.9 (11.2 – 17.1)	11,371,000
60 years and older	1,409	16.0 (13.1 – 19.5)	7,741,000
Gender			
Males	4,055	7.3 (5.7 – 9.4)	10,305,000
Females	4,256	13.5 (11.7 – 15.5)	19,830,000
Race/ethnicity			
Mexican Americans	2,212	7.5 (5.3 – 10.4)	2,031,000
Non-Hispanic Blacks	2,157	15.7 (13.6 – 18.0)	5,459,000
Non-Hispanic Whites	3,285	10.7 (9.1 – 12.5)	20,588,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.



Table 1.4.a.1. Serum 4-pyridoxic acid: Concentrations

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)					Sample size
		2.5th	5th	50th	95th	97.5th	
Total, 1 year and older	31.9 (30.3 – 33.7)	8.73 (8.19 – 9.06)	9.87 (9.53 – 10.2)	25.5 (24.6 – 26.5)	194 (174 – 223)	385 (329 – 505)	8,312
Age group							
1–5 years	25.9 (23.8 – 28.2)	8.90 (8.00 – 9.22)	10.5 (9.07 – 11.3)	24.2 (22.2 – 25.8)	96.9 (75.6 – 125)	130 (104 – 214)	917
6–11 years	23.5 (21.8 – 25.5)	8.11 (7.12 – 8.98)	9.46 (8.57 – 10.2)	21.6 (19.8 – 23.9)	85.6 (64.3 – 115)	111 (92.4 – 133)	922
12–19 years	20.9 (19.9 – 22.0)	7.74 (7.17 – 8.22)	8.85 (8.28 – 9.47)	19.0 (18.2 – 20.1)	70.5 (59.8 – 84.4)	94.5 (79.4 – 131)	1,985
20–39 years	26.8 (24.3 – 29.5)	8.02 (7.49 – 8.47)	9.16 (8.78 – 9.53)	22.2 (20.4 – 23.9)	160 (125 – 198)	271 (184 – 447)	1,698
40–59 years	34.7 (31.9 – 37.7)	9.36 (8.56 – 10.0)	10.7 (9.90 – 11.4)	27.3 (25.8 – 29.1)	212 (162 – 344)	705 (278 – 2,150)	1,381
60 years and older	58.6 (54.7 – 62.9)	11.6 (10.2 – 12.4)	13.1 (12.3 – 14.1)	47.6 (45.0 – 52.3)	464 (355 – 611)	873 (557 – 1,700)	1,409
Gender							
Males	32.1 (30.0 – 34.2)	9.24 (8.43 – 9.77)	10.6 (9.91 – 11.2)	26.0 (24.9 – 27.4)	171 (146 – 212)	334 (271 – 427)	4,055
Females	31.8 (30.2 – 33.5)	8.21 (7.89 – 8.65)	9.50 (9.15 – 9.76)	24.7 (23.4 – 26.1)	214 (188 – 255)	465 (349 – 712)	4,257
Race/ethnicity							
Mexican Americans	22.5 (21.0 – 24.1)	7.90 (7.09 – 8.46)	9.13 (8.66 – 9.55)	19.0 (18.1 – 20.1)	90.9 (74.7 – 136)	169 (127 – 355)	2,213
Non-Hispanic Blacks	21.6 (19.4 – 24.0)	7.21 (6.78 – 7.57)	8.04 (7.72 – 8.44)	17.8 (16.3 – 19.3)	119 (89.8 – 196)	232 (159 – 493)	2,157
Non-Hispanic Whites	37.1 (35.1 – 39.1)	9.65 (9.04 – 10.1)	11.1 (10.6 – 11.5)	29.3 (27.8 – 30.6)	224 (203 – 265)	498 (370 – 717)	3,285

Figure 1.4.a. Serum 4-pyridoxic acid: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2005–2006

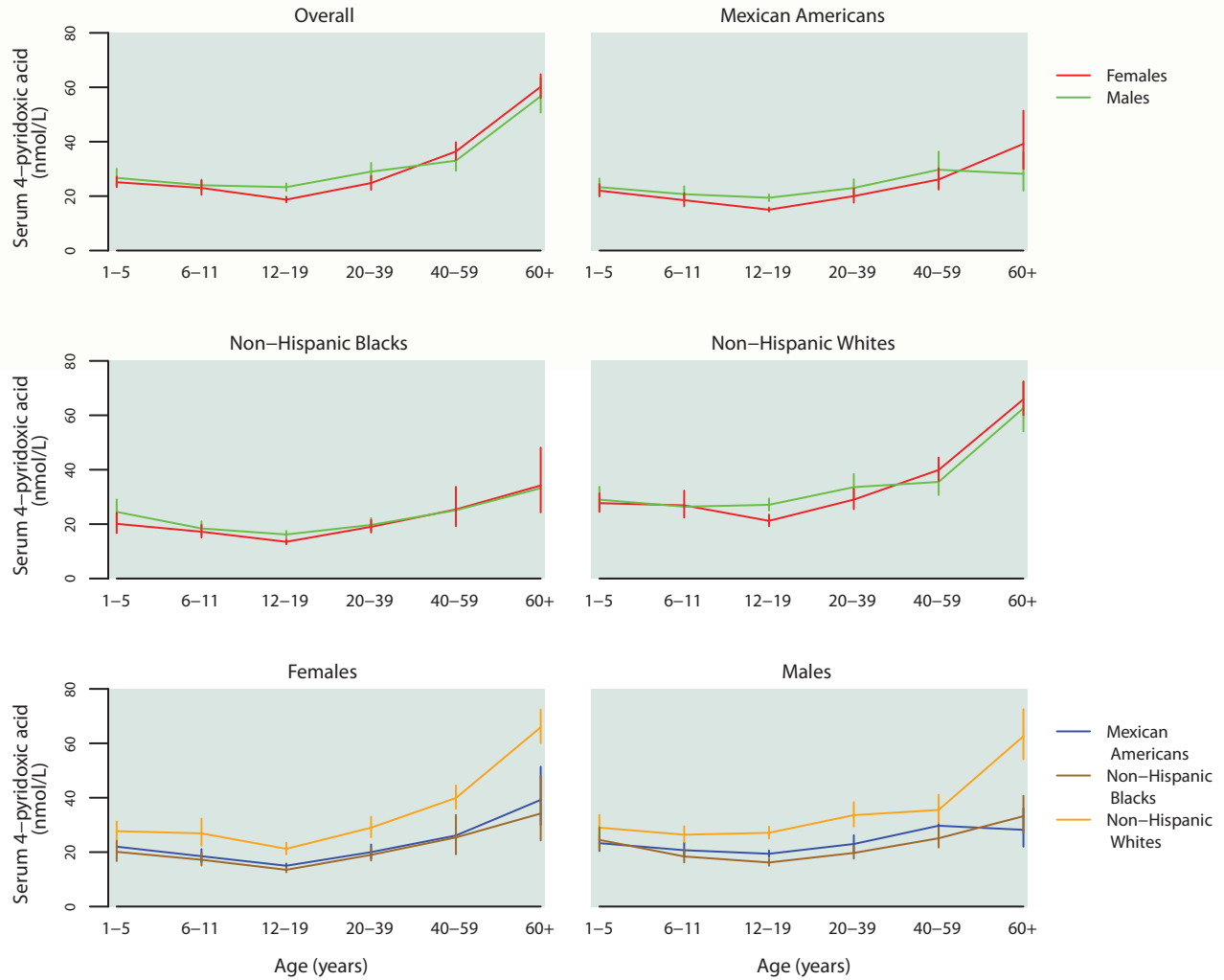


Table 1.4.a.2. Serum 4-pyridoxic acid: Total population

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	31.9 (30.3 – 33.7)	11.7 (11.4 – 12.2)	25.5 (24.6 – 26.5)	116 (105 – 128)	8,312
1–5 years	25.9 (23.8 – 28.2)	12.5 (11.4 – 13.3)	24.2 (22.2 – 25.8)	59.8 (49.8 – 79.6)	917
6–11 years	23.5 (21.8 – 25.5)	11.2 (10.2 – 12.0)	21.6 (19.8 – 23.9)	56.7 (48.4 – 71.5)	922
12–19 years	20.9 (19.9 – 22.0)	10.2 (9.88 – 10.6)	19.0 (18.2 – 20.1)	48.1 (44.1 – 54.5)	1,985
20–39 years	26.8 (24.3 – 29.5)	10.7 (10.0 – 11.1)	22.2 (20.4 – 23.9)	90.9 (73.2 – 115)	1,698
40–59 years	34.7 (31.9 – 37.7)	12.6 (11.8 – 13.6)	27.3 (25.8 – 29.1)	117 (105 – 138)	1,381
60 years and older	58.6 (54.7 – 62.9)	16.4 (14.9 – 18.3)	47.6 (45.0 – 52.3)	248 (208 – 321)	1,409
Males					
Total, 1 year and older	32.1 (30.0 – 34.2)	12.9 (12.1 – 13.6)	26.0 (24.9 – 27.4)	103 (92.2 – 118)	4,055
1–5 years	26.7 (23.7 – 30.0)	11.9 (10.5 – 14.1)	25.2 (22.8 – 27.0)	63.6 (48.5 – 111)	456
6–11 years	24.0 (22.1 – 26.1)	11.6 (9.92 – 12.4)	21.9 (20.2 – 24.1)	56.4 (46.0 – 83.0)	454
12–19 years	23.3 (21.9 – 24.7)	11.9 (10.9 – 12.6)	20.8 (19.7 – 21.9)	55.0 (46.8 – 67.0)	991
20–39 years	29.0 (26.1 – 32.2)	12.0 (10.9 – 13.2)	24.3 (22.5 – 26.0)	89.5 (65.9 – 124)	740
40–59 years	33.0 (29.3 – 37.2)	13.8 (11.8 – 15.2)	26.5 (24.4 – 30.2)	101 (76.3 – 124)	680
60 years and older	56.7 (50.7 – 63.5)	17.2 (15.1 – 18.9)	46.8 (41.8 – 53.3)	220 (178 – 292)	734
Females					
Total, 1 year and older	31.8 (30.2 – 33.5)	11.1 (10.9 – 11.3)	24.7 (23.4 – 26.1)	133 (116 – 151)	4,257
1–5 years	25.1 (23.3 – 27.1)	12.6 (11.9 – 13.0)	22.7 (20.8 – 25.4)	59.2 (48.3 – 76.4)	461
6–11 years	23.0 (20.5 – 25.8)	10.7 (9.57 – 11.5)	20.8 (18.6 – 24.2)	54.9 (44.7 – 90.5)	468
12–19 years	18.7 (17.7 – 19.8)	9.59 (9.31 – 9.88)	17.1 (16.3 – 18.0)	42.9 (35.5 – 52.2)	994
20–39 years	24.8 (22.3 – 27.5)	9.74 (9.31 – 10.4)	19.2 (17.3 – 22.1)	92.5 (77.5 – 118)	958
40–59 years	36.4 (33.3 – 39.8)	12.1 (11.3 – 12.7)	28.1 (25.2 – 31.1)	145 (116 – 192)	701
60 years and older	60.2 (56.1 – 64.8)	15.6 (14.0 – 17.9)	48.7 (43.5 – 56.9)	257 (219 – 328)	675

Table 1.4.a.3. Serum 4-pyridoxic acid: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for Mexican Americans in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	22.5 (21.0 – 24.1)	10.7 (10.0 – 11.2)	19.0 (18.1 – 20.1)	57.9 (48.0 – 66.1)	2,213
1–5 years	22.7 (20.7 – 24.8)	11.9 (10.7 – 12.8)	20.3 (19.1 – 22.2)	52.3 (41.3 – 62.3)	324
6–11 years	19.6 (17.7 – 21.7)	9.67 (8.75 – 10.7)	18.5 (16.0 – 20.3)	44.2 (36.3 – 58.1)	321
12–19 years	17.1 (16.4 – 17.8)	9.29 (8.70 – 9.81)	15.8 (14.8 – 16.8)	34.6 (31.5 – 42.8)	657
20–39 years	21.6 (19.3 – 24.1)	10.7 (9.33 – 11.4)	18.3 (16.8 – 19.9)	53.3 (43.8 – 76.4)	452
40–59 years	27.9 (24.6 – 31.6)	11.7 (10.1 – 12.7)	22.4 (20.5 – 24.6)	71.1 (60.0 – 114)	249
60 years and older	33.8 (27.9 – 41.0)	12.5 (11.0 – 14.7)	27.3 (23.6 – 31.2)	117 (75.3 – 311)	210
Males					
Total, 1 year and older	23.6 (21.9 – 25.6)	11.5 (10.8 – 12.0)	20.7 (19.4 – 21.7)	58.1 (45.6 – 68.9)	1,057
1–5 years	23.3 (20.4 – 26.5)	11.8 (10.7 – 13.7)	20.9 (18.9 – 22.9)	48.8 (38.0 – 78.1)	155
6–11 years	20.7 (18.2 – 23.6)	10.3 (8.64 – 11.4)	18.9 (16.5 – 20.9)	47.4 (39.5 – 59.3)	157
12–19 years	19.4 (18.2 – 20.6)	10.3 (9.71 – 10.8)	17.3 (16.8 – 18.4)	41.6 (34.1 – 59.2)	318
20–39 years	23.0 (20.1 – 26.2)	11.2 (9.36 – 12.7)	19.5 (17.6 – 22.2)	55.0 (42.2 – 85.5)	199
40–59 years	29.7 (24.2 – 36.4)	12.9 (12.5 – 13.9)	24.2 (21.2 – 28.4)	65.1 (45.1 – 230)	123
60 years and older	28.2 (22.0 – 36.1)	11.6† (5.00 – 14.6)	26.0 (19.9 – 33.3)	72.5† (50.8 – 193)	105
Females					
Total, 1 year and older	21.4 (20.1 – 22.7)	9.91 (9.35 – 10.6)	17.3 (16.4 – 18.3)	57.0 (49.5 – 70.1)	1,156
1–5 years	22.0 (19.9 – 24.4)	11.9 (9.70 – 12.5)	20.2 (17.5 – 22.6)	52.3 (38.6 – 64.8)	169
6–11 years	18.5 (16.3 – 21.1)	9.60 (7.35 – 10.7)	17.3 (15.1 – 20.4)	41.2 (31.1 – 53.4)	164
12–19 years	15.0 (14.3 – 15.8)	8.55 (7.66 – 9.16)	14.1 (13.2 – 15.1)	28.2 (25.2 – 33.6)	339
20–39 years	20.0 (17.6 – 22.8)	9.73 (7.90 – 11.1)	16.3 (14.7 – 18.6)	49.5 (41.4 – 81.1)	253
40–59 years	26.1 (22.4 – 30.3)	10.9 (9.79 – 11.6)	19.1 (14.7 – 25.2)	90.5 (54.6 – 289)	126
60 years and older	39.2 (30.0 – 51.4)	13.9† (11.1 – 15.7)	28.0 (23.3 – 35.2)	162† (78.4 – 3,380)	105

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

Table 1.4.a.4. Serum 4-pyridoxic acid: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for non-Hispanic blacks in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	21.6 (19.4 – 24.0)	9.28 (8.85 – 9.59)	17.8 (16.3 – 19.3)	60.5 (51.3 – 81.9)	2,157
1–5 years	22.2 (19.2 – 25.8)	10.1 (8.17 – 11.2)	19.5 (17.6 – 22.5)	61.7 (44.0 – 96.8)	226
6–11 years	17.8 (16.0 – 19.8)	9.03 (8.25 – 9.53)	15.3 (14.3 – 17.4)	43.9 (32.5 – 67.1)	254
12–19 years	14.8 (14.0 – 15.7)	8.28 (7.64 – 8.65)	13.9 (13.1 – 14.6)	28.9 (25.7 – 34.0)	676
20–39 years	19.3 (18.1 – 20.7)	8.89 (8.39 – 9.47)	15.4 (14.2 – 17.6)	51.4 (45.3 – 60.6)	371
40–59 years	25.3 (21.3 – 30.0)	9.62 (8.24 – 10.8)	19.2 (17.6 – 21.2)	103 (57.1 – 164)	339
60 years and older	33.8 (26.3 – 43.4)	12.2 (9.71 – 14.1)	27.4 (23.1 – 30.6)	113 (81.9 – 246)	291
Males					
Total, 1 year and older	21.8 (19.7 – 24.3)	9.68 (9.16 – 10.3)	18.5 (17.3 – 20.0)	55.7 (44.4 – 82.8)	1,070
1–5 years	24.5 (20.6 – 29.1)	10.3† (6.27 – 12.2)	20.9 (17.7 – 24.4)	83.7† (48.8 – 152)	108
6–11 years	18.4 (16.2 – 21.0)	9.50 (8.53 – 10.3)	15.9 (14.5 – 18.5)	44.1 (33.3 – 66.5)	133
12–19 years	16.2 (15.0 – 17.5)	9.11 (8.59 – 9.35)	15.5 (14.1 – 16.5)	30.9 (26.8 – 39.1)	348
20–39 years	19.7 (17.6 – 22.2)	9.68 (8.96 – 10.9)	17.4 (14.3 – 20.4)	44.3 (32.7 – 68.2)	170
40–59 years	25.1 (21.7 – 29.0)	9.58 (7.97 – 10.6)	19.3 (17.7 – 20.8)	71.2 (52.9 – 134)	157
60 years and older	33.2 (27.1 – 40.7)	12.5 (11.8 – 13.4)	24.3 (22.7 – 30.2)	109 (80.8 – 246)	154
Females					
Total, 1 year and older	21.3 (18.7 – 24.3)	8.88 (8.38 – 9.44)	17.1 (15.0 – 19.1)	64.9 (52.5 – 94.0)	1,087
1–5 years	20.1 (16.7 – 24.2)	8.59 (7.62 – 11.1)	19.0 (16.1 – 22.5)	42.6 (34.5 – 65.2)	118
6–11 years	17.2 (15.1 – 19.7)	8.50 (7.72 – 9.43)	14.8 (13.1 – 17.4)	40.6 (31.1 – 86.4)	121
12–19 years	13.5 (12.6 – 14.4)	7.56 (6.46 – 8.33)	12.7 (11.8 – 13.4)	25.6 (22.0 – 32.8)	328
20–39 years	19.0 (16.9 – 21.5)	8.42 (7.62 – 8.98)	14.3 (12.7 – 16.9)	57.7 (45.3 – 85.7)	201
40–59 years	25.4 (19.2 – 33.7)	9.64 (7.95 – 11.0)	18.8 (15.5 – 25.8)	107 (53.1 – 217)	182
60 years and older	34.2 (24.3 – 48.1)	11.6 (8.02 – 15.3)	28.0 (21.9 – 33.8)	116 (75.1 – 431)	137

