3. Trace Elements

Iron-Status Indicators

- Ferritin
- Soluble transferrin receptor
- Body iron

Iodine

Iron-Status Indicators

Background Information

Sources and Physiological Functions. Iron functions as a component of proteins and enzymes. Almost two-thirds of the iron in the body (approximately 2.5 grams of iron) is found in hemoglobin, the protein in red blood cells that carries oxygen to tissues, and about 15% is in the myoglobin of muscle tissue. The average American diet provides 10–15 milligrams (mg) of iron daily in the form of heme and nonheme iron. Heme iron is found in animal foods that originally contained hemoglobin and myoglobin, such as red meat, fish, and poultry. Nonheme iron is found in plant foods, such as lentils and beans, and also is provided in iron-enriched and iron-fortified foods. Although heme iron is absorbed better than nonheme iron, most dietary iron is nonheme iron (Miret 2003). Each day the body absorbs approximately 1–2 mg of iron to compensate for the 1 to 2 mg of iron that the (nonmenstruating) body loses (Institute of Medicine 2001). The current Dietary Guidelines for Americans list iron as a nutrient of concern for specific population groups. The guidelines recommend that pregnant women take an iron supplement, as recommended by an obstetrician or other health care provider (U.S. Department of Agriculture 2010).

Health Effects. Transporting iron from one organ to another is accomplished by the reversible binding of iron to the transport protein, transferrin, which will then form a complex with a highly specific transferrin receptor (TfR) located on the plasma membrane surfaces of cells. Intracellular iron availability is regulated through the increased expression of cellular TfR concentration by iron-deficient cells. Ferritin is the major iron-storage compound: its production increases in cells as iron supplies increase. The major function of ferritin is to provide a store of iron which may be used for haem synthesis when required. Although all cells are capable of storing iron, the liver, spleen, and bone marrow cells are primary iron-storage sites in people (Institute of Medicine 2001).

Iron deficiency and iron overload are the two major disorders of iron metabolism. Iron-deficiency anemia is the most severe form of iron deficiency. It is linked to many adverse consequences of iron deficiency, such as reduced physical capacity (Haas 2001) and poor pregnancy outcomes (Schorr 1994). Iron deficiency with and without anemia, however, has been linked to negative effects on cognitive development among infants and adolescents (Beard 1999; Grantham-McGregor 2001). Iron overload is the accumulation of excess iron in body tissues, and it usually occurs as a result of a genetic predisposition to absorb iron in excess of normal. However, it can also be caused by excessive ingestion of iron supplements or multiple blood transfusions (Pietrangelo 2004). In advanced stages of iron overload disease (hemochromatosis), the iron accumulates in the parenchymal cells of several organs, but particularly the liver, followed by the heart and pancreas; this condition can lead to organ dysfunction and even death (Pietrangelo 2004).

Intake Recommendations. The Recommended Dietary Allowance (RDA) for all age groups of men and postmenopausal women is 8 mg per day; the RDA for premenopausal women is 18 mg per day. The Tolerable Upper Uptake Level for adults is 45 mg per day of iron, a level based on gastrointestinal distress as an adverse effect (Institute of Medicine 2001).

Biochemical Indicators and Methods. Ferritin is present in the blood in very low concentrations. Serum ferritin is in equilibrium with tissue stores, and its concentration declines early in the development of iron deficiency. Low serum ferritin concentration thus is a sensitive indicator of iron deficiency, but it does not necessarily reflect the severity of the depletion as it progresses (World Health Organization 2011). Ferritin is also an acute-phase protein; acute and chronic diseases can result in increased ferritin concentration, potentially masking an iron-deficiency diagnosis. A review

article on serum ferritin written as part of a 2004 WHO/CDC Technical Consultation on the Assessment of Iron Status at the Population Level provides comprehensive information on this topic (Worwood 2007). The generally accepted cutoff value for serum ferritin below which iron stores are considered to be depleted is 15 nanogram per milliliter (ng/mL) for people aged 5 years and older and 12 ng/mL for people younger than 5 years of age (World Health Organization 2001; World Health Organization 2011). Serum ferritin concentrations above 200 ng/mL for adult males and 150 ng/mL for adult females are considered to represent severe risk of iron overload (World Health Organization 2001; World Health Organization 2011).

Soluble TfR (sTfR) is the truncated form of the membrane-bound TfR that is cleaved and released into the serum. The amount of sTfR is proportional to the number of membrane-bound TfR. sTfR circulates bound to transferrin, and its concentration is not strongly affected by concurrent inflammation or infection (Beard 2007). Serum sTfR concentration increases when the iron functional pool is depleted and during activated erythropoiesis (Kuiper-Kramer 1998). It continues to do so as the severity of iron-deficient erythropoiesis increases, reflecting the increasing number of receptors on the erythroid cells of the bone marrow. The measurement of sTfR is therefore a powerful tool for the diagnosis of iron deficiency or for monitoring erythropoiesis.

Serum ferritin is the most sensitive index of iron status when there are residual iron stores, whereas serum sTfR is more sensitive when there is functional iron deficiency (Skikne 1990). There is a close, linear relationship between the logarithm of the sTfR to serum ferritin ratio and stored iron (body iron) expressed as mg per kg body weight (Skikne 1990). Recently Cook et al. demonstrated that in healthy persons body iron may be estimated from the ratio of sTfR to serum ferritin (reported in microgram [μg]/mL for both assays) (2003). Body iron is in a positive balance (≥ 0 mg/kg) when there is residual storage iron or in a negative balance (< 0 mg/kg) when there is functional iron deficiency. The latter represents a deficit in iron required to maintain a normal hemoglobin concentration. The body iron methodology allows the full range of iron status of populations to be evaluated. Other iron status indicators, such as serum iron, total iron binding capacity, transferrin saturation, and erythrocyte protoporphyrin, were described in the previous report of this series. They are not included in the current report.

Clinical laboratories typically use conventional units for iron-status indicators: ferritin is calculated in nanograms per milliliter (ng/mL) and sTfR in milligrams per liter (mg/L). Conversion factors to international system (SI) units are as follows: 1 ng/mL = 2.247 picomole (pmol)/L for ferritin and 1 mg/L = 0.085 nanomole (nmol)/L for sTfR.

The most widely used methods to measure both serum ferritin and sTfR are immunoassay-based (ELISA, immuno-turbidimetry, immunonephelometry) (Worwood 2002a; Worwood 2002b). A WHO-supported international reference material from the United Kingdom National Institute for Biological Standards and Control (NIBSC) has been available for ferritin for several years (94/572); it has helped to improve the comparability of commercial kit assays. On the other hand, commercial kit assays for sTfR produce different results, making the use of assay-specific reference intervals and

cutoff values necessary (Beard 2007). Recently, the WHO supported the development of a reference reagent for sTfR by the NIBSC, and material 07-202 was released in 2010. It is hoped that this material will be used by manufacturers to standardize sTfR assays and promote the establishment of cutoff values used to assess the iron status of populations (Thorpe 2010).

Data in NHANES. Monitoring the iron status of the U.S. population has been an important component since the inception of NHANES in 1971, and each NHANES has included a battery of hematologic and biochemical indicators of iron status (Looker 1995). Since NHANES II (1976–1980), models that employ multiple biochemical iron-status indicators have been used to define iron deficiency in the population (Pilch 1984). The ferritin model (also known as the three-indicator model), using serum ferritin, transferrin saturation, and erythrocyte protoporphyrin, was developed in 1980 and applied to NHANES III (1988–1994) as well as to the first few years of the continuous NHANES survey beginning in 1999. Prevalence estimates of iron deficiency using the three-indicator model were similar in NHANES III (Looker 1997) and in NHANES 1999–2000 (Looker 2002).

Starting in 2003, NHANES limited the population of interest to children (1–5 years) and women of childbearing age (12–49 years). Furthermore, the measurement of serum sTfR was introduced, which allows the evaluation of iron status by the body iron model developed by Cook et al. (2003). Using data for children and non-pregnant women from NHANES 2003–2006, Cogswell et al. compared the new body iron model to the previously used ferritin model (2009). The agreement between the two models was fair to good. Among non-pregnant women, the body iron model produced lower estimates of iron deficiency prevalence and better predicted anemia. The body iron model appeared to be less affected by inflammation than the ferritin model.

Two national health objectives that relate to iron deficiency reduction are part of the objectives for Healthy People 2020: Objective NWS HP2020-21 (reduce iron deficiency among young children and females of childbearing age) and Objective NWS HP2020-22 (reduce iron deficiency among pregnant females) (http://www.healthypeople.gov/HP2020/). To provide data for these objectives, NHANES continues with periodic monitoring of iron status in the population groups of interest.

Ferritin and sTfR data presented in this report were generated by use of commercial assay kits. Serum ferritin was first measured by use of the BioRad QuantImune immunoradiometric assay (1999–2003), then by use of the Roche TinaQuant immunoturbidimetric assay on the Hitachi 912 clinical analyzer (2004–2006). The public release data file for 2003–2004 has already been adjusted to the new assay. We used adjustment equations provided in the analytical note for data from 1999–2002 to make the data comparable to the new assay (http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/L06TFR_C.htm#Analytic_Notes). Serum sTfR was measured with the Roche immunoturbidimetric assay on the Hitachi 912 clinical analyzer (2003–2006). We calculated body iron by using the following formula (Cook 2003): body iron (mg/kg) = -[log10 (sTfR * 1000 / ferritin) – 2.8229] / 0.1207. The sTfR concentration in this formula represents an adjusted concentration to make the Roche sTfR concentrations equivalent to the Flowers assay (1989) used in the development of the body iron model: Flowers sTfR = 1.5 * Roche sTfR + 0.35 mg/L (Pfeiffer 2007).

To estimate the prevalence of low serum ferritin concentrations, we used the generally accepted cutoff values mentioned above: 12 ng/mL for children 1-5 years of age and 15 ng/mL for women of childbearing age and males 6 years and older. To estimate the prevalence of high serum ferritin concentrations, we also used the cutoff values mentioned above: 150 ng/mL for women 12-49 years of age and 200 ng/mL for men 12 years and older. Due to the lack of generally accepted cutoff values for serum sTfR, we used the manufacturer provided assay-specific cutoff value of 4.4 mg/L to estimate the prevalence of high sTfR concentrations in women of childbearing age. The prevalence of low body iron (< 0 mg/kg) is indicative of the extent of iron deficiency in the population.

For more information about iron, see the Institute of Medicine's Dietary Reference Intake reports (Institute of Medicine 2001) and fact sheets from the National Institutes of Health, Office of Dietary Supplements (http://ods.od.nih.gov/Health_Information/Information_About_Individual_Dietary_Supplements.aspx).

Highlights

Serum concentrations of ferritin and sTfR in the U.S. population showed the following demographic patterns and characteristics:

- Children had the lowest ferritin concentrations and highest sTfR concentrations compared to other age groups.
- Regardless of the indicator selected (serum ferritin, sTfR, or body iron), the likelihood of being iron deficient varied by race/ethnic group.
- While children and women of childbearing age were at risk for iron deficiency, men were at risk for iron excess.

New data from NHANES 2003–2006 allow for the first time assessment of the iron status of children and women of childbearing age by way of a new indicator, body iron. Using the ferritin model in NHANES 1999–2000, Looker and colleagues (2002) showed that the prevalence of iron deficiency was higher in Mexican-American (22%) and non-Hispanic black (19%) women aged 12–49 years than for non-Hispanic white women (10%). We saw the same pattern in NHANES 2003–2006 for women of childbearing age by using low body iron < 0 mg/kg) as an indicator of iron deficiency (Figure H.3.a). We saw a higher prevalence of low body iron in Mexican-American children (1–5 years) than in non-Hispanic black and non-Hispanic white children (Figure H.3.a).

The prevalence estimates of iron deficiency may vary depending on which indicator or set of indicators is used. Furthermore, the prevalence may be overestimated by using only a single indicator. In women of childbearing age, we found the lowest prevalence by using body iron (10%), intermediate prevalence by using low ferritin concentrations (13%), and the highest prevalence by using high sTfR concentrations (19%) (Figure H.3.b).