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

Table 1.4.a.5. Serum 4-pyridoxic acid: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in nmol/L) for non-Hispanic whites in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 1 year and older	37.1 (35.1 – 39.1)	13.2 (12.6 – 13.8)	29.3 (27.8 – 30.6)	138 (120 – 154)	3,285
1–5 years	28.4 (25.2 – 31.8)	13.6 (11.9 – 15.1)	26.7 (24.2 – 29.2)	59.9 (49.8 – 104)	263
6–11 years	26.7 (24.1 – 29.5)	12.6 (11.8 – 13.3)	24.5 (22.4 – 26.0)	63.5 (50.7 – 96.3)	251
12–19 years	24.1 (22.4 – 26.0)	11.5 (10.6 – 12.8)	21.5 (21.0 – 22.2)	55.9 (47.7 – 74.7)	505
20–39 years	31.2 (27.5 – 35.4)	11.5 (10.7 – 12.6)	25.2 (22.6 – 28.1)	113 (89.1 – 155)	718
40–59 years	37.7 (34.1 – 41.6)	13.7 (12.5 – 14.8)	30.2 (27.9 – 32.2)	130 (111 – 148)	691
60 years and older	64.4 (58.5 – 70.9)	18.2 (15.3 – 20.2)	53.7 (48.7 – 57.9)	257 (220 – 328)	857
Males					
Total, 1 year and older	36.8 (34.1 – 39.6)	14.9 (13.7 – 15.7)	29.5 (27.7 – 31.3)	116 (105 – 136)	1,636
1–5 years	29.0 (24.9 – 33.7)	14.0 (9.91 – 16.0)	27.2 (24.5 – 31.1)	59.8 (47.3 – 130)	146
6–11 years	26.4 (23.7 – 29.5)	12.5 (11.7 – 13.9)	24.9 (21.6 – 26.0)	66.7 (45.2 – 92.9)	121
12–19 years	27.1 (25.0 – 29.4)	14.2 (13.4 – 15.5)	23.5 (21.4 – 26.1)	64.0 (54.7 – 80.3)	255
20–39 years	33.6 (29.4 – 38.4)	14.4 (12.0 – 15.6)	26.9 (24.2 – 29.4)	105 (71.2 – 187)	310
40–59 years	35.5 (30.7 – 41.1)	14.9 (12.5 – 17.5)	29.3 (26.0 – 33.1)	102 (81.5 – 141)	356
60 years and older	62.6 (54.1 – 72.5)	18.8 (15.9 – 21.2)	52.3 (44.8 – 60.1)	232 (195 – 344)	448
Females					
Total, 1 year and older	37.3 (35.4 – 39.4)	12.4 (11.6 – 12.7)	29.2 (26.8 – 31.4)	155 (136 – 176)	1,649
1–5 years	27.7 (24.5 – 31.3)	13.1 (11.1 – 15.1)	25.4 (20.8 – 29.9)	59.9 (49.8 – 99.2)	117
6–11 years	26.9 (22.4 – 32.3)	12.5 (10.7 – 13.7)	24.3 (20.7 – 29.2)	62.1 (47.7 – 189)	130
12–19 years	21.2 (19.2 – 23.5)	10.2 (9.58 – 11.0)	19.8 (18.0 – 21.1)	47.3 (40.3 – 69.4)	250
20–39 years	29.0 (25.5 – 33.0)	10.6 (9.87 – 11.0)	23.1 (19.3 – 26.9)	117 (90.2 – 161)	408
40–59 years	39.9 (35.9 – 44.5)	12.8 (12.1 – 13.6)	30.5 (26.6 – 34.8)	155 (128 – 223)	335
60 years and older	65.9 (60.1 – 72.4)	17.6 (14.1 – 20.4)	54.9 (47.4 – 63.8)	270 (242 – 343)	409

Table 1.5.a.1. Serum vitamin B12: Concentrations

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)						Sample size
		2.5th	5th	50th	95th	97.5th		
Total, 1 year and older	500 (489 – 511)	206 (201 – 212)	236 (227 – 244)	495 (483 – 505)	1,090 (1,050 – 1,110)	1,300 (1,250 – 1,340)	16,316	
Age group								
1–5 years	804 (776 – 833)	327 (280 – 368)	397 (344 – 432)	814 (783 – 858)	1,520 (1,470 – 1,630)	1,710 (1,600 – 1,810)	1,678	
6–11 years	728 (713 – 743)	354 (342 – 363)	396 (367 – 431)	724 (707 – 747)	1,280 (1,240 – 1,350)	1,440 (1,360 – 1,570)	1,747	
12–19 years	510 (499 – 521)	238 (224 – 250)	271 (264 – 277)	509 (495 – 526)	938 (901 – 975)	1,050 (1,020 – 1,140)	4,013	
20–39 years	454 (443 – 465)	210 (201 – 214)	231 (223 – 243)	451 (441 – 462)	884 (859 – 904)	1,010 (962 – 1,060)	3,214	
40–59 years	466 (451 – 482)	197 (177 – 210)	226 (214 – 237)	460 (446 – 475)	1,020 (934 – 1,100)	1,180 (1,110 – 1,350)	2,629	
60 years and older	482 (468 – 496)	166 (151 – 179)	210 (202 – 217)	481 (466 – 499)	1,070 (1,020 – 1,190)	1,380 (1,280 – 1,570)	3,035	
Gender								
Males	500 (490 – 509)	216 (210 – 222)	249 (238 – 259)	494 (484 – 505)	1,030 (994 – 1,060)	1,200 (1,150 – 1,240)	7,999	
Females	500 (487 – 514)	200 (189 – 206)	227 (216 – 236)	495 (480 – 508)	1,140 (1,100 – 1,180)	1,370 (1,330 – 1,410)	8,317	
Race/ethnicity								
Mexican Americans	549 (530 – 569)	224 (212 – 241)	260 (248 – 274)	527 (513 – 547)	1,170 (1,110 – 1,240)	1,600 (1,370 – 1,950)	4,205	
Non-Hispanic Blacks	565 (550 – 580)	223 (210 – 233)	266 (258 – 276)	556 (537 – 576)	1,240 (1,200 – 1,320)	1,430 (1,370 – 1,540)	4,285	
Non-Hispanic Whites	482 (470 – 495)	201 (194 – 209)	229 (222 – 239)	478 (465 – 491)	1,040 (999 – 1,080)	1,230 (1,170 – 1,310)	6,571	

Figure 1.5.a. Serum vitamin B12: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2006

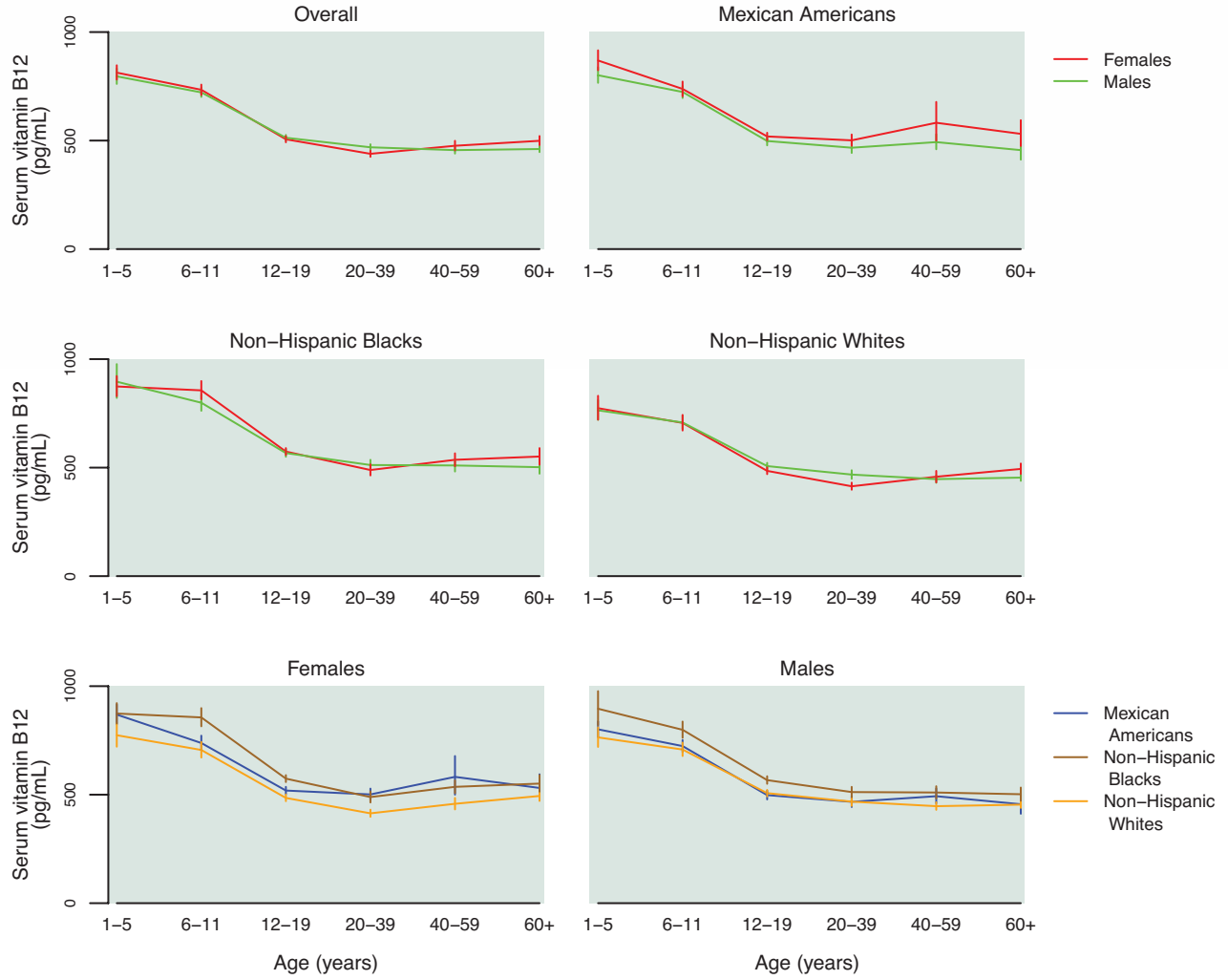


Table 1.5.a.2. Serum vitamin B12: Total population

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for the total U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	500 (489 – 511)	236 (227 – 244)	495 (483 – 505)	1,090 (1,050 – 1,110)	16,316
1–5 years	804 (776 – 833)	397 (344 – 432)	814 (783 – 858)	1,520 (1,470 – 1,630)	1,678
6–11 years	728 (713 – 743)	396 (367 – 431)	724 (707 – 747)	1,280 (1,240 – 1,350)	1,747
12–19 years	510 (499 – 521)	271 (264 – 277)	509 (495 – 526)	938 (901 – 975)	4,013
20–39 years	454 (443 – 465)	231 (223 – 243)	451 (441 – 462)	884 (859 – 904)	3,214
40–59 years	466 (451 – 482)	226 (214 – 237)	460 (446 – 475)	1,020 (934 – 1,100)	2,629
60 years and older	482 (468 – 496)	210 (202 – 217)	481 (466 – 499)	1,070 (1,020 – 1,190)	3,035
Males					
Total, 1 year and older	500 (490 – 509)	249 (238 – 259)	494 (484 – 505)	1,030 (994 – 1,060)	7,999
1–5 years	796 (761 – 832)	379 (302 – 423)	816 (775 – 862)	1,470 (1,430 – 1,520)	844
6–11 years	722 (701 – 744)	411 (363 – 439)	735 (713 – 761)	1,220 (1,140 – 1,270)	853
12–19 years	513 (500 – 526)	292 (272 – 309)	510 (494 – 534)	904 (866 – 951)	2,031
20–39 years	469 (456 – 483)	258 (242 – 270)	469 (454 – 485)	856 (820 – 893)	1,451
40–59 years	456 (440 – 472)	226 (212 – 246)	456 (442 – 469)	896 (825 – 985)	1,296
60 years and older	461 (447 – 475)	210 (193 – 223)	458 (442 – 480)	990 (937 – 1,100)	1,524
Females					
Total, 1 year and older	500 (487 – 514)	227 (216 – 236)	495 (480 – 508)	1,140 (1,100 – 1,180)	8,317
1–5 years	813 (781 – 847)	401 (343 – 444)	810 (772 – 863)	1,560 (1,470 – 1,740)	834
6–11 years	734 (710 – 758)	393 (362 – 421)	714 (687 – 748)	1,360 (1,290 – 1,460)	894
12–19 years	506 (492 – 520)	254 (243 – 266)	507 (487 – 526)	973 (928 – 1,050)	1,982
20–39 years	439 (425 – 453)	217 (206 – 227)	431 (420 – 446)	909 (868 – 980)	1,763
40–59 years	476 (455 – 499)	223 (200 – 241)	467 (444 – 489)	1,090 (1,020 – 1,160)	1,333
60 years and older	499 (479 – 521)	210 (200 – 218)	504 (477 – 530)	1,140 (1,050 – 1,310)	1,511

Table 1.5.a.3. Serum vitamin B12: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for Mexican Americans in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	549 (530 – 569)	260 (248 – 274)	527 (513 – 547)	1,170 (1,110 – 1,240)	4,205
1–5 years	833 (802 – 866)	450 (417 – 468)	842 (811 – 880)	1,480 (1,390 – 1,670)	540
6–11 years	730 (708 – 753)	409 (367 – 441)	729 (704 – 762)	1,210 (1,150 – 1,290)	587
12–19 years	508 (493 – 524)	270 (250 – 295)	505 (486 – 525)	909 (873 – 951)	1,280
20–39 years	483 (463 – 503)	249 (225 – 260)	467 (449 – 493)	955 (883 – 1,150)	778
40–59 years	535 (491 – 582)	248 (207 – 274)	483 (457 – 515)	1,310 (996 – 3,160)	468
60 years and older	496 (465 – 528)	220 (193 – 239)	458 (435 – 489)	1,240 (1,070 – 2,490)	552
Males					
Total, 1 year and older	526 (510 – 543)	258 (251 – 267)	513 (492 – 533)	1,060 (1,010 – 1,110)	2,036
1–5 years	801 (766 – 838)	423 (364 – 467)	805 (776 – 844)	1,450 (1,330 – 1,630)	261
6–11 years	724 (696 – 752)	386 (345 – 462)	735 (705 – 771)	1,150 (1,080 – 1,250)	285
12–19 years	498 (478 – 519)	271 (239 – 305)	494 (476 – 516)	866 (810 – 920)	637
20–39 years	467 (443 – 492)	252 (217 – 264)	459 (431 – 494)	855 (794 – 978)	345
40–59 years	493 (460 – 529)	249 (191 – 263)	463 (446 – 494)	1,050 (915 – 2,230)	236
60 years and older	456 (412 – 505)	224 (195 – 237)	404 (376 – 448)	1,210 (929 – 5,710)	272
Females					
Total, 1 year and older	574 (548 – 602)	263 (241 – 288)	550 (522 – 573)	1,290 (1,180 – 1,630)	2,169
1–5 years	869 (824 – 916)	456 (420 – 500)	887 (834 – 910)	1,590 (1,400 – 1,890)	279
6–11 years	738 (704 – 772)	413 (370 – 441)	716 (690 – 762)	1,280 (1,160 – 1,620)	302
12–19 years	519 (502 – 536)	269 (255 – 291)	518 (495 – 549)	951 (892 – 1,060)	643
20–39 years	501 (476 – 528)	248 (220 – 271)	476 (452 – 509)	1,190 (984 – 2,080)	433
40–59 years	582 (500 – 678)	243 (182 – 306)	520 (464 – 574)	1,950 (1,010 – 6,830)	232
60 years and older	531 (475 – 594)	210 (169 – 258)	494 (459 – 537)	1,370 (1,110 – 2,950)	280

Table 1.5.a.4. Serum vitamin B12: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for non-Hispanic blacks in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	565 (550 – 580)	266 (258 – 276)	556 (537 – 576)	1,240 (1,200 – 1,320)	4,285
1–5 years	885 (835 – 938)	431 (340 – 479)	899 (827 – 965)	1,770 (1,550 – 2,020)	476
6–11 years	827 (800 – 854)	448 (398 – 470)	817 (800 – 842)	1,560 (1,440 – 1,670)	553
12–19 years	570 (557 – 584)	284 (270 – 297)	571 (551 – 585)	1,110 (1,050 – 1,160)	1,415
20–39 years	499 (483 – 516)	259 (227 – 277)	497 (480 – 512)	941 (894 – 1,050)	706
40–59 years	524 (506 – 543)	264 (220 – 286)	515 (494 – 544)	1,120 (1,070 – 1,200)	622
60 years and older	530 (504 – 558)	225 (199 – 252)	531 (505 – 565)	1,240 (1,100 – 1,510)	513
Males					
Total, 1 year and older	564 (549 – 580)	267 (257 – 282)	546 (533 – 571)	1,230 (1,140 – 1,320)	2,136
1–5 years	896 (821 – 977)	418 (293 – 494)	910 (822 – 1,010)	1,800 (1,570 – 2,150)	236
6–11 years	799 (762 – 837)	428 (350 – 466)	811 (743 – 840)	1,540 (1,370 – 1,780)	272
12–19 years	567 (550 – 585)	294 (268 – 322)	567 (541 – 585)	1,040 (993 – 1,140)	742
20–39 years	512 (488 – 536)	277 (256 – 290)	507 (482 – 527)	950 (872 – 1,160)	337
40–59 years	510 (482 – 539)	241 (204 – 269)	509 (488 – 541)	988 (863 – 1,250)	292
60 years and older	502 (472 – 533)	211 (142 – 241)	494 (459 – 521)	1,220 (998 – 1,770)	257
Females					
Total, 1 year and older	565 (545 – 587)	265 (233 – 282)	563 (531 – 597)	1,250 (1,200 – 1,340)	2,149
1–5 years	874 (829 – 922)	431 (257 – 489)	880 (798 – 957)	1,650 (1,470 – 2,050)	240
6–11 years	856 (815 – 899)	468 (383 – 501)	834 (801 – 887)	1,570 (1,430 – 1,710)	281
12–19 years	574 (558 – 590)	272 (259 – 288)	576 (551 – 595)	1,160 (1,110 – 1,210)	673
20–39 years	489 (464 – 515)	231 (207 – 271)	487 (460 – 518)	938 (880 – 1,080)	369
40–59 years	536 (507 – 566)	273 (219 – 295)	527 (492 – 568)	1,170 (1,100 – 1,400)	330
60 years and older	551 (514 – 590)	232 (187 – 265)	576 (524 – 613)	1,280 (1,110 – 1,620)	256

Table 1.5.a.5. Serum vitamin B12: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for non-Hispanic whites in the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 1 year and older	482 (470 – 495)	229 (222 – 239)	478 (465 – 491)	1,040 (999 – 1,080)	6,571
1–5 years	769 (730 – 810)	375 (298 – 411)	777 (730 – 830)	1,470 (1,410 – 1,560)	476
6–11 years	707 (686 – 729)	392 (345 – 435)	703 (674 – 734)	1,230 (1,170 – 1,350)	448
12–19 years	496 (484 – 509)	269 (253 – 276)	498 (481 – 517)	887 (833 – 952)	1,042
20–39 years	440 (426 – 455)	226 (215 – 238)	438 (424 – 452)	853 (814 – 889)	1,434
40–59 years	453 (435 – 471)	225 (208 – 236)	448 (434 – 465)	980 (867 – 1,090)	1,340
60 years and older	476 (461 – 492)	209 (200 – 217)	477 (460 – 499)	1,050 (990 – 1,170)	1,831
Males					
Total, 1 year and older	487 (475 – 498)	244 (228 – 256)	483 (471 – 496)	981 (946 – 1,030)	3,235
1–5 years	764 (720 – 811)	353 (261 – 416)	799 (739 – 861)	1,380 (1,320 – 1,500)	254
6–11 years	708 (678 – 740)	405† (343 – 441)	715 (680 – 753)	1,160† (1,080 – 1,250)	216
12–19 years	507 (492 – 522)	293 (271 – 316)	505 (486 – 535)	847 (803 – 941)	523
20–39 years	468 (448 – 488)	263 (230 – 275)	469 (448 – 493)	826 (786 – 900)	631
40–59 years	447 (430 – 465)	226 (199 – 248)	448 (435 – 464)	879 (781 – 984)	682
60 years and older	454 (439 – 469)	208 (181 – 221)	455 (434 – 481)	952 (887 – 1,050)	929
Females					
Total, 1 year and older	478 (462 – 494)	220 (210 – 230)	471 (454 – 488)	1,080 (1,040 – 1,140)	3,336
1–5 years	774 (721 – 831)	381† (325 – 431)	763 (700 – 835)	1,530† (1,450 – 1,760)	222
6–11 years	706 (671 – 743)	377 (316 – 421)	679 (648 – 742)	1,340 (1,180 – 1,490)	232
12–19 years	485 (470 – 501)	246 (226 – 259)	486 (468 – 508)	913 (842 – 1,030)	519
20–39 years	414 (398 – 431)	211 (197 – 223)	405 (387 – 427)	874 (797 – 936)	803
40–59 years	458 (432 – 485)	220 (199 – 236)	447 (419 – 483)	1,040 (900 – 1,180)	658
60 years and older	494 (471 – 519)	210 (199 – 217)	500 (470 – 523)	1,090 (1,030 – 1,320)	902

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

Table 1.5.b. Serum vitamin B12: Concentrations by survey cycle

Geometric mean and selected percentiles of serum concentrations (in pg/mL) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 3 years and older					
1999–2000	487 (481 – 494)	240 (234 – 245)	483 (474 – 494)	993 (970 – 1,040)	7,524
2001–2002	488 (479 – 497)	236 (232 – 241)	485 (474 – 494)	1,000 (971 – 1,040)	8,390
2003–2004	489 (472 – 507)	238 (225 – 252)	486 (467 – 500)	1,020 (979 – 1,080)	7,837
2005–2006	502 (489 – 516)	231 (221 – 242)	497 (482 – 511)	1,100 (1,060 – 1,130)	7,694
Age group					
3–5 years					
1999–2000	757 (682 – 839)	441 (321 – 459)	735 (663 – 827)	1,380 (1,300 – 1,730)	361
2001–2002	804 (773 – 837)	471 (426 – 518)	815 (783 – 836)	1,380 (1,250 – 1,560)	439
2003–2004	768 (716 – 824)	393 (285 – 422)	775 (716 – 852)	1,550 (1,310 – 1,800)	449
2005–2006	877 (841 – 913)	482 (437 – 507)	894 (826 – 950)	1,470 (1,430 – 1,660)	444
6–11 years					
1999–2000	695 (659 – 733)	362 (330 – 401)	704 (676 – 738)	1,250 (1,170 – 1,340)	885
2001–2002	691 (669 – 714)	386 (340 – 412)	696 (672 – 724)	1,270 (1,190 – 1,330)	1,022
2003–2004	711 (689 – 733)	375 (344 – 419)	714 (679 – 736)	1,240 (1,190 – 1,360)	843
2005–2006	745 (721 – 769)	418 (381 – 442)	741 (710 – 768)	1,290 (1,230 – 1,370)	904
12–19 years					
1999–2000	501 (491 – 511)	263 (235 – 280)	506 (494 – 518)	954 (905 – 1,010)	2,123
2001–2002	511 (495 – 528)	269 (256 – 289)	516 (496 – 536)	934 (899 – 983)	2,208
2003–2004	500 (483 – 518)	267 (255 – 282)	504 (481 – 528)	911 (871 – 949)	2,059
2005–2006	519 (505 – 534)	273 (269 – 281)	519 (496 – 544)	966 (907 – 1,040)	1,954
20–39 years					
1999–2000	445 (438 – 451)	234 (219 – 240)	448 (432 – 459)	807 (791 – 824)	1,470
2001–2002	445 (432 – 458)	230 (217 – 239)	445 (432 – 457)	822 (776 – 893)	1,715
2003–2004	451 (434 – 468)	240 (225 – 253)	449 (431 – 465)	826 (787 – 888)	1,555
2005–2006	457 (443 – 472)	227 (214 – 239)	452 (440 – 468)	913 (889 – 964)	1,659
40–59 years					
1999–2000	460 (447 – 474)	234 (208 – 256)	447 (432 – 466)	909 (861 – 952)	1,198
2001–2002	460 (450 – 471)	232 (221 – 238)	456 (443 – 465)	942 (879 – 1,020)	1,478
2003–2004	460 (435 – 486)	226 (215 – 243)	456 (438 – 479)	957 (833 – 1,110)	1,276
2005–2006	472 (452 – 493)	223 (195 – 244)	464 (444 – 485)	1,060 (984 – 1,130)	1,353
60 years and older					
1999–2000	482 (467 – 496)	228 (212 – 243)	470 (460 – 483)	1,030 (950 – 1,130)	1,487
2001–2002	473 (455 – 491)	220 (204 – 231)	479 (465 – 493)	1,000 (962 – 1,030)	1,528
2003–2004	477 (459 – 496)	208 (198 – 221)	477 (454 – 494)	1,060 (967 – 1,310)	1,655
2005–2006	487 (466 – 508)	211 (197 – 219)	495 (464 – 511)	1,070 (1,030 – 1,220)	1,380
Gender					
Males					
1999–2000	487 (479 – 495)	255 (235 – 264)	488 (478 – 498)	956 (901 – 1,020)	3,682
2001–2002	490 (476 – 505)	247 (235 – 257)	485 (468 – 497)	963 (919 – 1,010)	4,059
2003–2004	490 (476 – 505)	250 (229 – 266)	486 (469 – 499)	971 (944 – 1,020)	3,871
2005–2006	500 (487 – 514)	247 (226 – 259)	497 (482 – 512)	1,040 (987 – 1,110)	3,740
Females					
1999–2000	488 (481 – 495)	233 (222 – 241)	478 (465 – 495)	1,030 (981 – 1,090)	3,842
2001–2002	486 (476 – 496)	230 (219 – 237)	485 (474 – 495)	1,040 (998 – 1,090)	4,331
2003–2004	488 (467 – 509)	228 (212 – 245)	486 (463 – 504)	1,080 (1,010 – 1,160)	3,966
2005–2006	504 (486 – 523)	224 (208 – 236)	497 (476 – 516)	1,150 (1,110 – 1,190)	3,954
Race/ethnicity					
Mexican Americans					
1999–2000	551 (523 – 581)	268 (259 – 281)	527 (509 – 542)	1,200 (1,140 – 1,310)	2,571
2001–2002	516 (491 – 543)	249 (227 – 271)	496 (468 – 535)	1,050 (1,010 – 1,120)	2,124
2003–2004	543 (513 – 575)	285 (264 – 304)	520 (504 – 538)	1,080 (994 – 1,210)	1,919
2005–2006	536 (512 – 561)	245 (223 – 257)	515 (487 – 554)	1,180 (1,110 – 1,280)	2,009
Non-Hispanic Blacks					
1999–2000	582 (565 – 599)	286 (261 – 304)	583 (569 – 603)	1,220 (1,150 – 1,270)	1,712
2001–2002	556 (542 – 570)	269 (250 – 282)	554 (544 – 568)	1,160 (1,100 – 1,220)	2,000
2003–2004	561 (538 – 585)	281 (262 – 294)	553 (523 – 584)	1,150 (1,090 – 1,310)	2,058
2005–2006	559 (540 – 579)	256 (231 – 270)	546 (528 – 575)	1,250 (1,200 – 1,340)	2,032
Non-Hispanic Whites					
1999–2000	468 (460 – 476)	235 (231 – 240)	467 (454 – 478)	916 (890 – 951)	2,556
2001–2002	474 (462 – 485)	233 (227 – 237)	473 (460 – 486)	959 (899 – 1,020)	3,594
2003–2004	470 (452 – 489)	228 (216 – 244)	469 (449 – 488)	966 (920 – 1,050)	3,272
2005–2006	487 (470 – 504)	228 (217 – 239)	482 (462 – 502)	1,050 (1,010 – 1,100)	3,062

Figure 1.5.b. Serum vitamin B12: Concentrations by survey cycle

Selected percentiles in pg/mL (95% conence intervals), National Health and Nutrition Examination Survey, 1999–2006

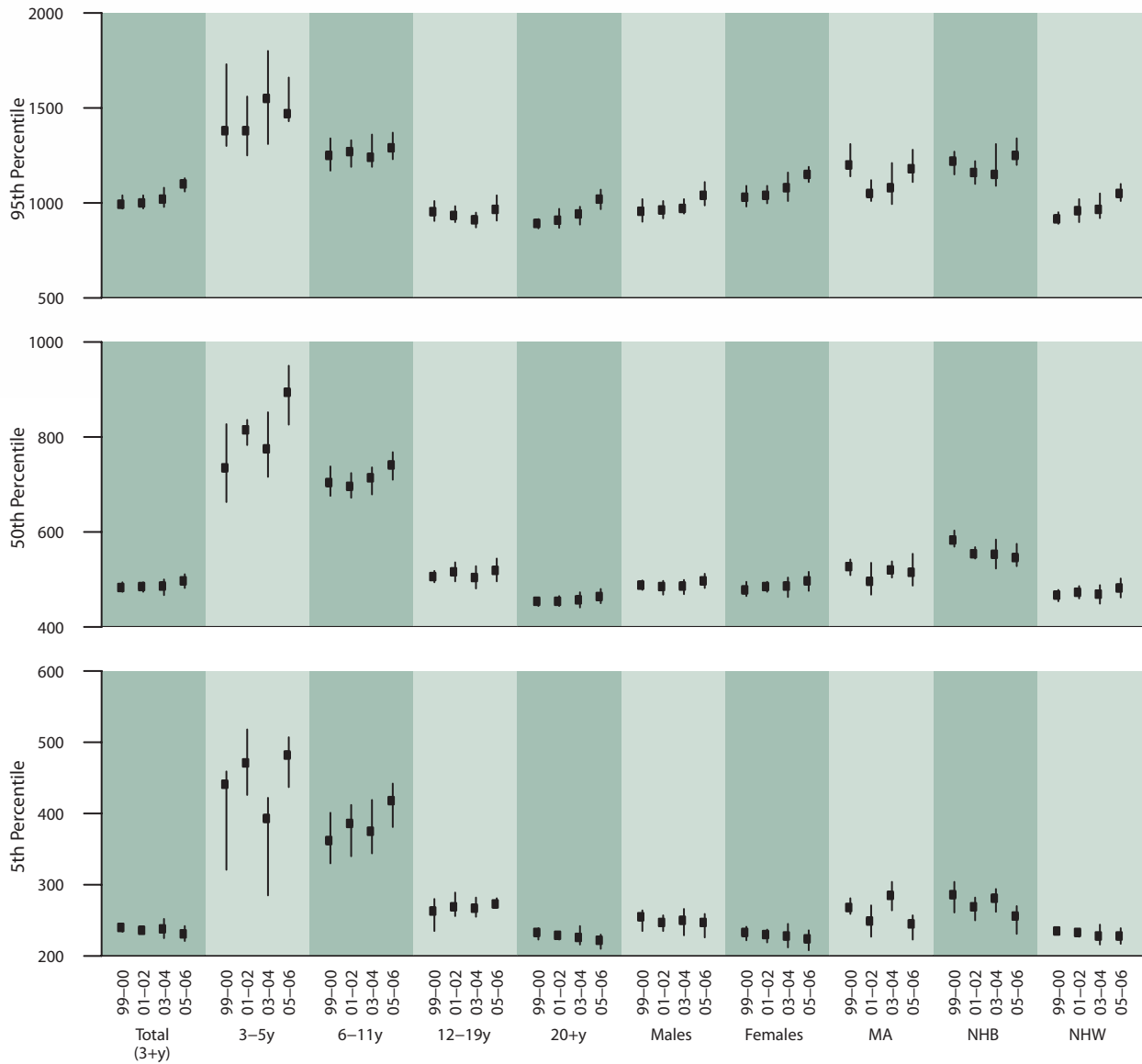


Table 1.5.c. Serum vitamin B12: Prevalence

Prevalence (in percent) of low serum vitamin B12 concentration (< 200 pg/mL) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 1 year and older	16,316	2.0 (1.6 – 2.4)	5,563,000
Age group			
1–5 years	1,678	§	§
6–11 years	1,747	§	§
12–19 years	4,013	0.6 (0.4 – 1.0)	210,000
20–39 years	3,214	1.5 (1.2 – 2.0)	1,211,000
40–59 years	2,629	2.6 (1.8 – 3.7)	2,057,000
60 years and older	3,035	3.9 (3.1 – 4.9)	1,815,000
Gender			
Males	7,999	1.6 (1.3 – 2.0)	2,165,000
Females	8,317	2.3 (1.9 – 2.9)	3,402,000
Race/ethnicity			
Mexican Americans	4,205	1.0 (0.7 – 1.5)	265,000
Non-Hispanic Blacks	4,285	1.2 (0.8 – 1.8)	398,000
Non-Hispanic Whites	6,571	2.2 (1.8 – 2.7)	4,289,000

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

Table 1.5.d. Serum vitamin B12: Prevalence by survey cycle

Prevalence (in percent) of low serum vitamin B12 concentration (< 200 pg/mL) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 3 years and older			
1999–2000	7,524	1.9 (1.5 – 2.3)	4,933,000
2001–2002	8,390	1.8 (1.5 – 2.2)	4,762,000
2003–2004	7,837	1.6 (1.2 – 2.2)	4,506,000
2005–2006	7,694	2.4 (1.9 – 3.0)	6,642,000
Age group			
3–5 years			
1999–2000	361	§	§
2001–2002	439	§	§
2003–2004	449	§	§
2005–2006	444	§	§
6–11 years			
1999–2000	885	§	§
2001–2002	1,022	§	§
2003–2004	843	§	§
2005–2006	904	§	§
12–19 years			
1999–2000	2,123	0.8‡ (0.4 – 1.7)	251,000‡
2001–2002	2,208	0.9 (0.5 – 1.6)	276,000
2003–2004	2,059	0.6‡ (0.3 – 1.3)	214,000‡
2005–2006	1,954	0.6‡ (0.3 – 1.2)	209,000‡
20–39 years			
1999–2000	1,470	2.2 (1.4 – 3.3)	1,683,000
2001–2002	1,715	1.8 (1.2 – 2.8)	1,436,000
2003–2004	1,555	1.0‡ (0.5 – 2.0)	805,000‡
2005–2006	1,659	2.0 (1.6 – 2.7)	1,636,000
40–59 years			
1999–2000	1,198	2.4 (1.5 – 4.0)	1,708,000
2001–2002	1,478	1.8 (1.1 – 3.1)	1,399,000
2003–2004	1,276	1.9 (1.3 – 2.9)	1,508,000
2005–2006	1,353	3.3 (1.9 – 5.5)	2,695,000
60 years and older			
1999–2000	1,487	2.7 (1.9 – 3.8)	1,159,000
2001–2002	1,528	3.6 (2.7 – 4.6)	1,590,000
2003–2004	1,655	3.9 (2.9 – 5.3)	1,806,000
2005–2006	1,380	3.9 (2.8 – 5.5)	1,895,000
Gender			
Males			
1999–2000	3,682	1.7 (1.2 – 2.4)	2,113,000
2001–2002	4,059	1.3 (1.0 – 1.8)	1,699,000
2003–2004	3,871	1.3 (0.9 – 1.9)	1,727,000
2005–2006	3,740	1.9 (1.4 – 2.5)	2,615,000
Females			
1999–2000	3,842	2.1 (1.7 – 2.6)	2,824,000
2001–2002	4,331	2.2 (1.7 – 3.0)	3,063,000
2003–2004	3,966	2.0 (1.4 – 2.8)	2,787,000
2005–2006	3,954	2.8 (2.0 – 3.9)	4,024,000
Race/ethnicity			
Mexican Americans			
1999–2000	2,571	0.8‡ (0.4 – 1.5)	154,000‡
2001–2002	2,124	1.8 (1.0 – 3.3)	419,000
2003–2004	1,919	0.7‡ (0.3 – 1.4)	166,000‡
2005–2006	2,009	1.5 (0.8 – 2.5)	376,000
Non-Hispanic Blacks			
1999–2000	1,712	§	§
2001–2002	2,000	§	§
2003–2004	2,058	0.7‡ (0.3 – 1.6)	239,000‡
2005–2006	2,032	1.6 (1.0 – 2.6)	551,000
Non-Hispanic Whites			
1999–2000	2,556	2.1 (1.6 – 2.7)	3,858,000
2001–2002	3,594	2.0 (1.6 – 2.5)	3,733,000
2003–2004	3,272	1.9 (1.3 – 2.7)	3,572,000
2005–2006	3,062	2.6 (2.0 – 3.5)	4,978,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

Table 1.6.a.1. Plasma total homocysteine: Concentrations

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for the total U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)					Sample size
		2.5th	5th	50th	95th	97.5th	
Total, 20 years and older	8.21 (8.06 – 8.37)	4.48 (4.35 – 4.57)	5.00 (4.85 – 5.12)	8.04 (7.91 – 8.17)	14.3 (13.9 – 15.0)	17.2 (16.5 – 18.3)	8,999
Age group							
20–39 years	7.14 (7.04 – 7.24)	3.93 (3.77 – 4.05)	4.44 (4.30 – 4.52)	7.09 (6.99 – 7.22)	11.2 (10.9 – 11.6)	12.4 (12.1 – 13.0)	3,267
40–59 years	8.33 (8.17 – 8.50)	4.84 (4.61 – 5.02)	5.25 (5.15 – 5.36)	8.13 (8.02 – 8.29)	13.9 (13.3 – 14.5)	16.8 (15.8 – 18.3)	2,651
60 years and older	10.1 (9.85 – 10.4)	5.79 (5.56 – 5.99)	6.37 (6.07 – 6.50)	9.79 (9.57 – 10.1)	17.9 (17.1 – 18.9)	21.2 (20.1 – 22.7)	3,081
Gender							
Males	9.00 (8.83 – 9.18)	5.64 (5.48 – 5.73)	5.96 (5.86 – 6.08)	8.68 (8.56 – 8.84)	14.8 (14.2 – 15.6)	18.0 (16.6 – 19.7)	4,329
Females	7.55 (7.36 – 7.74)	4.12 (3.94 – 4.20)	4.52 (4.40 – 4.69)	7.30 (7.13 – 7.47)	13.8 (13.1 – 14.8)	16.8 (15.8 – 17.9)	4,670
Race/ethnicity							
Mexican Americans	7.09 (6.95 – 7.23)	3.91 (3.76 – 4.01)	4.35 (4.20 – 4.50)	7.02 (6.87 – 7.18)	11.7 (11.2 – 12.2)	12.9 (12.3 – 13.9)	1,814
Non-Hispanic Blacks	8.22 (8.03 – 8.42)	4.42 (4.20 – 4.58)	4.89 (4.61 – 5.05)	8.00 (7.82 – 8.22)	14.8 (14.4 – 15.7)	18.2 (17.0 – 20.0)	1,871
Non-Hispanic Whites	8.39 (8.22 – 8.57)	4.65 (4.43 – 4.85)	5.18 (5.03 – 5.34)	8.21 (8.07 – 8.37)	14.5 (14.0 – 15.2)	17.0 (16.4 – 18.1)	4,670

Figure 1.6.a. Plasma total homocysteine: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2006