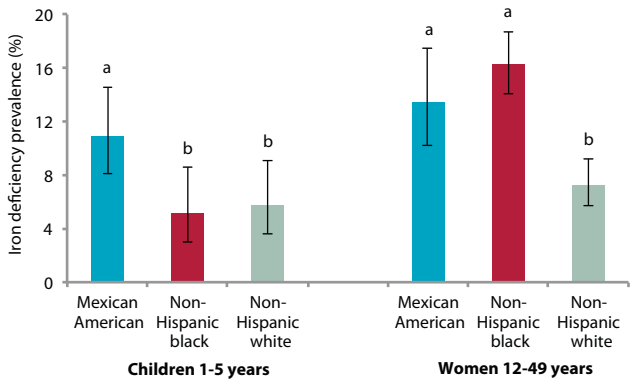

Figure H.3.a. *Age-adjusted prevalence estimates of low body iron stores (< 0 mg/kg) in U.S. children and women by race/ethnicity, National Health and Nutrition Examination Survey, 2003–2006.*

Error bars represent 95% confidence intervals. Bars not sharing a common letter differ within children and women ($p < 0.05$). Age adjustment was done using direct standardization.

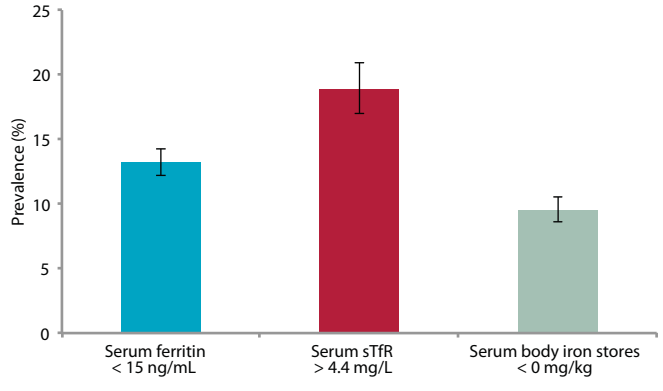

Figure H.3.b. *Prevalence estimates of low serum ferritin, high serum soluble transferrin receptor, and low serum body iron in U.S. women 12–49 years of age, National Health and Nutrition Examination Survey, 2003–2006.*

Error bars represent 95% confidence intervals.

Women were at risk for iron deficiency, while men were at risk for iron excess, as can be seen from the large differences in the prevalence of low and high serum ferritin concentrations between men and women (Figure H.3.c). During NHANES 1999–2002, the prevalence of low serum ferritin concentrations (< 15 ng/mL) was much lower in 12–49 year-old men (1%) than in 12–49 year-old women (13%). Conversely, the prevalence of high serum ferritin concentrations (> 200 ng/mL for men and > 150 ng/mL for women) was much higher in men (29%) than in women (6%). NHANES 2003–2006 showed similar prevalence estimates for women as were seen in 1999–2002. No data are available for men in 2003–2006.

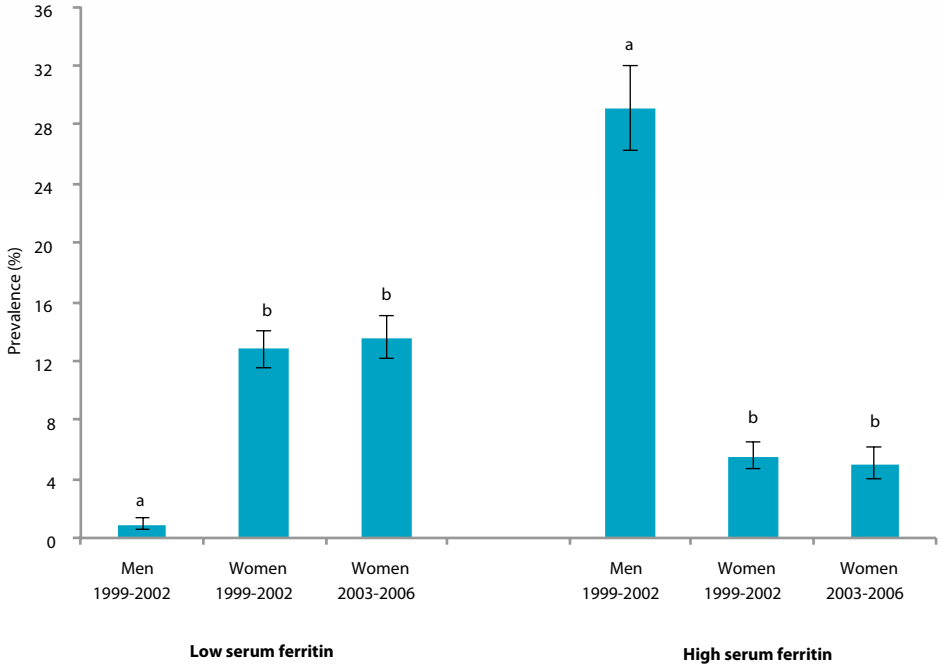

Figure H.3.c. *Age-adjusted prevalence estimates of low (< 15 ng/mL) and high serum ferritin (> 200 ng/mL for men and > 150 ng/mL for women) in U.S. men and women aged 12–49 years, National Health and Nutrition Examination Survey, 1999–2006.*

Error bars represent 95% confidence intervals. Within each ferritin status category, bars not sharing a common letter differ ($p < 0.05$). Age adjustment was done using direct standardization.

Serum ferritin has been assessed as part of NHANES for many years, allowing for the evaluation of temporal changes in concentrations. Overall, there were only minor changes in serum ferritin concentrations in women of childbearing age over a period of almost two decades (Figure H.3.d). Age-adjusted mean serum ferritin concentrations in women of childbearing age were slightly lower (< 10%) in 1999–2002 and 2003–2006 than in 1988–1994. We observed the same pattern for non-Hispanic white women, while serum ferritin concentrations decreased further during 2003–2006 for non-Hispanic black women. Mexican-American women had lower serum ferritin concentrations in 1999–2002 than in 1988–1994, but concentrations in 2003–2006 did not differ from concentrations in the two previous time periods.