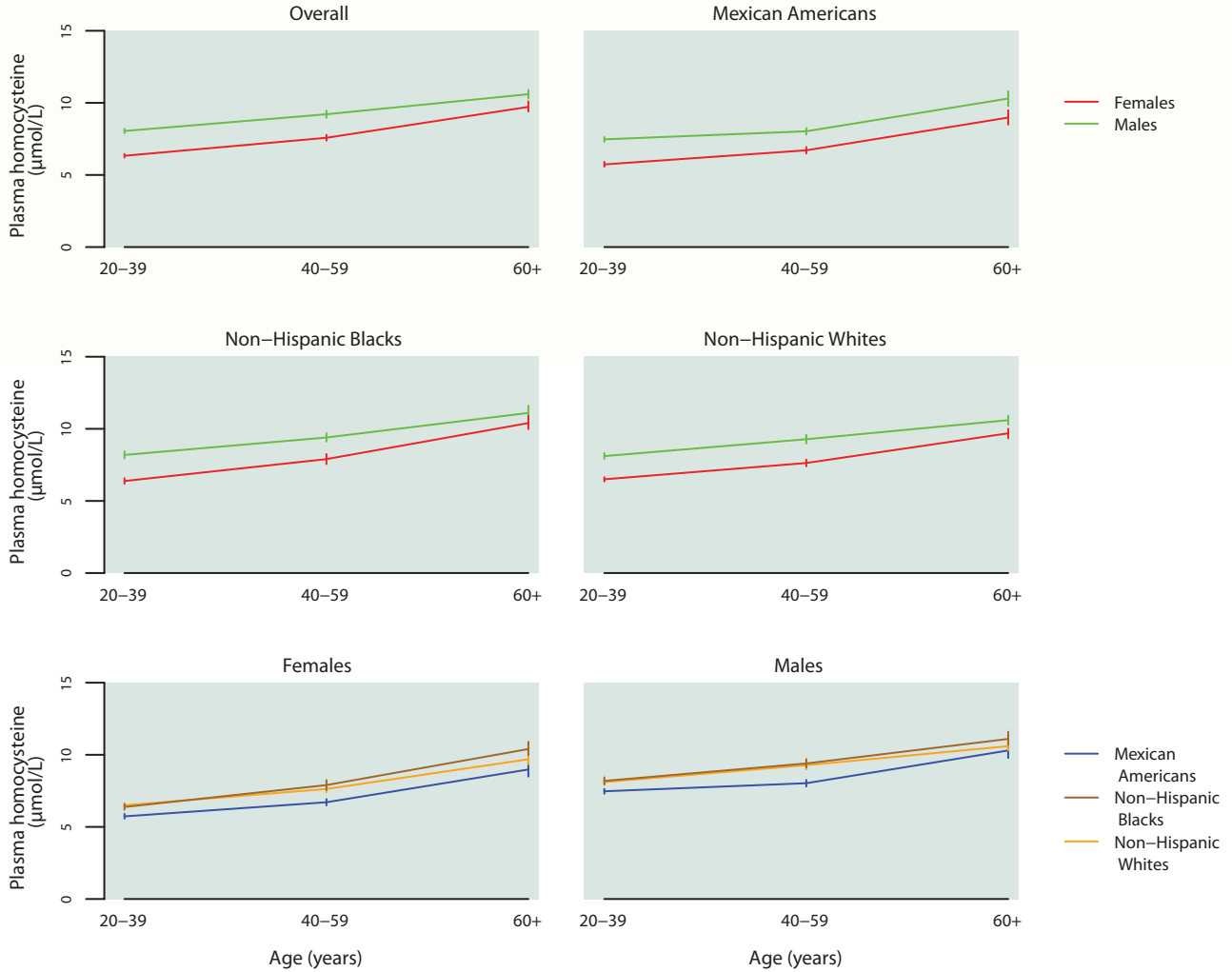


Table 1.6.a.2. Plasma total homocysteine: Total population

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for the total U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 20 years and older	8.21 (8.06 – 8.37)	5.00 (4.85 – 5.12)	8.04 (7.91 – 8.17)	14.3 (13.9 – 15.0)	8,999
20–39 years	7.14 (7.04 – 7.24)	4.44 (4.30 – 4.52)	7.09 (6.99 – 7.22)	11.2 (10.9 – 11.6)	3,267
40–59 years	8.33 (8.17 – 8.50)	5.25 (5.15 – 5.36)	8.13 (8.02 – 8.29)	13.9 (13.3 – 14.5)	2,651
60 years and older	10.1 (9.85 – 10.4)	6.37 (6.07 – 6.50)	9.79 (9.57 – 10.1)	17.9 (17.1 – 18.9)	3,081
Males					
Total, 20 years and older	9.00 (8.83 – 9.18)	5.96 (5.86 – 6.08)	8.68 (8.56 – 8.84)	14.8 (14.2 – 15.6)	4,329
20–39 years	8.05 (7.90 – 8.20)	5.65 (5.47 – 5.76)	7.94 (7.80 – 8.05)	11.9 (11.5 – 12.5)	1,473
40–59 years	9.21 (8.96 – 9.47)	6.28 (6.15 – 6.43)	8.86 (8.61 – 9.08)	14.3 (13.6 – 15.9)	1,306
60 years and older	10.6 (10.3 – 10.9)	6.89 (6.52 – 7.10)	10.4 (10.0 – 10.8)	18.0 (16.9 – 19.0)	1,550
Females					
Total, 20 years and older	7.55 (7.36 – 7.74)	4.52 (4.40 – 4.69)	7.30 (7.13 – 7.47)	13.8 (13.1 – 14.8)	4,670
20–39 years	6.33 (6.21 – 6.46)	3.96 (3.79 – 4.11)	6.31 (6.17 – 6.46)	9.87 (9.47 – 10.5)	1,794
40–59 years	7.58 (7.38 – 7.78)	4.90 (4.67 – 5.07)	7.30 (7.11 – 7.53)	13.0 (12.1 – 15.1)	1,345
60 years and older	9.72 (9.40 – 10.1)	6.02 (5.75 – 6.27)	9.43 (9.05 – 9.69)	17.8 (16.7 – 19.2)	1,531

Table 1.6.a.3. Plasma total homocysteine: Mexican Americans

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for Mexican Americans in the U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 20 years and older	7.09 (6.95 – 7.23)	4.35 (4.20 – 4.50)	7.02 (6.87 – 7.18)	11.7 (11.2 – 12.2)	1,814
20–39 years	6.61 (6.48 – 6.74)	4.05 (3.88 – 4.31)	6.61 (6.47 – 6.73)	10.6 (9.97 – 11.1)	789
40–59 years	7.36 (7.21 – 7.52)	4.77 (4.38 – 4.92)	7.33 (7.20 – 7.47)	10.9 (10.5 – 12.3)	470
60 years and older	9.55 (9.14 – 9.98)	6.07 (5.48 – 6.41)	9.32 (8.82 – 9.88)	16.0 (15.2 – 18.0)	555
Males					
Total, 20 years and older	7.85 (7.70 – 8.01)	5.50 (5.33 – 5.69)	7.74 (7.56 – 7.90)	12.2 (11.6 – 12.6)	866
20–39 years	7.47 (7.30 – 7.64)	5.38 (5.05 – 5.59)	7.38 (7.15 – 7.68)	11.3 (10.9 – 11.9)	353
40–59 years	8.03 (7.80 – 8.26)	5.71 (4.81 – 6.08)	7.91 (7.67 – 8.25)	11.8 (10.7 – 13.4)	239
60 years and older	10.3 (9.78 – 10.8)	6.79 (5.75 – 7.27)	10.0 (9.44 – 10.5)	16.0 (15.1 – 18.4)	274
Females					
Total, 20 years and older	6.34 (6.17 – 6.51)	3.91 (3.76 – 4.02)	6.28 (6.10 – 6.50)	10.6 (10.1 – 11.5)	948
20–39 years	5.73 (5.57 – 5.91)	3.67 (3.41 – 3.82)	5.77 (5.57 – 5.99)	8.52 (8.11 – 9.49)	436
40–59 years	6.71 (6.49 – 6.94)	4.39 (3.91 – 4.78)	6.68 (6.36 – 6.86)	10.1 (9.32 – 12.2)	231
60 years and older	8.98 (8.49 – 9.49)	5.67 (4.83 – 6.08)	8.50 (8.07 – 9.07)	15.9 (14.2 – 19.8)	281

Table 1.6.a.4. Plasma total homocysteine: Non-Hispanic blacks

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for non-Hispanic blacks in the U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 20 years and older	8.22 (8.03 – 8.42)	4.89 (4.61 – 5.05)	8.00 (7.82 – 8.22)	14.8 (14.4 – 15.7)	1,871
20–39 years	7.14 (6.95 – 7.34)	4.46 (4.20 – 4.61)	7.14 (6.98 – 7.36)	11.2 (10.8 – 11.8)	720
40–59 years	8.55 (8.31 – 8.79)	5.28 (5.10 – 5.39)	8.42 (8.14 – 8.70)	14.7 (13.9 – 17.1)	626
60 years and older	10.7 (10.4 – 11.0)	6.45 (6.00 – 6.95)	10.3 (10.1 – 10.7)	20.7 (18.8 – 23.6)	525
Males					
Total, 20 years and older	9.09 (8.91 – 9.27)	5.93 (5.73 – 6.16)	8.78 (8.58 – 8.96)	15.3 (14.5 – 16.4)	896
20–39 years	8.19 (7.95 – 8.44)	5.72 (5.42 – 5.88)	8.04 (7.80 – 8.25)	12.1 (11.6 – 13.1)	340
40–59 years	9.40 (9.12 – 9.70)	6.17 (5.70 – 6.41)	9.11 (8.82 – 9.41)	15.3 (14.2 – 18.2)	292
60 years and older	11.1 (10.7 – 11.6)	6.76 (6.39 – 7.30)	10.9 (10.3 – 11.3)	21.1 (17.5 – 24.9)	264
Females					
Total, 20 years and older	7.59 (7.34 – 7.85)	4.52 (4.23 – 4.74)	7.23 (7.07 – 7.53)	14.7 (13.5 – 15.9)	975
20–39 years	6.38 (6.19 – 6.58)	4.19 (3.80 – 4.38)	6.43 (6.25 – 6.72)	9.79 (9.22 – 10.6)	380
40–59 years	7.90 (7.56 – 8.25)	4.98 (4.46 – 5.23)	7.73 (7.22 – 8.08)	13.7 (11.9 – 16.1)	334
60 years and older	10.4 (9.98 – 10.9)	6.15 (5.74 – 6.83)	9.93 (9.50 – 10.5)	20.7 (18.7 – 24.7)	261

Table 1.6.a.5. Plasma total homocysteine: Non-Hispanic whites

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for non-Hispanic whites in the U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 20 years and older	8.39 (8.22 – 8.57)	5.18 (5.03 – 5.34)	8.21 (8.07 – 8.37)	14.5 (14.0 – 15.2)	4,670
20–39 years	7.26 (7.13 – 7.40)	4.51 (4.33 – 4.79)	7.26 (7.07 – 7.39)	11.2 (10.9 – 11.9)	1,458
40–59 years	8.40 (8.21 – 8.60)	5.36 (5.19 – 5.51)	8.24 (8.09 – 8.44)	13.6 (13.1 – 14.9)	1,353
60 years and older	10.1 (9.82 – 10.4)	6.38 (6.09 – 6.59)	9.82 (9.57 – 10.1)	17.6 (16.7 – 18.4)	1,859
Males					
Total, 20 years and older	9.15 (8.94 – 9.36)	6.13 (5.95 – 6.24)	8.80 (8.61 – 8.99)	14.9 (14.2 – 16.0)	2,274
20–39 years	8.11 (7.91 – 8.32)	5.69 (5.47 – 5.85)	8.00 (7.85 – 8.14)	11.8 (11.2 – 12.7)	641
40–59 years	9.28 (8.98 – 9.59)	6.35 (6.21 – 6.55)	8.89 (8.61 – 9.16)	14.2 (13.4 – 16.0)	687
60 years and older	10.6 (10.3 – 10.9)	6.95 (6.65 – 7.15)	10.4 (10.0 – 10.8)	17.8 (16.6 – 19.0)	946
Females					
Total, 20 years and older	7.75 (7.54 – 7.96)	4.72 (4.49 – 4.93)	7.53 (7.34 – 7.70)	14.0 (13.3 – 15.2)	2,396
20–39 years	6.50 (6.35 – 6.65)	3.98 (3.77 – 4.13)	6.46 (6.29 – 6.59)	10.2 (9.55 – 11.0)	817
40–59 years	7.63 (7.40 – 7.87)	4.99 (4.70 – 5.18)	7.38 (7.16 – 7.62)	13.0 (11.8 – 15.8)	666
60 years and older	9.69 (9.34 – 10.0)	6.03 (5.71 – 6.28)	9.48 (9.05 – 9.73)	17.1 (16.3 – 18.7)	913

Table 1.6.b. Plasma total homocysteine: Concentrations by survey cycle

Geometric mean and selected percentiles of plasma concentrations (in $\mu\text{mol/L}$) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 20 years and older					
1999–2000	8.07 (7.95 – 8.18)	4.82 (4.65 – 5.02)	7.94 (7.82 – 8.04)	14.3 (13.5 – 15.0)	4,192
2001–2002	8.21 (8.04 – 8.38)	5.01 (4.86 – 5.15)	8.01 (7.84 – 8.17)	14.4 (13.9 – 15.1)	4,759
2003–2004	8.56 (8.32 – 8.81)	5.31 (5.15 – 5.40)	8.33 (8.14 – 8.55)	14.9 (14.2 – 15.9)	4,509
2005–2006	7.88 (7.73 – 8.04)	4.78 (4.60 – 4.94)	7.76 (7.60 – 7.90)	13.7 (13.1 – 14.5)	4,490
Age group					
3–5 years					
1999–2000	4.21 (4.05 – 4.39)	2.81 (2.56 – 2.98)	4.19 (4.02 – 4.42)	6.31 (5.75 – 7.70)	376
2001–2002	4.31 (4.16 – 4.46)	2.95 (2.65 – 3.21)	4.28 (4.20 – 4.44)	6.15 (5.89 – 6.50)	454
2003–2004	4.36 (4.18 – 4.55)	3.10 (2.87 – 3.19)	4.42 (4.14 – 4.65)	6.28 (5.72 – 6.66)	454
6–11 years					
1999–2000	4.35 (4.18 – 4.54)	2.91 (2.55 – 3.09)	4.36 (4.20 – 4.50)	6.49 (6.21 – 6.78)	899
2001–2002	4.67 (4.58 – 4.77)	3.27 (3.04 – 3.44)	4.61 (4.53 – 4.73)	6.94 (6.60 – 7.21)	1,034
2003–2004	4.65 (4.53 – 4.78)	3.22 (2.99 – 3.37)	4.68 (4.51 – 4.82)	6.62 (6.44 – 6.77)	852
12–19 years					
1999–2000	5.87 (5.70 – 6.05)	3.65 (3.37 – 3.81)	5.83 (5.70 – 6.01)	9.58 (9.23 – 10.6)	2,132
2001–2002	6.03 (5.88 – 6.19)	3.96 (3.64 – 4.14)	5.90 (5.73 – 6.11)	9.48 (9.30 – 10.1)	2,225
2003–2004	6.30 (6.14 – 6.47)	4.26 (4.08 – 4.36)	6.21 (6.02 – 6.43)	10.0 (9.43 – 10.7)	2,073
20–39 years					
1999–2000	7.19 (7.04 – 7.35)	4.23 (4.06 – 4.42)	7.26 (7.03 – 7.43)	11.9 (11.3 – 12.5)	1,474
2001–2002	7.27 (7.12 – 7.42)	4.42 (4.21 – 4.67)	7.16 (7.08 – 7.25)	12.0 (11.6 – 12.8)	1,720
2003–2004	7.47 (7.33 – 7.62)	4.71 (4.47 – 4.99)	7.42 (7.30 – 7.58)	11.3 (11.0 – 12.0)	1,561
2005–2006	6.81 (6.67 – 6.95)	4.21 (3.99 – 4.42)	6.72 (6.61 – 6.84)	11.0 (10.4 – 11.5)	1,706
40–59 years					
1999–2000	8.27 (8.07 – 8.48)	5.18 (5.05 – 5.27)	8.08 (7.94 – 8.26)	13.5 (12.4 – 15.6)	1,209
2001–2002	8.30 (8.17 – 8.43)	5.35 (5.16 – 5.48)	8.17 (8.02 – 8.31)	13.4 (12.7 – 14.1)	1,494
2003–2004	8.67 (8.42 – 8.93)	5.60 (5.33 – 5.74)	8.44 (8.20 – 8.61)	14.4 (13.6 – 16.2)	1,280
2005–2006	8.01 (7.84 – 8.18)	5.13 (4.82 – 5.25)	7.90 (7.70 – 8.07)	12.8 (12.5 – 14.1)	1,371
60 years and older					
1999–2000	9.78 (9.53 – 10.0)	6.10 (6.03 – 6.17)	9.45 (9.23 – 9.75)	17.6 (16.9 – 18.7)	1,509
2001–2002	10.2 (9.76 – 10.6)	6.36 (6.12 – 6.64)	9.79 (9.33 – 10.2)	18.6 (17.7 – 19.6)	1,545
2003–2004	10.6 (10.2 – 10.9)	6.62 (6.33 – 6.99)	10.3 (9.93 – 10.6)	19.0 (17.6 – 20.2)	1,668
2005–2006	9.69 (9.36 – 10.0)	6.01 (5.75 – 6.29)	9.40 (9.05 – 9.75)	17.5 (16.2 – 18.5)	1,413
Gender					
(20 years and older)					
Males					
1999–2000	8.90 (8.69 – 9.11)	5.77 (5.57 – 5.92)	8.65 (8.42 – 8.92)	15.0 (14.2 – 16.6)	1,959
2001–2002	9.06 (8.89 – 9.23)	6.08 (5.86 – 6.24)	8.74 (8.53 – 8.96)	14.9 (14.3 – 15.8)	2,255
2003–2004	9.35 (9.06 – 9.65)	6.28 (6.09 – 6.42)	8.92 (8.67 – 9.17)	15.3 (14.5 – 16.7)	2,177
2005–2006	8.67 (8.49 – 8.84)	5.82 (5.70 – 5.92)	8.42 (8.25 – 8.59)	14.2 (13.2 – 15.2)	2,152
Females					
1999–2000	7.37 (7.23 – 7.52)	4.31 (4.07 – 4.53)	7.30 (7.14 – 7.42)	13.1 (12.7 – 14.3)	2,233
2001–2002	7.50 (7.32 – 7.68)	4.53 (4.32 – 4.73)	7.23 (7.06 – 7.36)	13.6 (12.9 – 14.8)	2,504
2003–2004	7.89 (7.61 – 8.18)	4.86 (4.51 – 5.03)	7.60 (7.39 – 7.87)	14.3 (13.4 – 15.8)	2,332
2005–2006	7.22 (7.00 – 7.45)	4.40 (4.19 – 4.51)	6.98 (6.80 – 7.15)	13.1 (12.1 – 14.9)	2,338
Race/ethnicity					
(20 years and older)					
Mexican Americans					
1999–2000	7.28 (7.06 – 7.50)	4.22 (3.96 – 4.58)	7.08 (6.88 – 7.36)	12.5 (11.8 – 13.9)	1,146
2001–2002	7.18 (6.85 – 7.53)	4.27 (4.00 – 4.47)	7.10 (6.80 – 7.34)	12.4 (11.8 – 13.7)	1,009
2003–2004	7.30 (7.11 – 7.49)	4.49 (4.25 – 4.57)	7.31 (7.17 – 7.42)	11.9 (11.3 – 12.7)	904
2005–2006	6.90 (6.74 – 7.05)	4.31 (3.99 – 4.44)	6.75 (6.62 – 6.94)	11.2 (10.8 – 12.2)	910
Non-Hispanic Blacks					
1999–2000	8.14 (7.87 – 8.41)	4.71 (4.25 – 4.87)	7.91 (7.51 – 8.34)	15.3 (14.7 – 16.6)	773
2001–2002	8.29 (8.03 – 8.55)	4.64 (4.40 – 5.08)	7.93 (7.72 – 8.17)	15.4 (14.4 – 17.9)	872
2003–2004	8.53 (8.24 – 8.83)	5.04 (4.84 – 5.24)	8.29 (7.99 – 8.59)	14.9 (14.4 – 16.6)	869
2005–2006	7.94 (7.72 – 8.17)	4.73 (4.50 – 4.90)	7.74 (7.50 – 7.95)	14.7 (14.0 – 15.5)	1,002
Non-Hispanic Whites					
1999–2000	8.19 (8.07 – 8.30)	5.09 (4.82 – 5.19)	8.03 (7.93 – 8.22)	14.3 (13.5 – 14.8)	1,874
2001–2002	8.37 (8.21 – 8.54)	5.18 (5.04 – 5.26)	8.14 (7.98 – 8.28)	14.6 (14.0 – 15.7)	2,514
2003–2004	8.74 (8.50 – 8.99)	5.46 (5.37 – 5.57)	8.53 (8.29 – 8.72)	15.1 (14.2 – 16.1)	2,406
2005–2006	8.06 (7.89 – 8.24)	4.97 (4.70 – 5.15)	7.94 (7.83 – 8.04)	13.9 (13.2 – 14.8)	2,264

Figure 1.6.b. Plasma total homocysteine: Concentrations by survey cycle

Selected percentiles in $\mu\text{mol/L}$ (95% confidence intervals), National Health and Nutrition Examination Survey, 1999–2006

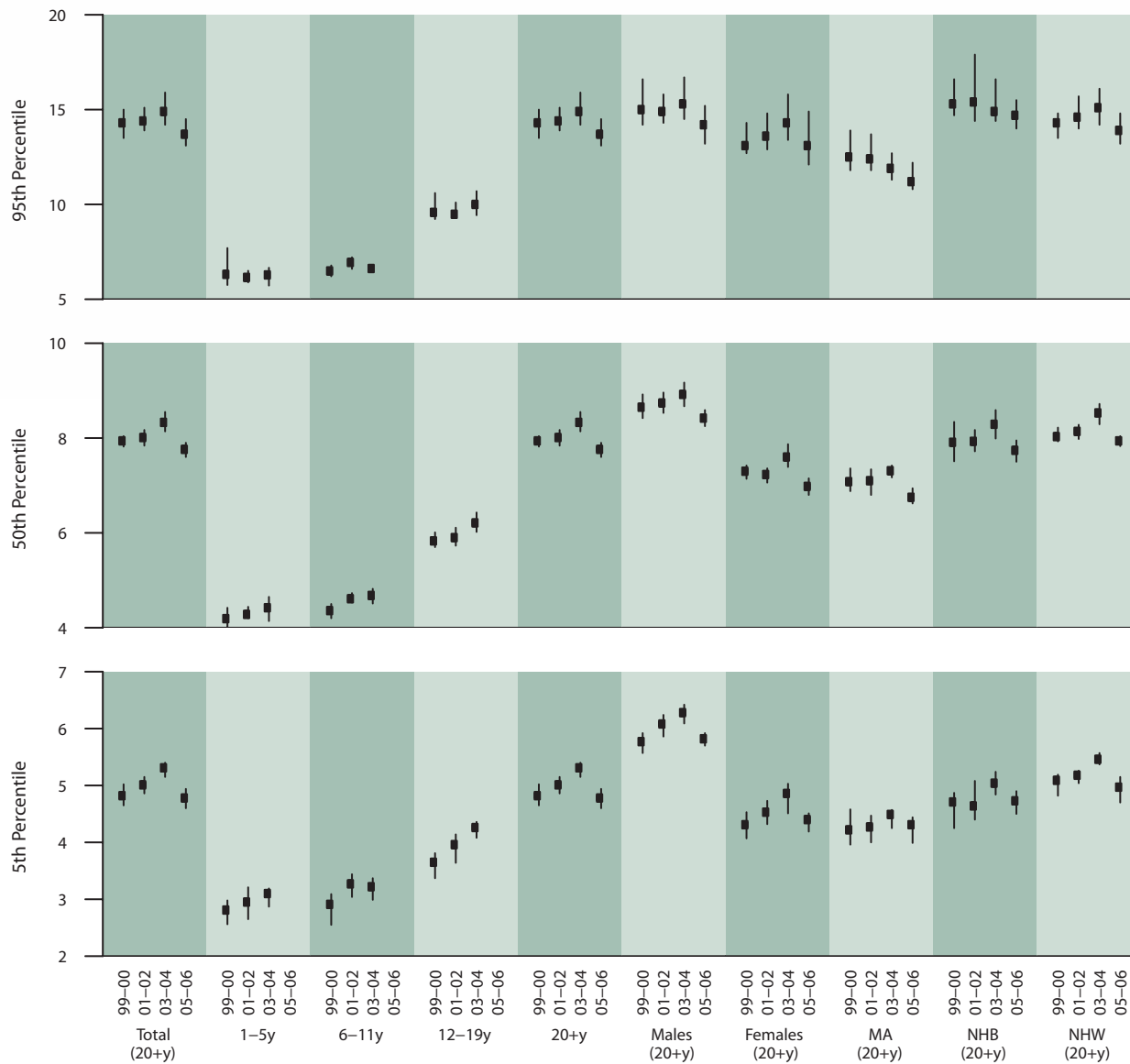


Table 1.6.c. Plasma total homocysteine: Prevalence

Prevalence (in percent) of high Plasma total homocysteine concentration (> 13 µmol/L) for the U.S. population aged 20 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 20 years and older	8,999	7.7 (6.8 – 8.8)	15,825,000
Age group			
20–39 years	3,267	1.9 (1.4 – 2.4)	1,482,000
40–59 years	2,651	7.0 (5.6 – 8.7)	5,553,000
60 years and older	3,081	18.5 (16.3 – 21.0)	8,620,000
Gender			
Males	4,329	9.2 (7.9 – 10.6)	9,021,000
Females	4,670	6.4 (5.2 – 7.7)	6,796,000
Race/ethnicity			
Mexican Americans	1,814	2.1 (1.5 – 2.9)	336,000
Non-Hispanic Blacks	1,871	8.9 (7.7 – 10.2)	2,005,000
Non-Hispanic Whites	4,670	8.3 (7.1 – 9.6)	12,066,000

Table 1.6.d. Plasma total homocysteine: Prevalence by survey cycle

Prevalence (in percent) of high Plasma total homocysteine concentration (> 13 µmol/L) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 20 years and older			
1999–2000	4,192	6.9 (6.0 – 8.1)	13,319,000
2001–2002	4,759	7.8 (6.5 – 9.2)	15,479,000
2003–2004	4,509	9.5 (7.9 – 11.3)	19,421,000
2005–2006	4,490	6.0 (5.1 – 6.9)	12,553,000
Age group			
3–5 years			
1999–2000	376	§	§
2001–2002	454	§	§
2003–2004	454	§	§
6–11 years			
1999–2000	899	§	§
2001–2002	1,034	§	§
2003–2004	852	§	§
12–19 years			
1999–2000	2,132	1.5‡ (0.8 – 2.8)	466,000‡
2001–2002	2,225	0.9 (0.5 – 1.6)	294,000
2003–2004	2,073	1.1‡ (0.5 – 2.1)	358,000‡
20–39 years			
1999–2000	1,474	2.6 (1.6 – 4.3)	2,058,000
2001–2002	1,720	3.2 (2.2 – 4.6)	2,505,000
2003–2004	1,561	2.4 (1.7 – 3.4)	1,923,000
2005–2006	1,706	1.3 (0.8 – 2.2)	1,034,000
40–59 years			
1999–2000	1,209	5.9 (4.3 – 8.1)	4,188,000
2001–2002	1,494	5.8 (4.4 – 7.5)	4,378,000
2003–2004	1,280	9.4 (7.0 – 12.4)	7,396,000
2005–2006	1,371	4.7 (3.6 – 6.2)	3,894,000
60 years and older			
1999–2000	1,509	17.3 (14.8 – 20.3)	7,441,000
2001–2002	1,545	20.5 (17.1 – 24.5)	9,180,000
2003–2004	1,668	21.6 (19.2 – 24.2)	10,039,000
2005–2006	1,413	15.6 (12.3 – 19.5)	7,527,000
Gender			
(20 years and older)			
Males			
1999–2000	1,959	8.6 (7.0 – 10.4)	7,854,000
2001–2002	2,255	9.6 (7.8 – 11.7)	9,136,000
2003–2004	2,177	11.4 (9.4 – 13.7)	11,197,000
2005–2006	2,152	7.0 (5.6 – 8.7)	7,036,000
Females			
1999–2000	2,233	5.4 (4.5 – 6.6)	5,459,000
2001–2002	2,504	6.1 (4.9 – 7.5)	6,342,000
2003–2004	2,332	7.7 (6.0 – 9.8)	8,202,000
2005–2006	2,338	5.1 (3.8 – 6.8)	5,525,000
Race/ethnicity			
(20 years and older)			
Mexican Americans			
1999–2000	1,146	4.4 (3.3 – 5.9)	542,000
2001–2002	1,009	3.8 (2.5 – 5.5)	542,000
2003–2004	904	2.7 (1.8 – 4.0)	426,000
2005–2006	910	1.6 (1.0 – 2.5)	263,000
Non-Hispanic Blacks			
1999–2000	773	8.6 (6.7 – 10.8)	1,872,000
2001–2002	872	9.6 (7.8 – 11.8)	2,120,000
2003–2004	869	10.8 (8.7 – 13.2)	2,435,000
2005–2006	1,002	7.0 (6.0 – 8.2)	1,640,000
Non-Hispanic Whites			
1999–2000	1,874	7.0 (6.0 – 8.1)	9,938,000
2001–2002	2,514	8.4 (6.9 – 10.3)	12,142,000
2003–2004	2,406	10.1 (8.3 – 12.2)	14,718,000
2005–2006	2,264	6.5 (5.4 – 7.7)	9,541,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

Table 1.7.a.1. Plasma methylmalonic acid: Concentrations

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Geometric mean (95% conf. interval)		Selected percentiles (95% conf. interval)					Sample size
	2.5th	5th	50th	95th	97.5th			
Total, 3 years and older	134 (128 – 140)	63.2 (60.5 – 65.6)	70.0 (67.3 – 72.8)	127 (122 – 132)	293 (277 – 320)	387 (359 – 428)	7,544	
Age group								
3–5 years	120 (110 – 130)	61.1† (54.6 – 63.4)	65.2 (56.6 – 72.1)	117 (109 – 124)	269 (235 – 307)	299† (271 – 516)	421	
6–11 years	117 (111 – 123)	60.6 (56.9 – 64.4)	67.5 (61.0 – 72.6)	113 (109 – 118)	228 (204 – 253)	258 (229 – 461)	806	
12–19 years	118 (115 – 122)	62.4 (56.8 – 64.4)	67.3 (64.8 – 70.0)	115 (110 – 118)	222 (210 – 263)	280 (247 – 326)	1,979	
20–39 years	122 (116 – 127)	61.4 (57.0 – 64.4)	67.3 (64.2 – 69.6)	116 (110 – 123)	246 (231 – 275)	303 (279 – 368)	1,496	
40–59 years	137 (129 – 144)	62.9 (59.2 – 67.8)	70.9 (66.6 – 75.0)	130 (124 – 138)	275 (252 – 338)	387 (324 – 572)	1,230	
60 years and older	177 (169 – 186)	79.7 (73.5 – 83.6)	89.9 (83.6 – 94.5)	163 (156 – 170)	429 (392 – 482)	628 (536 – 822)	1,612	
Gender								
Males	136 (130 – 142)	65.0 (63.0 – 67.9)	72.4 (69.4 – 75.4)	127 (123 – 132)	299 (277 – 339)	406 (364 – 526)	3,719	
Females	131 (125 – 138)	61.3 (58.2 – 63.9)	68.1 (65.2 – 71.3)	126 (120 – 132)	287 (272 – 315)	362 (328 – 403)	3,825	
Race/ethnicity								
Mexican Americans	111 (108 – 114)	56.2 (53.3 – 58.0)	61.9 (58.6 – 64.4)	106 (100 – 112)	230 (209 – 254)	300 (248 – 387)	1,834	
Non-Hispanic Blacks	109 (104 – 114)	55.3 (52.3 – 57.9)	61.1 (57.7 – 64.1)	105 (99.3 – 111)	224 (206 – 246)	270 (249 – 298)	1,993	
Non-Hispanic Whites	143 (136 – 150)	69.4 (65.1 – 72.9)	76.9 (73.1 – 79.9)	135 (129 – 141)	308 (283 – 340)	393 (360 – 480)	3,152	

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

Figure 1.7.a. Plasma methylmalonic acid: Concentrations by age group

Geometric mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2004

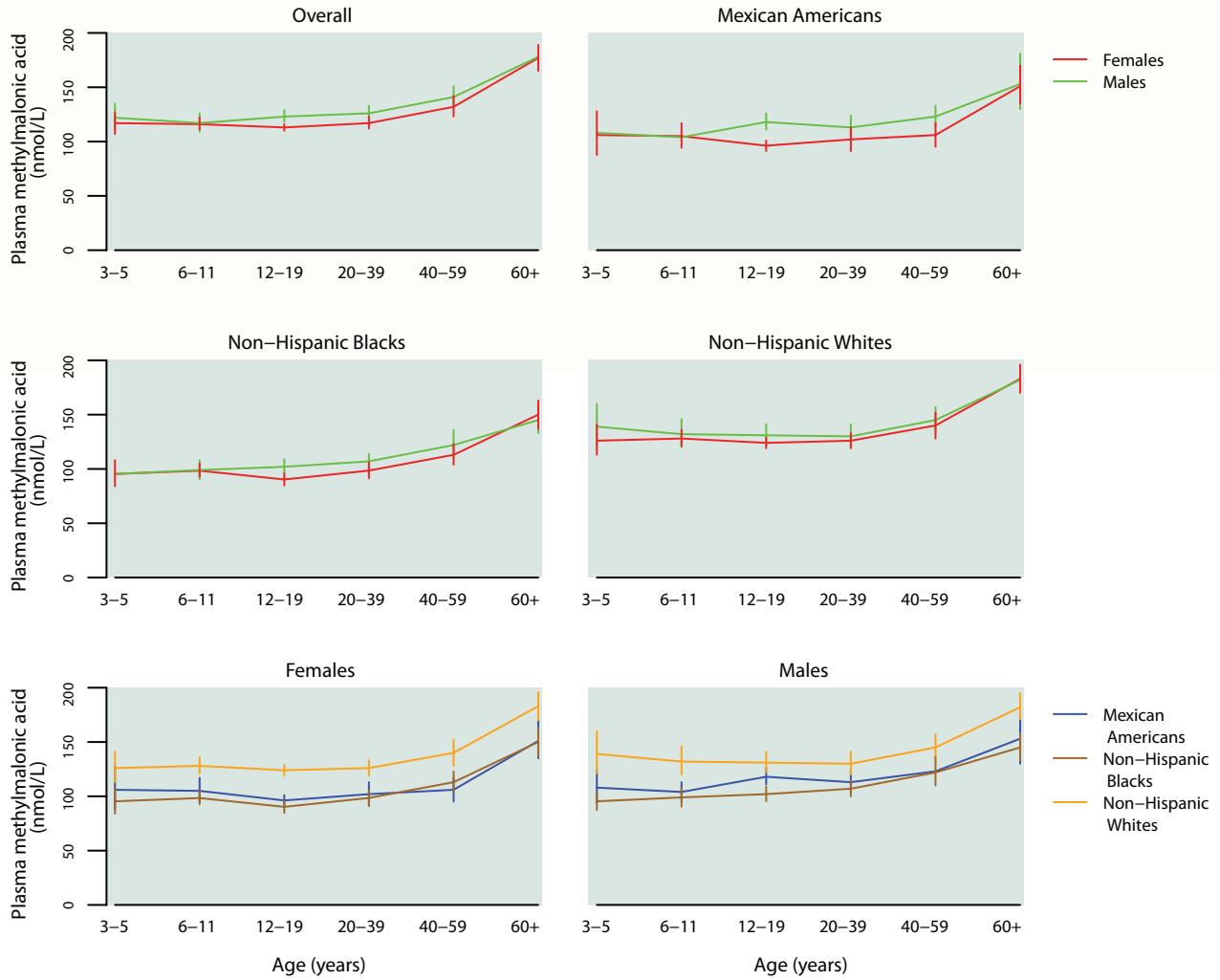


Table 1.7.a.2. Plasma methylmalonic acid: Total population

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for the total U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	134 (128 – 140)	79.6 (76.4 – 82.4)	127 (122 – 132)	231 (218 – 249)	7,544
3–5 years	120 (110 – 130)	74.5 (67.8 – 79.0)	117 (109 – 124)	198 (169 – 269)	421
6–11 years	117 (111 – 123)	77.6 (72.5 – 79.9)	113 (109 – 118)	184 (168 – 205)	806
12–19 years	118 (115 – 122)	75.1 (72.5 – 78.2)	115 (110 – 118)	189 (179 – 201)	1,979
20–39 years	122 (116 – 127)	75.5 (71.7 – 79.2)	116 (110 – 123)	201 (188 – 219)	1,496
40–59 years	137 (129 – 144)	82.3 (77.2 – 86.3)	130 (124 – 138)	223 (209 – 238)	1,230
60 years and older	177 (169 – 186)	102 (96.8 – 106)	163 (156 – 170)	328 (312 – 358)	1,612
Males					
Total, 3 years and older	136 (130 – 142)	82.8 (79.4 – 85.3)	127 (123 – 132)	231 (217 – 253)	3,719
3–5 years	122 (110 – 135)	71.6 (65.1 – 78.7)	118 (103 – 129)	239 (180 – 272)	223
6–11 years	117 (109 – 126)	75.9 (69.5 – 79.4)	112 (107 – 119)	191 (167 – 223)	385
12–19 years	123 (118 – 129)	79.2 (76.7 – 81.4)	119 (112 – 125)	197 (179 – 210)	1,016
20–39 years	126 (120 – 133)	78.7 (72.6 – 85.9)	119 (111 – 125)	209 (194 – 223)	705
40–59 years	141 (132 – 151)	86.2 (79.9 – 93.2)	134 (128 – 141)	224 (206 – 266)	608
60 years and older	178 (168 – 189)	99.0 (93.0 – 103)	162 (155 – 174)	351 (328 – 373)	782
Females					
Total, 3 years and older	131 (125 – 138)	77.5 (73.7 – 81.0)	126 (120 – 132)	231 (217 – 250)	3,825
3–5 years	117 (107 – 127)	75.5 (65.7 – 79.7)	117 (109 – 122)	169 (155 – 276)	198
6–11 years	116 (111 – 122)	78.7 (73.9 – 81.4)	115 (109 – 119)	177 (164 – 207)	421
12–19 years	113 (110 – 116)	71.4 (67.8 – 74.1)	109 (106 – 113)	181 (171 – 203)	963
20–39 years	117 (112 – 123)	73.0 (68.4 – 76.5)	113 (106 – 120)	197 (180 – 218)	791
40–59 years	132 (123 – 142)	79.0 (71.2 – 85.3)	126 (119 – 136)	222 (208 – 236)	622
60 years and older	177 (165 – 189)	106 (97.3 – 111)	164 (155 – 170)	315 (291 – 357)	830

Table 1.7.a.3. Plasma methylmalonic acid: Mexican Americans

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for Mexican Americans in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	111 (108 – 114)	69.4 (67.1 – 72.4)	106 (100 – 112)	186 (174 – 201)	1,834
3–5 years	107 (94.2 – 122)	74.1† (65.1 – 76.9)	106 (87.8 – 118)	150† (133 – 279)	111
6–11 years	105 (96.7 – 113)	70.8 (61.5 – 77.1)	101 (92.6 – 112)	152 (142 – 192)	258
12–19 years	107 (102 – 112)	65.8 (62.4 – 69.8)	104 (98.3 – 109)	167 (160 – 184)	599
20–39 years	108 (99.2 – 117)	67.7 (65.0 – 70.6)	103 (92.6 – 116)	181 (156 – 242)	322
40–59 years	115 (110 – 119)	71.7 (65.4 – 75.8)	108 (102 – 115)	201 (178 – 220)	216
60 years and older	152 (138 – 168)	87.6 (81.1 – 92.8)	138 (125 – 159)	272 (245 – 368)	328
Males					
Total, 3 years and older	116 (114 – 119)	74.3 (69.8 – 77.3)	109 (106 – 114)	199 (185 – 217)	911
3–5 years	108 (93.9 – 124)	72.6† (57.0 – 81.5)	105 (87.6 – 119)	145† (131 – 307)	59
6–11 years	104 (96.1 – 113)	70.2 (50.9 – 79.4)	105 (90.5 – 113)	148 (138 – 232)	124
12–19 years	118 (111 – 126)	72.9 (67.6 – 78.7)	111 (104 – 119)	198 (171 – 242)	306
20–39 years	113 (104 – 124)	75.6 (64.0 – 81.1)	106 (99.5 – 113)	189 (157 – 363)	149
40–59 years	123 (114 – 133)	73.4 (65.2 – 76.6)	116 (103 – 131)	218 (173 – 330)	113
60 years and older	153 (130 – 181)	89.1 (80.1 – 95.3)	137 (119 – 158)	268 (234 – 411)	160
Females					
Total, 3 years and older	105 (99.3 – 112)	67.0 (61.7 – 68.7)	102 (92.6 – 110)	176 (157 – 201)	923
3–5 years	106 (87.6 – 128)	74.1† (57.0 – 81.0)	105 (80.4 – 127)	152† (124 – 228)	52
6–11 years	105 (94.3 – 117)	72.4 (58.9 – 77.7)	99.7 (89.6 – 115)	160 (145 – 218)	134
12–19 years	96.2 (91.3 – 101)	61.6 (55.1 – 66.5)	95.5 (90.0 – 102)	150 (142 – 156)	293
20–39 years	102 (91.2 – 113)	65.4 (56.5 – 68.0)	99.5 (81.5 – 119)	170 (147 – 208)	173
40–59 years	106 (95.2 – 117)	69.8† (58.0 – 75.4)	101 (95.6 – 109)	181† (137 – 247)	103
60 years and older	151 (135 – 170)	83.4 (77.3 – 96.5)	140 (120 – 171)	279 (243 – 333)	168