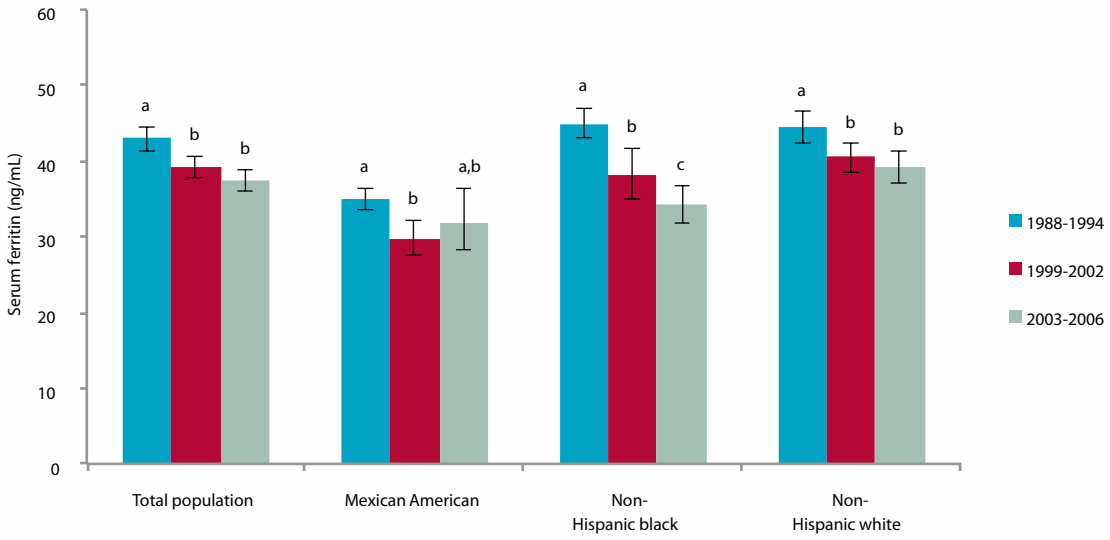

Figure H.3.d. *Age-adjusted geometric mean concentrations of serum ferritin in U.S. women aged 12–49 years by race/ethnicity, National Health and Nutrition Examination Survey, 1988–2006.*

Error bars represent 95% confidence intervals. Within a demographic group, bars not sharing a common letter differ ($p < 0.05$). Age adjustment was done using direct standardization.

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 determinants of these blood concentrations (e.g., dietary intake, supplement usage, smoking, BMI). A multivariate analysis may alter the size and statistical significance of these categorical differences. Furthermore, additional significant differences of smaller magnitude may be present despite their lack of mention here (e.g., if confidence limits slightly overlap or if differences are 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/arithmetic mean concentrations (NHANES 2003–2006):

- The distribution of body iron was reasonably symmetric and for that reason we present arithmetic means.
- Serum ferritin concentrations increased with age (Table 3.1.a.1 and Figure 3.1.a).
- sTfR concentrations were highest in children than for both adolescent and adult women (Table 3.2.a.1 and Figure 3.2.a).
- Body iron was lowest in children, intermediate in adolescent women, and highest in adult women (Table 3.3.a.1 and Figure 3.3.a).
- Non-Hispanic whites had higher serum ferritin concentrations than Mexican Americans, and non-Hispanic blacks had intermediate concentrations (Table 3.1.a.1).
- Non-Hispanic whites had lower sTfR concentrations than Mexican Americans, who had lower concentrations still than non-Hispanic blacks (Table 3.2.a.1).
- Non-Hispanic whites had higher body iron than the other two race/ethnic groups (Table 3.3.a.1).

Changes in geometric/arithmetic mean concentrations across survey cycles:

- All three iron status indicators remained stable across the survey cycles measured: serum ferritin geometric mean concentrations (Table 3.1.b) between 1999 and 2006; sTfR geometric mean concentrations (Table 3.2.b) and body iron arithmetic means (Table 3.3.b) between 2003 and 2006.

Prevalence estimates of low or high biochemical indicator concentrations:

- In 2003–2006, approximately 9% of children (1–5 years) (Table 3.1.c.1) had serum ferritin concentrations < 12 ng/mL and 14% of women (12–49 years) had serum ferritin concentrations < 15 ng/mL (Table 3.1.c.2). Approximately 5% of women (12–49 years) (Table 3.1.c.3) had high serum ferritin concentrations (> 150 ng/mL), indicating severe risk of iron overload.
- The prevalence of low serum ferritin concentrations did not change between 1999 and 2006 in children (Table 3.1.d.1) and women of childbearing age (Table 3.1.d.2), nor between 1999 and 2002 in males 6 years and older (Table 3.1.d.3). The prevalence of high serum ferritin concentrations also remained constant between 1999 and 2006 in women of childbearing age (Table 3.1.d.4) and between 1999–2002 in men 12 years and older (Table 3.1.d.5).
- In 2003–2006, approximately 19% of women (12–49 years) had serum sTfR concentrations > 4.4 mg/L (Table 3.2.c), and the prevalence was the same in both survey cycles (Table 3.2.d).
- Less than 10% of children (8% of boys and 5% of girls 1–5 years) and 10% of women (12–49 years) had negative body iron balance, indicative of iron deficiency (Tables 3.3.c.1 and 3.3.c.2), and the prevalence was the same in both survey cycles (Tables 3.3.d.1 and 3.3.d.2).