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

Table 1.7.a.4. Plasma methylmalonic acid: Non-Hispanic blacks

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for non-Hispanic blacks in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	109 (104 – 114)	68.4 (65.1 – 71.0)	105 (99.3 – 111)	177 (167 – 188)	1,993
3–5 years	95.4 (87.4 – 104)	62.7 (54.6 – 72.2)	99.4 (86.5 – 106)	139 (125 – 159)	146
6–11 years	98.7 (92.9 – 105)	65.9 (56.1 – 71.0)	96.6 (92.1 – 103)	147 (139 – 159)	290
12–19 years	96.0 (90.6 – 102)	63.9 (60.0 – 66.4)	93.2 (89.7 – 97.7)	147 (135 – 160)	721
20–39 years	102 (96.5 – 108)	66.7 (56.2 – 70.0)	99.3 (91.3 – 107)	161 (151 – 177)	328
40–59 years	117 (108 – 126)	74.1 (63.5 – 78.1)	114 (99.8 – 122)	193 (161 – 246)	275
60 years and older	148 (137 – 159)	91.8 (76.6 – 105)	142 (131 – 147)	245 (217 – 299)	233
Males					
Total, 3 years and older	112 (107 – 117)	69.6 (67.8 – 72.6)	108 (101 – 113)	184 (171 – 199)	992
3–5 years	95.4 (87.4 – 104)	65.2† (< LOD – 73.4)	101 (87.6 – 107)	125† (121 – 140)	76
6–11 years	99.0 (90.5 – 108)	64.3 (50.7 – 69.3)	97.4 (86.2 – 109)	150 (138 – 177)	135
12–19 years	102 (95.5 – 109)	69.5 (64.4 – 72.8)	97.9 (92.3 – 103)	154 (143 – 179)	381
20–39 years	107 (99.9 – 114)	69.3 (64.1 – 72.9)	102 (97.0 – 114)	157 (149 – 182)	161
40–59 years	122 (110 – 136)	71.5 (61.4 – 77.4)	117 (104 – 124)	226 (179 – 280)	130
60 years and older	145 (133 – 158)	85.0† (77.2 – 98.7)	138 (125 – 150)	237† (212 – 322)	109
Females					
Total, 3 years and older	107 (100 – 114)	66.9 (62.2 – 70.8)	104 (95.7 – 110)	172 (161 – 187)	1,001
3–5 years	95.4 (84.0 – 108)	59.3† (< LOD – 71.8)	95.6 (80.0 – 108)	141† (126 – 268)	70
6–11 years	98.4 (92.6 – 105)	68.7 (57.1 – 74.3)	95.9 (89.5 – 105)	145 (135 – 155)	155
12–19 years	90.3 (84.7 – 96.2)	59.4 (56.1 – 64.1)	89.6 (85.8 – 94.5)	139 (128 – 151)	340
20–39 years	98.5 (91.3 – 106)	64.5 (52.6 – 68.2)	92.9 (85.7 – 101)	162 (142 – 197)	167
40–59 years	113 (104 – 123)	75.0 (62.0 – 82.2)	110 (97.7 – 120)	169 (151 – 211)	145
60 years and older	150 (137 – 163)	96.5 (72.9 – 107)	143 (129 – 152)	247 (216 – 334)	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 1.7.a.5. Plasma methylmalonic acid: Non-Hispanic whites

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for non-Hispanic whites in the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 3 years and older	143 (136 – 150)	86.7 (82.8 – 89.9)	135 (129 – 141)	242 (229 – 266)	3,152
3–5 years	133 (123 – 145)	80.5 (64.1 – 94.6)	128 (119 – 140)	246 (200 – 274)	115
6–11 years	130 (122 – 139)	87.3 (77.5 – 95.7)	122 (114 – 135)	213 (189 – 232)	196
12–19 years	128 (122 – 133)	79.9 (77.7 – 83.3)	122 (119 – 127)	203 (188 – 217)	525
20–39 years	128 (121 – 136)	82.7 (76.3 – 87.1)	123 (115 – 132)	204 (194 – 228)	708
40–59 years	142 (134 – 152)	86.6 (80.6 – 92.9)	136 (128 – 145)	227 (210 – 258)	642
60 years and older	182 (173 – 192)	105 (99.1 – 109)	167 (161 – 176)	341 (316 – 365)	966
Males					
Total, 3 years and older	144 (137 – 152)	91.0 (85.8 – 94.2)	134 (127 – 142)	240 (224 – 274)	1,535
3–5 years	139 (121 – 160)	73.7† (63.0 – 99.4)	130 (118 – 155)	267† (242 – 279)	62
6–11 years	132 (120 – 146)	91.6† (72.1 – 101)	120 (111 – 141)	207† (184 – 266)	91
12–19 years	131 (122 – 141)	83.4 (78.2 – 89.6)	125 (119 – 133)	204 (179 – 256)	266
20–39 years	130 (120 – 141)	88.1 (69.7 – 93.3)	123 (113 – 137)	205 (186 – 231)	319
40–59 years	145 (135 – 157)	95.7 (82.6 – 99.6)	138 (130 – 145)	224 (203 – 275)	321
60 years and older	182 (171 – 195)	101 (95.8 – 104)	168 (159 – 187)	364 (330 – 390)	476
Females					
Total, 3 years and older	141 (135 – 148)	84.1 (79.2 – 88.1)	135 (129 – 141)	246 (231 – 261)	1,617
3–5 years	126 (113 – 141)	80.7† (54.0 – 103)	122 (113 – 140)	168† (151 – 311)	53
6–11 years	128 (121 – 136)	86.5† (71.3 – 92.4)	122 (116 – 129)	209† (170 – 251)	105
12–19 years	124 (119 – 129)	77.6 (73.9 – 80.2)	119 (115 – 127)	202 (179 – 231)	259
20–39 years	126 (119 – 133)	80.0 (75.3 – 84.5)	121 (114 – 132)	203 (187 – 239)	389
40–59 years	140 (128 – 152)	82.8 (71.4 – 90.2)	135 (122 – 147)	231 (219 – 259)	321
60 years and older	183 (170 – 196)	109 (103 – 116)	166 (161 – 175)	318 (299 – 360)	490

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

Table 1.7.b. Plasma methylmalonic acid: Concentrations by survey cycle

Geometric mean and selected percentiles of plasma concentrations (in nmol/L) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2004.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 3 years and older					
1999–2000	132 (129 – 136)	64.9 (62.8 – 67.0)	123 (119 – 126)	280 (266 – 298)	7,597
2001–2002	130 (126 – 133)	63.8 (61.3 – 66.4)	119 (116 – 123)	276 (263 – 293)	8,451
2003–2004	134 (128 – 140)	70.0 (67.3 – 72.8)	127 (122 – 132)	293 (277 – 320)	7,544
Age group					
3–5 years					
1999–2000	124 (118 – 131)	67.4 (61.8 – 71.6)	116 (111 – 122)	237 (197 – 332)	376
2001–2002	116 (112 – 121)	63.9 (61.8 – 66.0)	108 (104 – 113)	219 (195 – 244)	453
2003–2004	120 (110 – 130)	65.2 (56.6 – 72.1)	117 (109 – 124)	269 (235 – 307)	421
6–11 years					
1999–2000	125 (117 – 134)	66.9 (63.5 – 70.3)	117 (107 – 130)	210 (191 – 319)	898
2001–2002	118 (114 – 122)	62.6 (57.7 – 66.8)	113 (109 – 118)	200 (187 – 224)	1,031
2003–2004	117 (111 – 123)	67.5 (61.0 – 72.6)	113 (109 – 118)	228 (204 – 253)	806
12–19 years					
1999–2000	118 (112 – 125)	60.2 (55.1 – 63.5)	109 (103 – 117)	231 (206 – 291)	2,132
2001–2002	115 (112 – 119)	56.9 (54.6 – 59.1)	107 (104 – 110)	228 (216 – 264)	2,220
2003–2004	118 (115 – 122)	67.3 (64.8 – 70.0)	115 (110 – 118)	222 (210 – 263)	1,979
20–39 years					
1999–2000	124 (119 – 129)	62.4 (59.7 – 64.9)	116 (110 – 121)	259 (235 – 295)	1,474
2001–2002	121 (116 – 125)	59.5 (55.9 – 61.8)	112 (107 – 117)	239 (226 – 268)	1,715
2003–2004	122 (116 – 127)	67.3 (64.2 – 69.6)	116 (110 – 123)	246 (231 – 275)	1,496
40–59 years					
1999–2000	133 (130 – 137)	65.4 (62.6 – 68.1)	124 (122 – 127)	251 (239 – 277)	1,210
2001–2002	131 (127 – 135)	71.2 (66.4 – 73.4)	120 (117 – 124)	264 (231 – 302)	1,491
2003–2004	137 (129 – 144)	70.9 (66.6 – 75.0)	130 (124 – 138)	275 (252 – 338)	1,230
60 years and older					
1999–2000	168 (163 – 174)	80.3 (67.7 – 89.1)	149 (145 – 155)	423 (392 – 458)	1,507
2001–2002	172 (164 – 180)	76.9 (74.1 – 79.8)	156 (150 – 162)	487 (413 – 604)	1,541
2003–2004	177 (169 – 186)	89.9 (83.6 – 94.5)	163 (156 – 170)	429 (392 – 482)	1,612
Gender					
Males					
1999–2000	136 (132 – 141)	67.2 (64.5 – 70.0)	127 (123 – 131)	288 (265 – 309)	3,708
2001–2002	133 (129 – 138)	66.4 (62.7 – 70.1)	123 (120 – 127)	273 (258 – 294)	4,091
2003–2004	136 (130 – 142)	72.4 (69.4 – 75.4)	127 (123 – 132)	299 (277 – 339)	3,719
Females					
1999–2000	128 (124 – 132)	63.3 (61.1 – 65.5)	118 (114 – 122)	276 (262 – 294)	3,889
2001–2002	126 (123 – 130)	62.3 (59.9 – 64.7)	115 (111 – 119)	277 (261 – 301)	4,360
2003–2004	131 (125 – 138)	68.1 (65.2 – 71.3)	126 (120 – 132)	287 (272 – 315)	3,825
Race/ethnicity					
Mexican Americans					
1999–2000	110 (106 – 114)	56.2 (54.9 – 57.5)	100 (97.3 – 103)	225 (198 – 270)	2,595
2001–2002	111 (107 – 115)	53.7 (51.0 – 56.5)	103 (99.0 – 108)	225 (218 – 235)	2,131
2003–2004	111 (108 – 114)	61.9 (58.6 – 64.4)	106 (100 – 112)	230 (209 – 254)	1,834
Non-Hispanic Blacks					
1999–2000	108 (103 – 113)	57.5 (52.6 – 60.7)	98.3 (91.5 – 105)	217 (192 – 250)	1,732
2001–2002	112 (108 – 116)	55.6 (53.0 – 58.2)	102 (98.3 – 107)	220 (200 – 258)	2,036
2003–2004	109 (104 – 114)	61.1 (57.7 – 64.1)	105 (99.3 – 111)	224 (206 – 246)	1,993
Non-Hispanic Whites					
1999–2000	140 (136 – 144)	72.0 (69.8 – 74.2)	131 (126 – 135)	290 (272 – 311)	2,573
2001–2002	137 (133 – 141)	70.6 (66.8 – 72.7)	126 (122 – 130)	288 (272 – 304)	3,605
2003–2004	143 (136 – 150)	76.9 (73.1 – 79.9)	135 (129 – 141)	308 (283 – 340)	3,152

Figure 1.7.b. Plasma methylmalonic acid: Concentrations by survey cycle

Selected percentiles in nmol/L (95% confidence intervals), National Health and Nutrition Examination Survey, 1999–2004

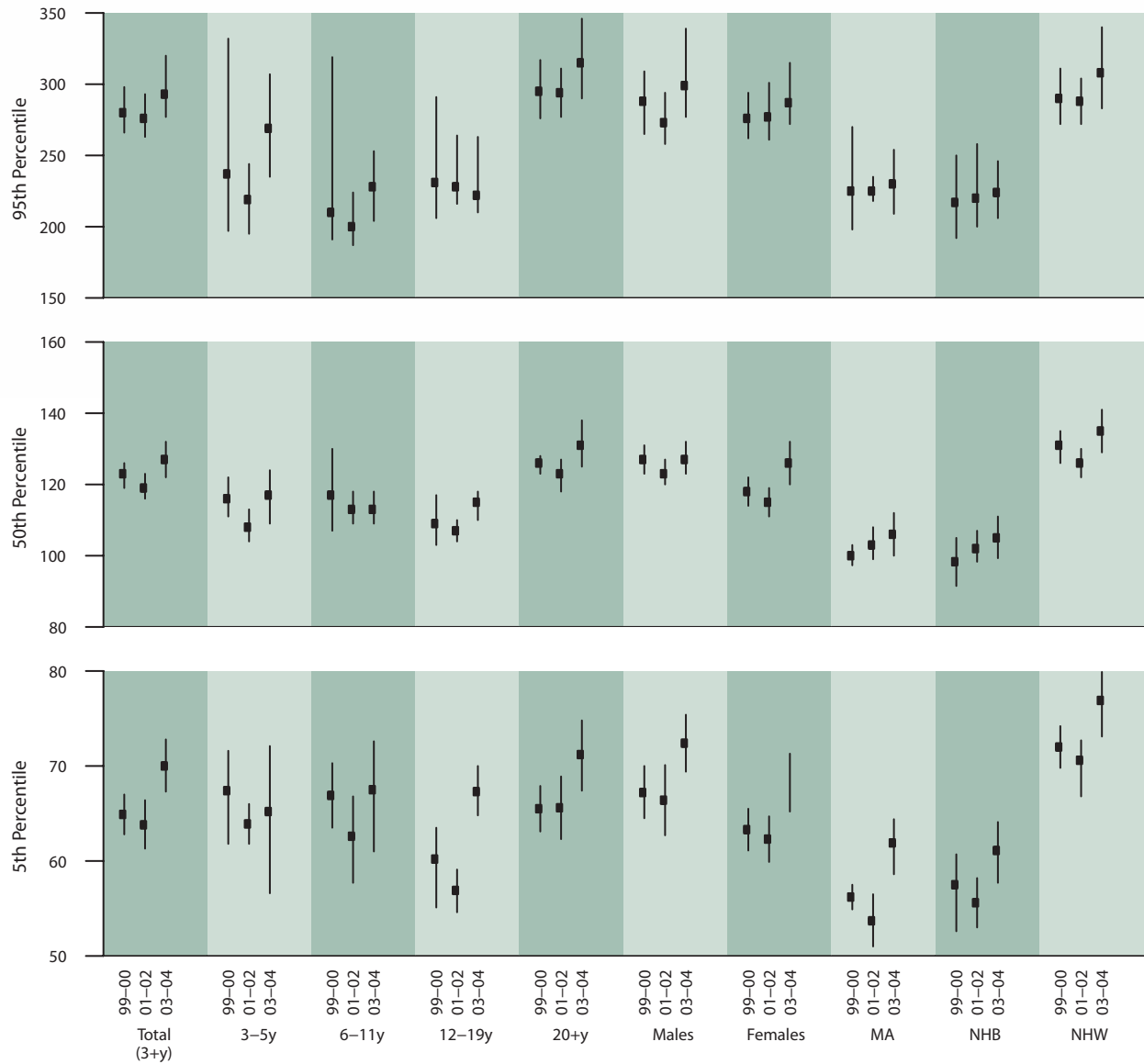


Table 1.7.c. Plasma methylmalonic acid: Prevalence

Prevalence (in percent) of high plasma methylmalonic acid concentration (> 271 nmol/L) for the U.S. population aged 3 years and older, National Health and Nutrition Examination Survey, 2003–2004.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 3 years and older	7,544	6.5 (5.3 – 7.9)	18,411,000
Age group			
3–5 years	421	4.5‡ (2.0 – 9.7)	916,000‡
6–11 years	806	§	§
12–19 years	1,979	3.2 (2.2 – 4.6)	1,054,000
20–39 years	1,496	3.8 (2.9 – 5.1)	3,066,000
40–59 years	1,230	5.8 (4.1 – 8.1)	4,557,000
60 years and older	1,612	16.7 (13.7 – 20.1)	7,748,000
Gender			
Males	3,719	6.8 (5.4 – 8.6)	9,439,000
Females	3,825	6.2 (5.0 – 7.7)	8,965,000
Race/ethnicity			
Mexican Americans	1,834	2.8 (1.7 – 4.4)	722,000
Non-Hispanic Blacks	1,993	2.5 (1.8 – 3.4)	846,000
Non-Hispanic Whites	3,152	7.6 (6.1 – 9.4)	14,546,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.
 § Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

Table 1.7.d. Plasma methylmalonic acid: Prevalence by survey cycle

Prevalence (in percent) of high plasma methylmalonic acid concentration (> 271 nmol/L) for the U.S. population, National Health and Nutrition Examination Survey, 1999–2004.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 3 years and older			
1999–2000	7,597	5.5 (4.8 – 6.3)	14,367,000
2001–2002	8,451	5.3 (4.6 – 6.0)	14,218,000
2003–2004	7,544	6.5 (5.3 – 7.9)	17,887,000
Age group			
3–5 years			
1999–2000	376	§	§
2001–2002	453	§	§
2003–2004	421	4.5‡ (2.0 – 9.7)	553,000‡
6–11 years			
1999–2000	898	2.5‡ (1.1 – 5.6)	623,000‡
2001–2002	1,031	1.5‡ (0.7 – 3.0)	372,000‡
2003–2004	806	§	§
12–19 years			
1999–2000	2,132	3.3 (2.1 – 5.3)	1,061,000
2001–2002	2,220	3.3 (2.1 – 5.3)	1,079,000
2003–2004	1,979	3.2 (2.2 – 4.6)	1,054,000
20–39 years			
1999–2000	1,474	4.5 (3.2 – 6.1)	3,496,000
2001–2002	1,715	3.7 (2.6 – 5.0)	2,888,000
2003–2004	1,496	3.8 (2.9 – 5.1)	3,066,000
40–59 years			
1999–2000	1,210	4.0 (3.0 – 5.2)	2,803,000
2001–2002	1,491	4.7 (3.6 – 6.1)	3,557,000
2003–2004	1,230	5.8 (4.1 – 8.1)	4,557,000
60 years and older			
1999–2000	1,507	13.9 (11.7 – 16.6)	5,986,000
2001–2002	1,541	13.9 (12.0 – 16.1)	6,225,000
2003–2004	1,612	16.7 (13.7 – 20.1)	7,748,000
Gender			
Males			
1999–2000	3,708	5.7 (4.7 – 6.9)	7,231,000
2001–2002	4,091	5.1 (4.3 – 6.0)	6,671,000
2003–2004	3,719	6.8 (5.4 – 8.6)	9,157,000
Females			
1999–2000	3,889	5.3 (4.5 – 6.3)	7,133,000
2001–2002	4,360	5.5 (4.6 – 6.5)	7,546,000
2003–2004	3,825	6.2 (5.0 – 7.7)	8,723,000
Race/ethnicity			
Mexican Americans			
1999–2000	2,595	3.2 (2.0 – 5.0)	632,000
2001–2002	2,131	2.9 (2.2 – 3.8)	656,000
2003–2004	1,834	2.8 (1.7 – 4.4)	687,000
Non-Hispanic Blacks			
1999–2000	1,732	2.5 (1.6 – 3.7)	803,000
2001–2002	2,036	2.6 (1.7 – 3.9)	842,000
2003–2004	1,993	2.5 (1.8 – 3.4)	817,000
Non-Hispanic Whites			
1999–2000	2,573	6.1 (5.3 – 7.1)	11,346,000
2001–2002	3,605	5.9 (5.2 – 6.8)	11,036,000
2003–2004	3,152	7.6 (6.1 – 9.4)	14,198,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

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Vitamin C (Ascorbic Acid)

Background Information

Sources and Physiological Functions. Vitamin C, a water-soluble vitamin, is a collective term used to refer to L-ascorbic acid (the functional form of the vitamin), dehydro-L-ascorbic acid (the oxidized form, DHA), and monodehydro-L-ascorbic acid (the free radical form). Greater than 95% of vitamin C in human plasma exists as ascorbic acid (Jacob 1990). The most abundant dietary sources of vitamin C are orange juice, grapefruit juice, peaches, sweet red peppers, and papayas, followed by a variety of other fruits, vegetables, and fortified cereals. Vitamin C is a powerful antioxidant and a cofactor in various reduction reactions; it is a known electron donor for at least eight human enzymes involved in the hydroxylation of collagen and the biosynthesis of carnitine, hormones, and amino acids. Humans and a few other mammals, such as monkeys and guinea pigs, are unable to biosynthesize vitamin C from glucose and must obtain the vitamin from outside sources.

Approximately 70–90% of the ascorbic acid consumed is absorbed by the human body at usual intakes of 30–180 milligrams per day (mg/d). Bioavailability of vitamin C from food or supplemental sources is equivalent. Vitamin C administered after the plasma has reached a point of saturation (approximately 70 $\mu\text{mol/L}$) will likely be excreted as unmetabolized ascorbic acid in the urine (Institute of Medicine 2000).