Table 3.1.a.1. Serum ferritin: Concentrations

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for children aged 1–5 years and women aged 12–49 years in the U.S. population, 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	35.7 (34.4 – 37.1)	4.65 (4.52 – 4.78)	6.99 (6.15 – 7.71)	36.2 (34.7 – 38.1)	143 (133 – 157)	194 (177 – 210)	6,012
(Children 1–5 years women 12–49 years),							
Age group							
1–5 years (Children)	26.2 (25.2 – 27.3)	6.68 (5.19 – 7.72)	9.14 (7.87 – 9.82)	26.7 (25.5 – 27.9)	65.6 (59.6 – 68.1)	77.5 (70.2 – 91.4)	1,482
12–19 years (Women)	29.3 (27.7 – 30.9)	4.64 (4.31 – 4.98)	6.83 (5.19 – 7.77)	31.9 (29.9 – 33.3)	81.4 (76.7 – 92.2)	103 (91.8 – 134)	1,991
20–39 years (Women)	38.1 (36.1 – 40.2)	4.67 (4.45 – 4.88)	7.19 (5.66 – 8.21)	40.5 (38.3 – 43.3)	135 (114 – 159)	176 (153 – 206)	1,780
40–49 years (Women)	43.2 (39.0 – 47.7)	4.38 (4.06 – 4.69)	5.81 (4.73 – 7.10)	45.9 (40.5 – 50.7)	211 (184 – 262)	264 (231 – 317)	759
Gender							
Males (1–5 years)	26.2 (24.9 – 27.7)	6.90 (4.61 – 7.90)	8.90 (8.01 – 9.68)	26.9 (25.1 – 28.5)	63.6 (56.9 – 70.7)	77.9 (67.7 – 111)	757
Females (1–5, 12–49 years)	36.6 (35.2 – 38.1)	4.62 (4.48 – 4.75)	6.80 (5.96 – 7.56)	38.1 (36.0 – 39.4)	145 (136 – 165)	198 (180 – 219)	5,255
Race/ethnicity							
(Children 1–5 years, women 12–49 years)							
Mexican Americans	30.2 (27.5 – 33.1)	4.18 (3.78 – 4.43)	4.87 (4.62 – 5.46)	31.7 (28.7 – 34.0)	121 (101 – 161)	166 (140 – 231)	1,704
Non-Hispanic Blacks	33.5 (31.4 – 35.7)	4.13 (3.31 – 4.70)	5.49 (4.69 – 6.46)	33.7 (31.8 – 35.8)	165 (133 – 201)	212 (182 – 261)	1,676
Non-Hispanic Whites	37.5 (35.5 – 39.6)	4.89 (4.66 – 5.44)	8.07 (6.52 – 8.85)	38.2 (35.9 – 39.8)	143 (131 – 159)	194 (172 – 233)	2,089

Figure 3.1. a . Serum ferritin: Concentrations by age group

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

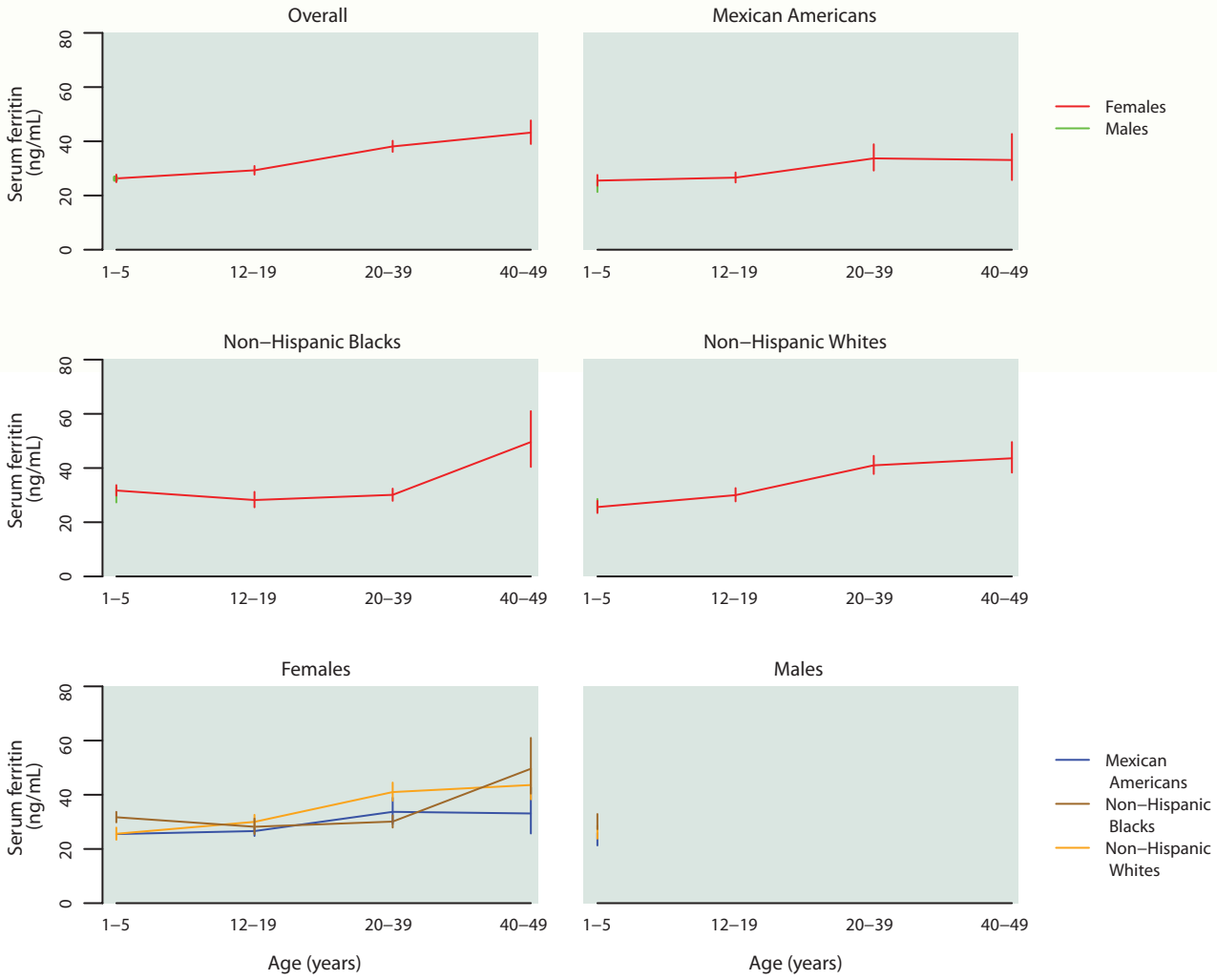

Table 3.1.a.2. Serum ferritin: Total population

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	35.7 (34.4 – 37.1)	6.99 (6.15 – 7.71)	36.2 (34.7 – 38.1)	143 (133 – 157)	6,012
1–5 years	26.2 (25.2 – 27.3)	9.14 (7.87 – 9.82)	26.7 (25.5 – 27.9)	65.6 (59.6 – 68.1)	1,482
Males					
1–5 years	26.2 (24.9 – 27.7)	8.90 (8.01 – 9.68)	26.9 (25.1 – 28.5)	63.6 (56.9 – 70.7)	757
Females					
Total, 1–5, 12–49 years	36.6 (35.2 – 38.1)	6.80 (5.96 – 7.56)	38.1 (36.0 – 39.4)	145 (136 – 165)	5,255
1–5 years	26.3 (24.9 – 27.7)	9.29 (6.81 – 10.1)	26.5 (24.8 – 28.0)	67.0 (59.2 – 74.3)	725
12–19 years	29.3 (27.7 – 30.9)	6.83 (5.19 – 7.77)	31.9 (29.9 – 33.3)	81.4 (76.7 – 92.2)	1,991
20–39 years	38.1 (36.1 – 40.2)	7.19 (5.66 – 8.21)	40.5 (38.3 – 43.3)	135 (114 – 159)	1,780
40–49 years	43.2 (39.0 – 47.7)	5.81 (4.73 – 7.10)	45.9 (40.5 – 50.7)	211 (184 – 262)	759

Table 3.1.a.3. Serum ferritin: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for Mexican-American children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	30.2 (27.5 – 33.1)	4.87 (4.62 – 5.46)	31.7 (28.7 – 34.0)	121 (101 – 161)	1,704
1–5 years	24.5 (22.8 – 26.3)	6.44 (4.69 – 7.69)	25.5 (23.5 – 27.6)	68.9 (57.7 – 83.3)	468
Males					
1–5 years	23.5 (21.3 – 25.9)	6.04 (4.33 – 7.21)	24.6 (23.1 – 27.0)	63.8 (52.5 – 118)	225
Females					
Total, 1–5, 12–49 years	31.0 (28.0 – 34.5)	4.84 (4.59 – 5.33)	33.2 (29.3 – 36.1)	126 (104 – 167)	1,479
1–5 years	25.5 (23.6 – 27.6)	6.81 (4.56 – 9.78)	26.7 (23.2 – 29.8)	69.6 (60.7 – 88.6)	243
12–19 years	26.6 (24.8 – 28.5)	6.35 (4.85 – 7.38)	27.3 (25.5 – 29.2)	89.6 (80.6 – 97.3)	647
20–39 years	33.7 (29.2 – 38.9)	4.89 (4.62 – 5.51)	37.1 (31.6 – 43.9)	139 (106 – 213)	434
40–49 years	33.1 (25.7 – 42.7)	4.27† (3.48 – 4.66)	34.3 (28.3 – 42.9)	170† (134 – 262)	155

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

Table 3.1.a.4. Serum ferritin: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for non-Hispanic black children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	33.5 (31.4 – 35.7)	5.49	(4.69 – 6.46)	33.7	(31.8 – 35.8)	165	(133 – 201)	1,676
1–5 years	30.8 (28.9 – 32.8)	11.4	(9.51 – 14.2)	30.7	(28.7 – 32.7)	72.5	(65.8 – 88.9)	429
Males								
1–5 years	30.0 (27.3 – 32.9)	10.6†	(5.39 – 14.4)	29.6	(26.6 – 33.4)	66.2†	(58.1 – 96.6)	218
Females								
Total, 1–5, 12–49 years	33.8 (31.5 – 36.2)	5.26	(4.56 – 6.25)	34.1	(32.1 – 36.9)	171	(139 – 207)	1,458
1–5 years	31.7 (29.8 – 33.7)	12.4†	(9.78 – 14.6)	31.6	(29.1 – 33.6)	75.8†	(67.6 – 89.4)	211
12–19 years	28.2 (25.5 – 31.2)	6.61	(4.97 – 7.55)	31.1	(27.4 – 33.7)	88.7	(79.4 – 104)	674
20–39 years	30.1 (27.9 – 32.4)	5.02	(4.22 – 6.08)	31.1	(28.4 – 34.1)	132	(122 – 173)	375
40–49 years	49.6 (40.4 – 61.0)	4.31†	(< LOD – 8.31)	53.5	(42.2 – 63.9)	257†	(207 – 531)	198

< 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 3.1.a.5. Serum ferritin: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for non-Hispanic white children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	37.5 (35.5 – 39.6)	8.07	(6.52 – 8.85)	38.2	(35.9 – 39.8)	143	(131 – 159)	2,089
1–5 years	25.9 (24.2 – 27.7)	9.30	(8.13 – 10.0)	26.3	(24.4 – 28.1)	61.4	(55.7 – 67.8)	416
Males								
1–5 years	26.1 (23.8 – 28.6)	9.13	(4.71 – 10.5)	27.1	(24.3 – 29.7)	56.9	(53.5 – 89.4)	229
Females								
Total, 1–5, 12–49 years	38.5 (36.3 – 40.7)	7.96	(6.36 – 8.78)	39.4	(37.2 – 41.0)	144	(135 – 167)	1,860
1–5 years	25.6 (23.4 – 27.9)	9.40†	(5.96 – 10.3)	25.5	(23.4 – 27.8)	63.7†	(53.8 – 87.4)	187
12–19 years	30.0 (27.7 – 32.6)	6.88	(4.67 – 8.55)	33.0	(31.1 – 34.9)	78.2	(70.9 – 93.0)	520
20–39 years	41.0 (37.8 – 44.5)	8.75	(7.16 – 10.1)	42.3	(39.2 – 47.0)	134	(112 – 171)	812
40–49 years	43.6 (38.3 – 49.6)	6.61	(4.82 – 8.43)	46.1	(39.7 – 51.2)	212	(164 – 266)	341