Health Effects. The clinical manifestation of vitamin C deficiency is scurvy. Scurvy can occur if intake is below 10 mg/d for many weeks. Important signs and symptoms of scurvy include coiled hairs, follicular hyperkeratosis, fatigue, bleeding gums, and delayed wound-healing (Institute of Medicine 2000). Too much vitamin C can cause gastrointestinal upset, but such upset is generally seen only at an intake exceeding 2 gram/d, and it usually disappears within one to two weeks of discontinuation. High intakes of vitamin C supplements have the potential to increase urinary oxalate excretion, which is a risk factor for the formation of calcium oxalate kidney stones, but evidence is conflicting.

Vitamin C, in combination with other supplements, including vitamin E, zinc, and *beta*-carotene, has been shown to slow the progression of age-related macular degeneration (AREDS Research Group 2001). There is conflicting evidence for the reduction of risk of cardiovascular disease mortality by vitamin C supplementation and its effect on cardiovascular health in general (Shekelle 2003). More research is also needed to determine the role vitamin C plays in cancer prevention and treatment.

Intake Recommendations. The recommended daily allowance (RDA) of vitamin C for adults is 120% of the EAR (estimated average requirement), which was determined by the maximally protective neutrophil vitamin C concentration. For men, this equates to 90 mg/d, with 75 mg being the appropriate daily amount for women (Institute of Medicine 2000). RDAs range from 15–25 mg/d for children one to eight years of age, 45–75 mg/d for boys aged nine to 18 years, and 45–65 mg/d for girls aged nine to 18 years. For infants aged 0 to 12 months, the RDA is set at the amount of vitamin C commonly received through regular breastfeeding and the additional amount obtained through solid foods during the seven to 12 month period (an average of 45 mg/d). A number of factors, such as bioavailability, interactions with other nutrients, smoking status, age, and gender, affect the amount of vitamin C required by humans. For example, people who smoke require an additional 35 mg/d of vitamin C due to the increased ascorbic acid needed to repair oxidant damage (Institute of Medicine 2000).

Biochemical Indicators and Methods.

Vitamin C status can be assessed by measuring total ascorbic acid (oxidized and reduced) in serum or plasma, buffy-coat, or leucocytes. Ascorbic acid in plasma is considered an index of the circulating vitamin available to tissues, and in leucocytes (particularly polymorphonuclear) it is believed to be a good indicator of tissue stores. Vitamin C deficiency is generally defined as plasma or serum concentrations less than 11.4 micromoles per liter ($\mu\text{mol/L}$), or the level at which signs and symptoms of scurvy may appear. Serum ascorbic acid concentrations between 11.4–23 $\mu\text{mol/L}$ are considered low (Gibson 2005).



Clinical laboratories generally use international system (SI) units for vitamin C ($\mu\text{mol/L}$); however, some use conventional units (mg per deciliter [mg/dL]). The conversion factor to conventional units is: $1 \mu\text{mol/L} = 0.0176 \text{ mg/dL}$.

High-performance liquid chromatography (HPLC) methods with electrochemical detection, which provide necessary sensitivity and specificity, are generally used to quantitate serum vitamin C concentrations. Older spectrophotometric assays were susceptible to interferences from a number of substances, such as riboflavin and aspirin. A multi-level standard reference material (SRM 970) is available from the National Institute of Standards and Technology (NIST) for human serum with certified values for ascorbic acid. The Micronutrients Measurement Quality Assurance Program (MMQAP) sponsored by NIST hosts inter-laboratory comparison studies directed at assuring high quality measurements of serum vitamin C.

Data in NHANES. An HPLC method with electrochemical detection was used to determine serum vitamin C concentrations in NHANES 2003–2006 (McCoy 2005). Because of the incorporation of an internal standard, improved accuracy and precision was achieved with this method compared to the previous method used during NHANES III (1988–1994).

An analysis of NHANES 2003–2004 data showed that the highest serum concentrations of vitamin C were found in children and older persons. Mean concentrations among adult smokers were one-third lower than those of nonsmokers. In NHANES 2003–2004, the prevalence of vitamin C deficiency was significantly lower than that during NHANES III, but smokers and low-income persons were among those at increased risk of deficiency (Schleicher 2009).

For more information about vitamin C, see the Institute of Medicine's Dietary Reference Intake reports (Institute of Medicine, Food and Nutrition Board 2000) and fact sheets from the National Institutes of Health, Office of Dietary Supplements (http://ods.od.nih.gov/factsheets/VitaminC_pf.asp).

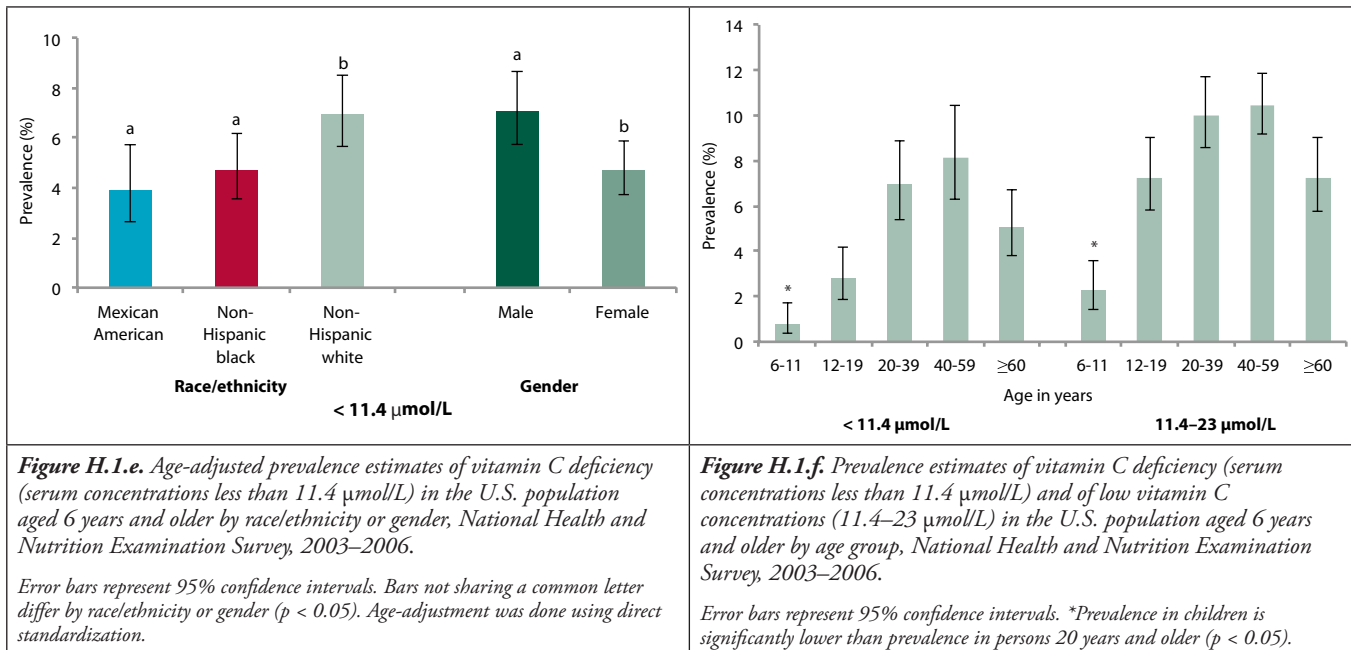
Highlights

Serum vitamin C concentrations in the U.S. population showed the following demographic patterns and characteristics:

- The highest concentrations were generally found in the youngest age group and higher concentrations were found in females compared to males.
- The likelihood of being vitamin C deficient or having low serum vitamin C concentrations varied by demographic subgroup.

Serum vitamin C concentrations less than $11.4 \mu\text{mol/L}$ may indicate vitamin C deficiency. Compared to non-Hispanic whites, Mexican Americans and non-Hispanic blacks had a lower risk of deficiency; compared to females, males had a higher risk of deficiency (Figure H.1.e). A number of important variables that impact vitamin C status are not addressed in this analysis, including smoking, overweight/obesity, socioeconomic status, and supplement use (Schleicher 2009). Considering that manifest vitamin C deficiency is rare in the United States (Olmedo 2006), persons categorized as vitamin C deficient may more likely experience latent scurvy, which is characterized by fatigue, irritability, vague, dull aching pains and weight loss (Prinzo 1999).

Serum vitamin C concentrations between $11.4\text{--}23 \mu\text{mol/L}$ are considered low. The prevalence of deficient ($< 11.4 \mu\text{mol/L}$) and of low ($11.4\text{--}23 \mu\text{mol/L}$) serum vitamin C concentrations was significantly lower in children than in persons 20 years and older (Figure H.1.f).



Detailed Observations

The selected observations mentioned below are derived from the tables and figures presented next. 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 blood concentration determinants (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 not statistically significant 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 G](#).

Arithmetic mean concentrations (NHANES 2003–2006):

- The distribution of serum vitamin C concentrations was reasonably symmetric and for that reason we present arithmetic means.
- Serum vitamin C concentrations followed a U-shaped pattern, with the lowest concentrations seen in 20–59 year old persons (Table 1.8.a.1 and Figure 1.8.a).
- Females had higher serum vitamin C concentrations than males (Table 1.8.a.1).
- We observed no differences in serum vitamin C concentrations among race/ethnic groups (Table 1.8.a.1).

Changes in arithmetic mean concentrations across survey cycles:

- No changes in the serum vitamin C concentrations (Table 1.8.b) were observed between 2003–2004 and 2005–2006.

Prevalence estimates of low or high biochemical indicator concentrations:

- Six percent of the population aged 6 years and older had serum vitamin C concentrations < 11.4 $\mu\text{mol/L}$ (Table 1.8.c).
- Children (<1%) and adolescents (3%) had a lower prevalence of low serum vitamin C concentrations than older age groups (5–8%).
- Non-Hispanic whites (7%) had a higher prevalence of low serum vitamin C concentrations than non-Hispanic blacks (4%) and Mexican Americans (3%).

Table 1.8.a.1. Serum vitamin C: Concentrations

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for the total U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)					Sample size
		2.5th	5th	50th	95th	97.5th	
Total, 6 years and older	56.1 (54.6 – 57.6)	6.12 (5.47 – 6.91)	9.61 (8.17 – 10.9)	56.3 (54.9 – 57.6)	103 (101 – 105)	116 (113 – 120)	14,579
Age group							
6–11 years	75.1 (73.0 – 77.2)	21.3 (16.1 – 24.2)	29.0 (25.0 – 33.7)	74.5 (72.6 – 76.5)	123 (115 – 131)	138 (128 – 153)	1,703
12–19 years	58.0 (55.9 – 60.2)	10.2 (7.68 – 11.9)	15.2 (11.9 – 17.0)	58.6 (55.9 – 60.7)	98.9 (94.5 – 103)	109 (105 – 115)	3,984
20–39 years	51.0 (48.8 – 53.2)	6.01 (4.60 – 7.31)	9.00 (7.48 – 10.3)	51.4 (49.2 – 53.9)	92.9 (89.4 – 96.9)	102 (98.0 – 107)	3,233
40–59 years	51.6 (49.7 – 53.4)	4.92 (4.06 – 5.69)	7.41 (5.91 – 8.77)	52.4 (50.6 – 53.9)	97.2 (94.3 – 101)	111 (105 – 117)	2,635
60 years and older	63.0 (61.5 – 64.6)	6.91 (5.53 – 7.90)	10.7 (8.16 – 13.6)	62.5 (61.1 – 63.9)	117 (112 – 121)	131 (127 – 142)	3,024
Gender							
Males	52.4 (50.9 – 54.0)	5.80 (4.89 – 6.48)	8.38 (7.09 – 9.70)	52.6 (51.2 – 54.0)	98.9 (96.4 – 102)	110 (107 – 115)	7,155
Females	59.7 (57.9 – 61.4)	7.06 (5.74 – 8.15)	11.2 (9.61 – 12.9)	59.6 (58.1 – 61.2)	106 (103 – 111)	121 (117 – 128)	7,424
Race/ethnicity							
Mexican Americans	55.2 (52.7 – 57.7)	9.49 (7.64 – 12.1)	15.1 (11.6 – 18.7)	55.1 (52.8 – 57.7)	93.7 (90.7 – 96.0)	101 (97.6 – 107)	3,628
Non-Hispanic Blacks	54.3 (52.7 – 56.0)	7.38 (5.75 – 9.18)	11.9 (10.0 – 14.0)	54.0 (52.2 – 55.9)	95.2 (92.7 – 97.5)	104 (101 – 110)	3,784
Non-Hispanic Whites	56.5 (54.6 – 58.4)	5.75 (5.05 – 6.36)	8.56 (7.26 – 9.92)	56.9 (54.9 – 58.7)	105 (103 – 108)	120 (115 – 125)	6,089

Figure 1.8.a. Serum vitamin C: Concentrations by age group

Arithmetic mean (95% confidence interval), National Health and Nutrition Examination Survey, 2003–2006

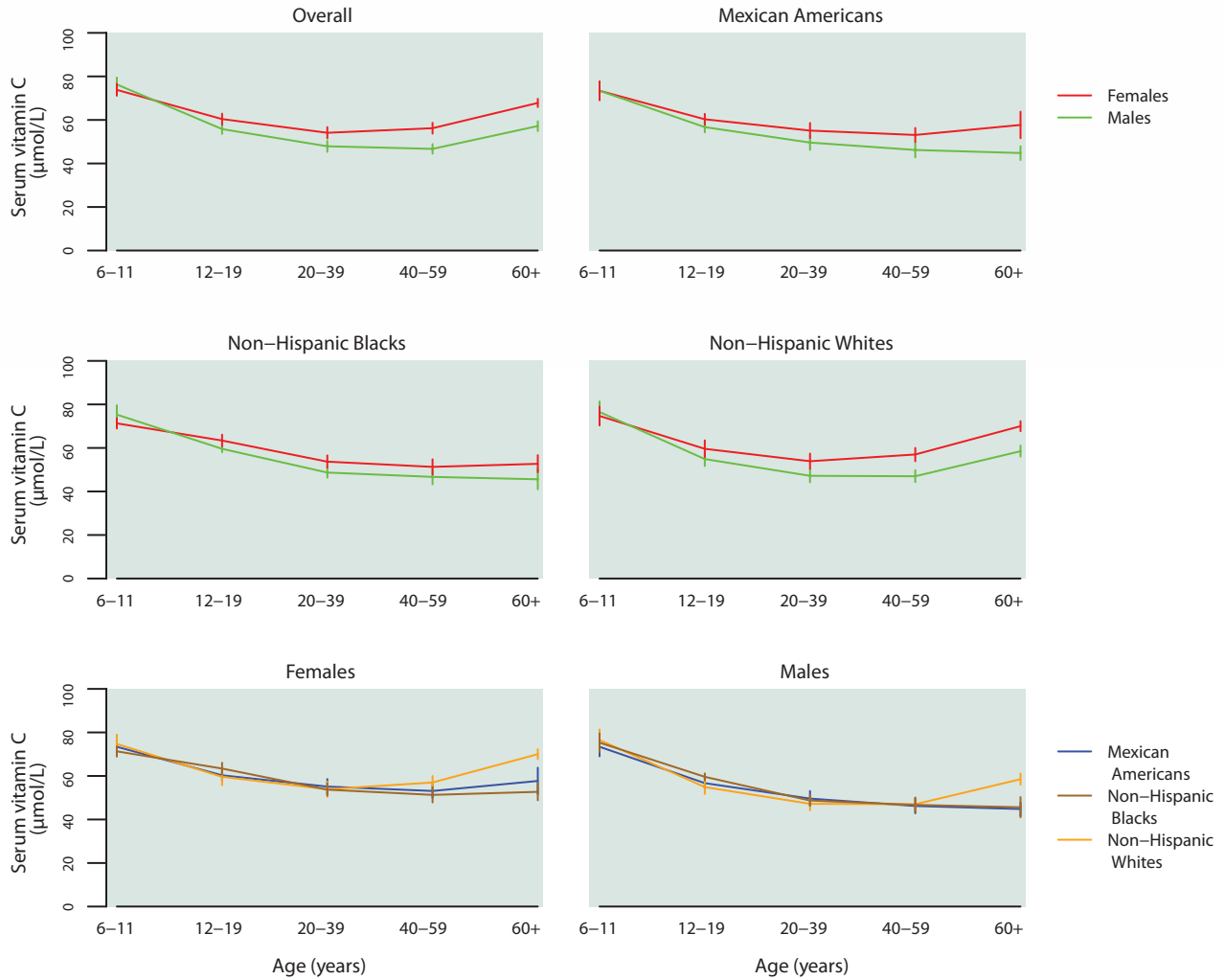


Table 1.8.a.2. Serum vitamin C: Total population

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for the total U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 6 years and older	56.1 (54.6 – 57.6)	9.61 (8.17 – 10.9)	56.3 (54.9 – 57.6)	103 (101 – 105)	14,579
6–11 years	75.1 (73.0 – 77.2)	29.0 (25.0 – 33.7)	74.5 (72.6 – 76.5)	123 (115 – 131)	1,703
12–19 years	58.0 (55.9 – 60.2)	15.2 (11.9 – 17.0)	58.6 (55.9 – 60.7)	98.9 (94.5 – 103)	3,984
20–39 years	51.0 (48.8 – 53.2)	9.00 (7.48 – 10.3)	51.4 (49.2 – 53.9)	92.9 (89.4 – 96.9)	3,233
40–59 years	51.6 (49.7 – 53.4)	7.41 (5.91 – 8.77)	52.4 (50.6 – 53.9)	97.2 (94.3 – 101)	2,635
60 years and older	63.0 (61.5 – 64.6)	10.7 (8.16 – 13.6)	62.5 (61.1 – 63.9)	117 (112 – 121)	3,024
Males					
Total, 6 years and older	52.4 (50.9 – 54.0)	8.38 (7.09 – 9.70)	52.6 (51.2 – 54.0)	98.9 (96.4 – 102)	7,155
6–11 years	76.3 (73.1 – 79.5)	30.4 (21.7 – 37.7)	76.2 (72.5 – 78.7)	123 (113 – 138)	837
12–19 years	55.8 (53.6 – 58.1)	14.7 (11.2 – 16.5)	56.0 (53.4 – 58.5)	94.0 (91.2 – 100)	2,022
20–39 years	47.9 (45.3 – 50.4)	8.58 (6.68 – 9.87)	48.4 (45.2 – 50.8)	87.5 (82.8 – 95.4)	1,463
40–59 years	46.7 (44.5 – 48.9)	6.38 (4.89 – 7.94)	48.2 (46.1 – 50.2)	88.4 (84.8 – 96.3)	1,305
60 years and older	57.2 (54.9 – 59.4)	7.92 (6.72 – 10.1)	57.2 (54.7 – 59.4)	110 (105 – 118)	1,528
Females					
Total, 6 years and older	59.7 (57.9 – 61.4)	11.2 (9.61 – 12.9)	59.6 (58.1 – 61.2)	106 (103 – 111)	7,424
6–11 years	73.8 (71.1 – 76.6)	28.5 (20.3 – 35.9)	72.4 (69.2 – 75.9)	123 (115 – 131)	866
12–19 years	60.4 (57.8 – 62.9)	15.7 (11.0 – 18.8)	61.4 (58.6 – 63.9)	102 (98.2 – 110)	1,962
20–39 years	54.1 (51.5 – 56.7)	9.90 (7.73 – 11.5)	55.3 (51.9 – 58.6)	96.1 (91.9 – 101)	1,770
40–59 years	56.2 (53.7 – 58.7)	9.34 (6.29 – 12.0)	56.4 (53.6 – 58.2)	103 (97.4 – 110)	1,330
60 years and older	67.8 (65.9 – 69.7)	14.3 (10.9 – 16.4)	67.0 (65.1 – 69.0)	121 (116 – 129)	1,496