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

Table 3.1.b. Serum ferritin: Concentrations by survey cycle

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for children aged 1–5 and women aged 12–49 years in 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 (Children 1–5 years, women 12–49 years)					
1999–2000	38.8 (36.7 – 41.0)	8.06 (5.23 – 9.99)	38.3 (34.7 – 42.5)	139 (129 – 173)	2,919
2001–2002	36.1 (34.2 – 38.0)	5.23 **	35.2 (33.2 – 37.2)	149 (136 – 175)	3,365
2003–2004	36.4 (34.7 – 38.3)	7.70 (5.80 – 8.58)	36.1 (34.6 – 38.6)	151 (141 – 173)	2,981
2005–2006	35.0 (32.9 – 37.2)	6.46 (5.69 – 7.19)	36.2 (33.6 – 38.7)	135 (113 – 167)	3,031
Age group					
1–5 years (Children)					
1999–2000	28.7 (26.9 – 30.7)	10.6 (5.95 – 13.5)	28.2 (26.0 – 31.6)	74.6 (57.9 – 94.2)	680
2001–2002	27.9 (25.6 – 30.5)	6.43 (5.23 – 9.79)	28.2 (26.2 – 30.4)	78.6 (68.5 – 105)	843
2003–2004	25.2 (23.7 – 26.8)	9.27 (8.08 – 9.76)	24.9 (23.2 – 26.7)	64.0 (57.0 – 67.8)	796
2005–2006	27.6 (26.0 – 29.2)	8.95 (7.95 – 9.78)	28.5 (27.4 – 30.1)	66.7 (63.2 – 77.2)	686
12–19 years (Women)					
1999–2000	32.5 (29.6 – 35.8)	9.26 (5.23 – 10.4)	32.8 (29.6 – 37.1)	83.3 (79.4 – 99.7)	1,048
2001–2002	30.1 (28.5 – 31.9)	6.55 (5.23 – 8.62)	32.5 (29.9 – 33.7)	84.5 (79.3 – 95.6)	1,120
2003–2004	28.0 (25.5 – 30.7)	6.11 (4.43 – 7.97)	30.1 (27.9 – 32.7)	86.4 (75.6 – 102)	998
2005–2006	30.6 (28.6 – 32.8)	7.21 (5.52 – 8.79)	33.4 (30.9 – 35.7)	79.0 (75.0 – 94.0)	993
20–39 years (Women)					
1999–2000	40.0 (36.0 – 44.4)	5.23 **	43.5 (36.3 – 52.2)	137 (118 – 187)	838
2001–2002	37.8 (35.2 – 40.5)	5.23 **	38.3 (34.5 – 41.7)	142 (119 – 192)	992
2003–2004	39.8 (37.1 – 42.7)	8.40 (7.52 – 9.20)	41.1 (39.2 – 44.6)	132 (111 – 172)	822
2005–2006	36.5 (33.5 – 39.9)	5.60 (4.70 – 7.17)	39.2 (34.1 – 44.6)	135 (110 – 179)	958
40–49 years (Women)					
1999–2000	50.3 (43.6 – 57.9)	9.15 (5.23 – 12.1)	50.0 (42.8 – 59.8)	227 (202 – 275)	353
2001–2002	43.7 (39.3 – 48.6)	5.23 **	46.5 (39.2 – 53.9)	221 (195 – 249)	410
2003–2004	46.6 (39.9 – 54.4)	5.16 (4.21 – 8.44)	47.1 (43.5 – 53.6)	227 (197 – 317)	365
2005–2006	40.0 (34.5 – 46.3)	6.26 (4.89 – 6.96)	41.6 (34.0 – 51.7)	169 (144 – 264)	394
Gender					
Males (1–5 years)					
1999–2000	27.4 (25.4 – 29.6)	10.8 (6.11 – 13.1)	26.6 (24.7 – 28.4)	73.7 (55.4 – 95.7)	377
2001–2002	26.1 (23.4 – 29.0)	5.23 **	27.4 (24.4 – 30.3)	77.9 (67.2 – 112)	428
2003–2004	25.0 (23.1 – 27.1)	9.19 (6.68 – 10.2)	24.8 (22.5 – 27.0)	57.3 (55.3 – 67.6)	415
2005–2006	27.8 (25.8 – 29.9)	8.71 (8.18 – 9.54)	29.3 (26.9 – 31.0)	70.4 (55.8 – 105)	342
Females (1–5, 12–49 years)					
1999–2000	40.0 (37.7 – 42.5)	7.86 (5.23 – 9.85)	40.8 (37.0 – 45.1)	146 (132 – 179)	2,542
2001–2002	37.0 (35.2 – 38.9)	5.23 **	36.3 (34.5 – 38.3)	157 (141 – 186)	2,937
2003–2004	37.7 (35.6 – 39.8)	7.60 (5.49 – 8.51)	38.7 (36.0 – 40.1)	158 (143 – 186)	2,566
2005–2006	35.6 (33.4 – 37.9)	6.31 (5.46 – 7.04)	37.2 (34.2 – 40.0)	137 (115 – 176)	2,689
Race/ethnicity (Children 1–5 years, women 12–49 years)					
Mexican Americans					
1999–2000	29.0 (26.6 – 31.6)	5.23 **	30.2 (27.9 – 32.7)	117 (81.2 – 179)	1,077
2001–2002	27.9 (25.6 – 30.4)	5.23 **	28.9 (26.8 – 31.3)	102 (82.4 – 162)	967
2003–2004	32.0 (27.4 – 37.4)	6.36 (4.30 – 7.98)	33.2 (28.1 – 36.8)	140 (98.8 – 203)	793
2005–2006	28.4 (25.7 – 31.4)	4.57 (4.01 – 5.22)	29.7 (27.6 – 32.9)	106 (98.4 – 119)	911
Non-Hispanic Blacks					
1999–2000	38.5 (34.3 – 43.3)	5.23 **	38.1 (33.1 – 44.9)	171 (130 – 382)	690
2001–2002	35.8 (31.0 – 41.3)	5.23 **	36.1 (32.7 – 40.2)	187 (138 – 263)	855
2003–2004	34.1 (30.5 – 38.2)	5.74 (4.17 – 7.50)	33.1 (30.0 – 36.9)	172 (127 – 267)	870
2005–2006	32.7 (30.5 – 35.1)	5.35 (4.67 – 6.15)	34.3 (31.1 – 38.1)	145 (127 – 179)	806
Non-Hispanic Whites					
1999–2000	41.1 (38.4 – 44.0)	9.77 (5.23 – 12.4)	41.0 (35.1 – 47.1)	146 (131 – 181)	838
2001–2002	37.0 (34.2 – 40.1)	6.86 (5.23 – 8.38)	35.5 (32.8 – 38.6)	141 (124 – 188)	1,236
2003–2004	37.7 (35.1 – 40.5)	8.37 (4.79 – 10.0)	38.3 (35.6 – 39.7)	147 (136 – 190)	1,069
2005–2006	37.3 (34.1 – 40.7)	7.57 (6.33 – 8.68)	38.1 (34.4 – 41.1)	135 (113 – 176)	1,020