Table 1.8.a.3. Serum vitamin C: Mexican Americans

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for Mexican Americans in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 6 years and older	55.2 (52.7 – 57.7)	15.1 (11.6 – 18.7)	55.1 (52.8 – 57.7)	93.7 (90.7 – 96.0)	3,628
6–11 years	73.4 (69.4 – 77.4)	28.3 (20.7 – 37.8)	74.2 (71.7 – 76.4)	113 (107 – 130)	563
12–19 years	58.5 (56.4 – 60.5)	20.3 (14.9 – 23.9)	59.0 (57.4 – 60.7)	92.7 (90.6 – 95.2)	1,266
20–39 years	52.2 (49.4 – 54.9)	15.9 (12.2 – 20.6)	52.4 (49.9 – 54.5)	85.7 (80.9 – 90.6)	782
40–59 years	49.5 (46.9 – 52.1)	9.55 (7.54 – 14.0)	51.0 (47.5 – 54.7)	83.6 (80.0 – 85.2)	470
60 years and older	51.8 (47.8 – 55.8)	9.48 (2.78 – 14.5)	50.5 (46.0 – 55.9)	93.6 (88.9 – 103)	547
Males					
Total, 6 years and older	52.7 (50.0 – 55.5)	13.6 (8.67 – 17.5)	53.3 (50.4 – 55.7)	90.8 (87.6 – 94.5)	1,762
6–11 years	73.4 (69.0 – 77.8)	28.2 (20.8 – 37.5)	74.6 (71.4 – 77.2)	113 (108 – 134)	275
12–19 years	56.7 (54.3 – 59.1)	18.9 (10.6 – 23.3)	57.4 (55.2 – 59.5)	90.1 (86.9 – 93.0)	628
20–39 years	49.6 (46.2 – 53.1)	14.2 (7.50 – 22.1)	50.8 (47.7 – 54.4)	79.5 (73.6 – 86.6)	351
40–59 years	46.2 (42.8 – 49.7)	8.27 (4.43 – 13.6)	46.3 (43.5 – 53.5)	76.5 (73.9 – 87.2)	239
60 years and older	44.8 (41.6 – 47.9)	7.27 (1.70 – 10.0)	44.0 (38.1 – 48.9)	86.3 (78.5 – 94.2)	269
Females					
Total, 6 years and older	58.0 (55.4 – 60.6)	18.6 (14.1 – 21.5)	58.1 (54.8 – 60.8)	95.1 (92.4 – 99.2)	1,866
6–11 years	73.4 (69.1 – 77.7)	26.5 (18.0 – 41.2)	73.3 (70.7 – 76.2)	113 (103 – 129)	288
12–19 years	60.3 (57.8 – 62.8)	22.4 (18.8 – 24.7)	60.7 (58.4 – 62.7)	95.1 (90.9 – 104)	638
20–39 years	55.1 (51.7 – 58.6)	18.5 (12.8 – 22.6)	54.0 (50.6 – 58.0)	90.0 (84.3 – 102)	431
40–59 years	53.1 (49.9 – 56.3)	10.6 (7.49 – 18.2)	54.5 (50.0 – 58.9)	85.2 (83.9 – 92.9)	231
60 years and older	57.7 (51.6 – 63.8)	14.3 (1.10 – 23.2)	58.7 (48.3 – 64.2)	97.9 (93.4 – 116)	278

Table 1.8.a.4. Serum vitamin C: Non-Hispanic blacks

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for non-Hispanic blacks in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 6 years and older	54.3 (52.7 – 56.0)	11.9 (10.0 – 14.0)	54.0 (52.2 – 55.9)	95.2 (92.7 – 97.5)	3,784
6–11 years	73.4 (70.8 – 75.9)	39.7 (34.0 – 43.0)	72.8 (69.0 – 75.9)	107 (103 – 118)	544
12–19 years	61.5 (59.7 – 63.2)	28.1 (25.9 – 30.3)	61.3 (59.1 – 63.2)	95.0 (91.7 – 98.3)	1,400
20–39 years	51.5 (49.4 – 53.5)	14.7 (11.2 – 16.9)	50.4 (48.1 – 53.2)	87.3 (83.4 – 91.3)	711
40–59 years	49.2 (46.3 – 52.1)	8.58 (4.80 – 11.2)	48.9 (45.3 – 52.7)	93.1 (83.9 – 101)	619
60 years and older	49.8 (46.8 – 52.8)	6.69 (4.99 – 8.42)	50.8 (47.0 – 54.1)	95.9 (90.8 – 101)	510
Males					
Total, 6 years and older	52.6 (51.0 – 54.1)	10.2 (7.77 – 12.6)	52.1 (50.4 – 54.2)	92.8 (90.2 – 97.3)	1,895
6–11 years	75.3 (71.0 – 79.6)	42.4 (34.1 – 44.3)	75.8 (69.8 – 79.9)	108 (104 – 118)	272
12–19 years	59.6 (58.0 – 61.2)	28.6 (24.2 – 30.2)	58.8 (56.4 – 61.0)	91.6 (89.5 – 96.1)	735
20–39 years	48.7 (46.3 – 51.2)	12.4 (6.93 – 16.2)	48.0 (44.0 – 50.9)	81.5 (76.6 – 91.0)	337
40–59 years	46.7 (43.3 – 50.1)	7.24 (4.00 – 10.4)	46.6 (42.2 – 51.3)	82.8 (77.1 – 97.4)	291
60 years and older	45.6 (41.0 – 50.3)	5.02 (2.96 – 6.19)	45.6 (38.6 – 50.9)	93.0 (89.0 – 106)	260
Females					
Total, 6 years and older	55.8 (53.7 – 58.0)	13.5 (11.3 – 15.8)	55.8 (53.5 – 58.1)	95.9 (94.1 – 99.8)	1,889
6–11 years	71.3 (68.9 – 73.7)	36.8 (30.8 – 41.4)	68.8 (67.0 – 73.1)	106 (102 – 114)	272
12–19 years	63.4 (60.7 – 66.1)	27.6 (25.9 – 30.8)	63.8 (60.6 – 67.0)	96.0 (92.8 – 102)	665
20–39 years	53.7 (50.9 – 56.6)	15.7 (11.5 – 21.5)	52.7 (49.4 – 56.3)	90.5 (86.6 – 95.8)	374
40–59 years	51.3 (47.8 – 54.8)	9.84 (4.02 – 14.5)	50.4 (47.2 – 55.2)	95.9 (86.6 – 106)	328
60 years and older	52.7 (48.8 – 56.7)	9.64 (4.66 – 11.2)	54.0 (50.1 – 58.2)	96.5 (90.0 – 108)	250

Table 1.8.a.5. Serum vitamin C: Non-Hispanic whites

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for non-Hispanic whites in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Males and Females					
Total, 6 years and older	56.5 (54.6 – 58.4)	8.56 (7.26 – 9.92)	56.9 (54.9 – 58.7)	105 (103 – 108)	6,089
6–11 years	75.6 (72.5 – 78.8)	25.7 (18.7 – 31.8)	74.8 (70.9 – 77.7)	128 (118 – 144)	436
12–19 years	57.2 (54.0 – 60.4)	12.3 (9.88 – 15.7)	58.0 (53.2 – 61.5)	101 (95.4 – 107)	1,037
20–39 years	50.6 (47.8 – 53.3)	7.99 (6.39 – 8.99)	51.2 (47.7 – 55.1)	96.2 (91.2 – 102)	1,442
40–59 years	52.0 (49.7 – 54.3)	6.80 (5.56 – 8.33)	52.8 (51.2 – 55.2)	99.8 (96.0 – 103)	1,346
60 years and older	64.8 (63.0 – 66.7)	11.7 (8.22 – 14.7)	63.9 (62.4 – 65.3)	118 (114 – 123)	1,828
Males					
Total, 6 years and older	52.3 (50.4 – 54.1)	7.71 (6.50 – 8.82)	52.4 (50.5 – 54.5)	101 (98.2 – 104)	2,990
6–11 years	76.5 (71.7 – 81.4)	25.4† (14.0 – 34.1)	75.8 (69.2 – 80.6)	127† (117 – 155)	210
12–19 years	54.9 (51.7 – 58.1)	12.6 (9.73 – 16.2)	54.8 (51.4 – 59.1)	94.4 (91.6 – 104)	524
20–39 years	47.2 (44.2 – 50.3)	7.92 (6.52 – 8.79)	47.5 (44.1 – 50.7)	93.8 (85.8 – 98.7)	636
40–59 years	47.0 (44.3 – 49.8)	6.19 (4.90 – 7.44)	48.5 (46.4 – 51.0)	90.2 (86.4 – 101)	687
60 years and older	58.5 (56.0 – 61.1)	8.15 (6.84 – 11.5)	58.4 (55.6 – 60.7)	112 (106 – 119)	933
Females					
Total, 6 years and older	60.5 (58.2 – 62.8)	9.92 (8.18 – 11.7)	60.7 (58.5 – 62.8)	110 (106 – 114)	3,099
6–11 years	74.7 (70.3 – 79.0)	25.2 (9.65 – 36.1)	72.8 (68.7 – 78.2)	129 (115 – 145)	226
12–19 years	59.6 (55.8 – 63.5)	12.0 (8.98 – 15.7)	61.1 (56.9 – 64.7)	104 (98.6 – 120)	513
20–39 years	53.9 (50.4 – 57.4)	8.06 (5.40 – 9.86)	56.0 (50.2 – 60.7)	99.0 (93.1 – 106)	806
40–59 years	57.0 (53.9 – 60.0)	8.63 (5.81 – 11.1)	57.4 (53.5 – 59.8)	105 (98.0 – 113)	659
60 years and older	70.0 (67.7 – 72.3)	15.0 (10.9 – 17.9)	69.1 (66.5 – 72.6)	123 (117 – 131)	895

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

Table 1.8.b. Serum vitamin C: Concentrations by survey cycle

Arithmetic mean and selected percentiles of serum concentrations (in $\mu\text{mol/L}$) for the U.S. population, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 6 years and older					
2003–2004	55.8 (53.1 – 58.5)	8.55 (6.57 – 10.2)	56.3 (53.4 – 58.8)	103 (101 – 108)	7,277
2005–2006	56.4 (54.8 – 58.0)	11.1 (9.22 – 12.4)	56.3 (55.0 – 57.6)	102 (99.2 – 105)	7,302
Age group					
6–11 years					
2003–2004	74.3 (70.9 – 77.8)	27.8 (16.6 – 35.5)	73.7 (70.8 – 76.8)	126 (112 – 139)	823
2005–2006	75.9 (73.1 – 78.7)	32.0 (26.2 – 36.6)	75.0 (72.4 – 78.1)	121 (114 – 130)	880
12–19 years					
2003–2004	56.3 (52.9 – 59.8)	13.6 (10.2 – 16.2)	56.2 (52.1 – 60.0)	98.4 (93.6 – 106)	2,016
2005–2006	59.7 (57.0 – 62.4)	17.0 (13.4 – 20.8)	60.3 (57.3 – 63.5)	99.3 (93.0 – 107)	1,968
20–39 years					
2003–2004	49.7 (46.0 – 53.5)	7.34 (5.42 – 9.22)	50.0 (45.7 – 54.1)	95.0 (87.9 – 102)	1,540
2005–2006	52.2 (49.7 – 54.8)	11.3 (9.71 – 12.5)	52.8 (49.7 – 55.7)	91.9 (87.8 – 97.1)	1,693
40–59 years					
2003–2004	52.6 (49.4 – 55.8)	6.71 (5.02 – 8.71)	53.5 (51.2 – 56.6)	100 (95.5 – 105)	1,266
2005–2006	50.6 (48.3 – 52.9)	7.92 (5.51 – 10.9)	51.3 (48.9 – 53.4)	94.4 (90.1 – 100)	1,369
60 years and older					
2003–2004	63.2 (60.8 – 65.6)	10.3 (7.88 – 13.3)	62.5 (60.2 – 64.7)	119 (114 – 124)	1,632
2005–2006	62.9 (60.7 – 65.1)	11.8 (6.99 – 15.1)	62.6 (60.7 – 64.5)	113 (108 – 119)	1,392
Gender					
Males					
2003–2004	52.2 (49.4 – 54.9)	7.32 (5.74 – 9.08)	52.7 (50.1 – 55.2)	100 (97.7 – 103)	3,590
2005–2006	52.7 (51.0 – 54.3)	9.74 (7.88 – 11.0)	52.4 (50.9 – 53.9)	97.3 (93.7 – 102)	3,565
Females					
2003–2004	59.3 (56.4 – 62.3)	9.76 (7.89 – 11.4)	59.8 (56.7 – 62.5)	108 (102 – 115)	3,687
2005–2006	60.0 (57.9 – 62.1)	13.1 (11.1 – 15.6)	59.4 (57.7 – 61.4)	105 (101 – 111)	3,737
Race/ethnicity					
Mexican Americans					
2003–2004	55.4 (50.6 – 60.2)	14.0 (7.30 – 20.1)	55.6 (51.7 – 60.0)	93.1 (89.3 – 97.1)	1,766
2005–2006	55.1 (52.8 – 57.5)	17.1 (10.8 – 20.6)	54.6 (51.7 – 57.5)	94.2 (90.8 – 97.3)	1,862
Non-Hispanic Blacks					
2003–2004	52.9 (50.3 – 55.4)	11.1 (7.65 – 13.5)	52.0 (49.7 – 55.5)	93.7 (90.5 – 99.1)	1,880
2005–2006	55.7 (53.6 – 57.9)	13.0 (9.49 – 16.8)	55.4 (53.5 – 57.6)	95.6 (94.0 – 99.2)	1,904
Non-Hispanic Whites					
2003–2004	56.7 (53.1 – 60.3)	7.82 (6.24 – 9.09)	57.4 (53.1 – 60.6)	108 (103 – 115)	3,103
2005–2006	56.3 (54.5 – 58.0)	10.0 (7.77 – 11.7)	56.4 (54.7 – 58.0)	103 (100 – 106)	2,986

Figure 1.8.b. Serum vitamin C: Concentrations by survey cycle

Selected percentiles in $\mu\text{mol/L}$ (95% confidence intervals), National Health and Nutrition Examination Survey, 2003–2006

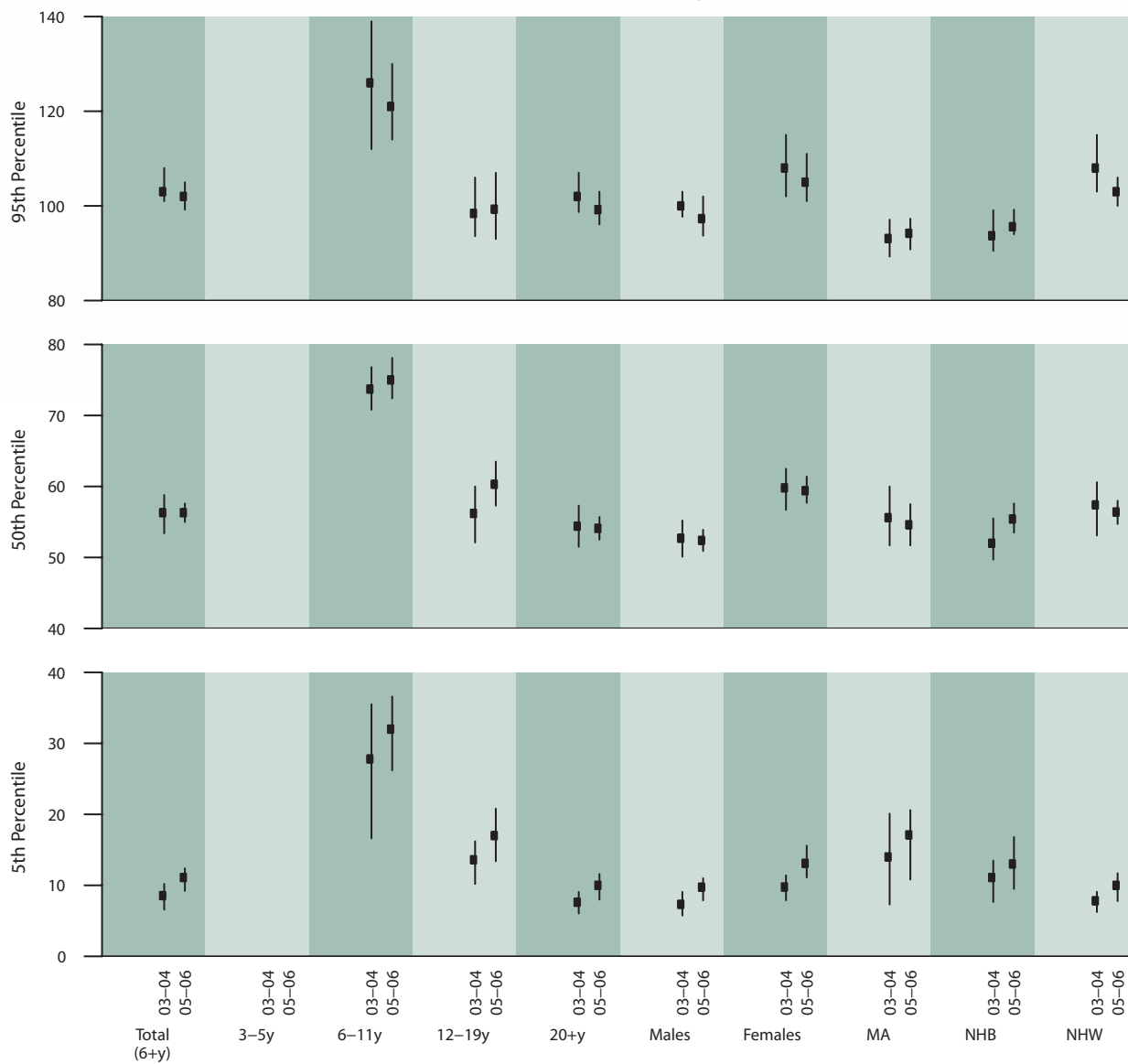


Table 1.8.c. Serum vitamin C: Prevalence

Prevalence (in percent) of low serum vitamin C concentration (< 11.4 µmol/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 6 years and older	14,579	6.0 (4.9 – 7.3)	15,757,000
Age group			
6–11 years	1,703	0.8‡ (0.4 – 1.7)	191,000‡
12–19 years	3,984	2.8 (1.9 – 4.2)	931,000
20–39 years	3,233	6.9 (5.4 – 8.9)	5,533,000
40–59 years	2,635	8.1 (6.3 – 10.5)	6,435,000
60 years and older	3,024	5.1 (3.8 – 6.8)	2,362,000
Gender			
Males	7,155	7.3 (5.9 – 9.0)	9,258,000
Females	7,424	4.8 (3.8 – 6.0)	6,476,000
Race/ethnicity			
Mexican Americans	3,628	3.1 (2.1 – 4.6)	715,000
Non-Hispanic Blacks	3,784	4.3 (3.2 – 5.7)	1,341,000
Non-Hispanic Whites	6,089	7.1 (5.8 – 8.7)	12,807,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.

Table 1.8.d. Serum vitamin C: Prevalence by survey cycle

Prevalence (in percent) of low serum vitamin C concentration (< 11.4 µmol/L) for the U.S. population, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Total, 6 years and older			
2003–2004	7,277	7.3 (5.5 – 9.6)	19,054,000
2005–2006	7,302	4.8 (3.7 – 6.1)	12,746,000
Age group			
6–11 years			
2003–2004	823	1.5‡ (0.7 – 3.6)	372,000‡
2005–2006	880	§	§
12–19 years			
2003–2004	2,016	3.3 (1.9 – 5.7)	1,090,000
2005–2006	1,968	2.3‡ (1.2 – 4.5)	783,000‡
20–39 years			
2003–2004	1,540	9.3 (6.7 – 12.8)	7,437,000
2005–2006	1,693	4.5 (3.2 – 6.4)	3,618,000
40–59 years			
2003–2004	1,266	9.2 (6.5 – 13.0)	7,294,000
2005–2006	1,369	7.1 (4.7 – 10.5)	5,815,000
60 years and older			
2003–2004	1,632	5.5 (3.9 – 7.5)	2,543,000
2005–2006	1,392	4.7 (2.8 – 7.8)	2,272,000
Gender			
Males			
2003–2004	3,590	8.4 (6.0 – 11.8)	10,772,000
2005–2006	3,565	6.1 (4.8 – 7.7)	7,914,000
Females			
2003–2004	3,687	6.1 (4.6 – 8.0)	8,247,000
2005–2006	3,737	3.5 (2.4 – 5.1)	4,827,000
Race/ethnicity			
Mexican Americans			
2003–2004	1,766	3.7 (2.0 – 6.7)	840,000
2005–2006	1,862	2.6 (1.6 – 4.2)	627,000
Non-Hispanic Blacks			
2003–2004	1,880	4.8 (3.4 – 6.8)	1,510,000
2005–2006	1,904	3.8 (2.3 – 6.2)	1,199,000
Non-Hispanic Whites			
2003–2004	3,103	8.6 (6.4 – 11.5)	15,534,000
2005–2006	2,986	5.6 (4.2 – 7.4)	10,186,000

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate.

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.

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