** The minimum value is reported. The desired percentile does not exist because it is less than the estimated cumulative distribution evaluated at the minimum.

Figure 3.1.b. Serum ferritin: Concentrations by survey cycle

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

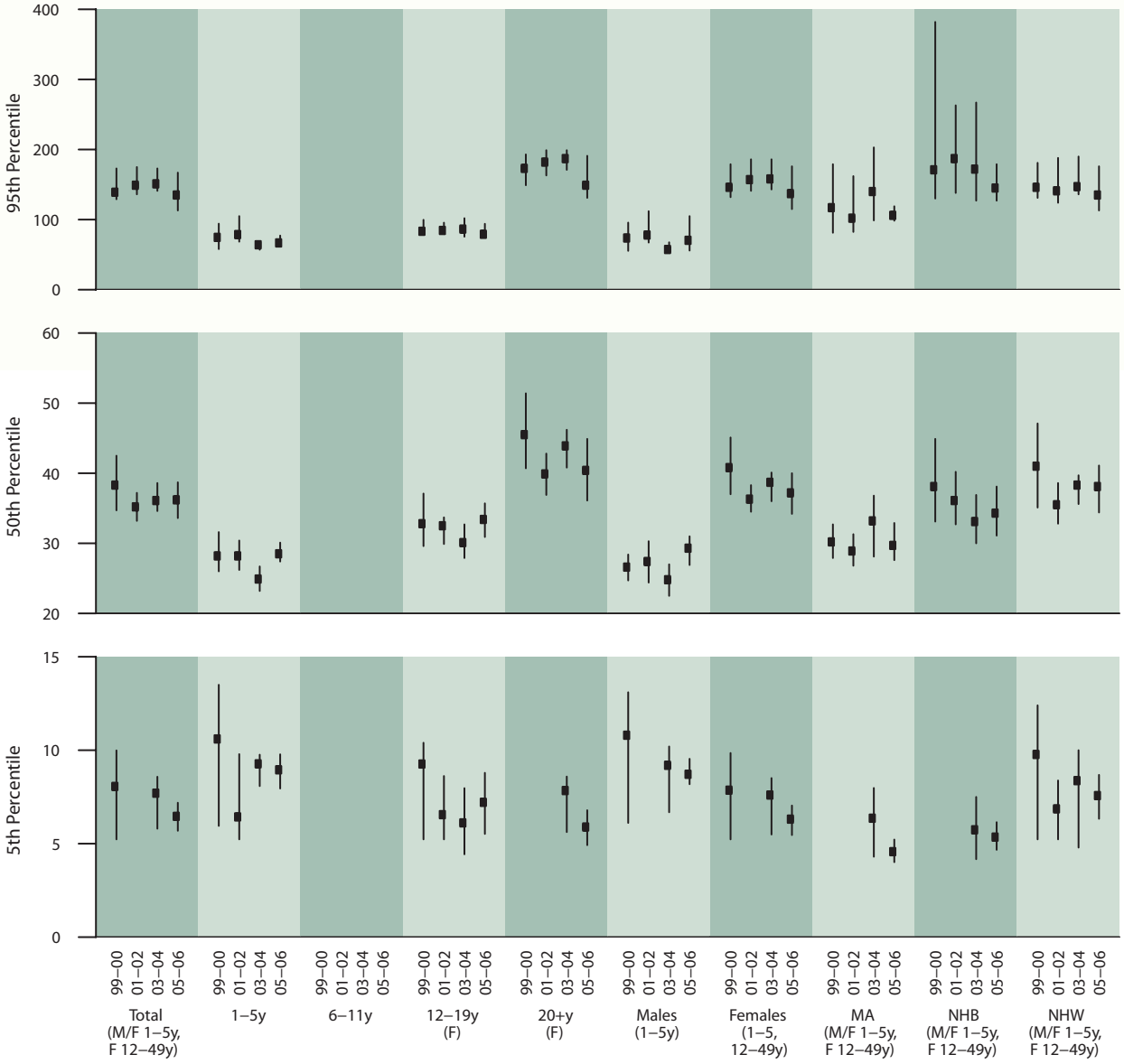

Table 3.1.c.1. Serum ferritin: Prevalence

Prevalence (in percent) of low serum ferritin concentration (< 12 ng/mL) for children in the U.S. population aged 1–5 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Children, 1–5 years	1,482	8.9 (7.1 – 11.2)	1,810,000
Gender			
Males	757	9.2 (7.1 – 11.9)	953,000
Females	725	8.6 (6.2 – 11.8)	855,000
Race/ethnicity			
Mexican Americans	468	11.4 (8.6 – 15.1)	348,000
Non-Hispanic Blacks	429	4.9 (3.1 – 7.8)	148,000
Non-Hispanic Whites	416	9.8 (6.9 – 13.7)	1,134,000

Table 3.1.c.2. Serum ferritin: Prevalence

Prevalence (in percent) of low serum ferritin concentration (< 15 ng/mL) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years	4,530	13.6 (12.2 – 15.2)	10,748,000
Age group			
12–19 years	1,991	15.2 (12.4 – 18.4)	2,462,000
20–49 years	2,539	13.2 (11.8 – 14.8)	8,299,000
Race/ethnicity			
Mexican Americans	1,236	18.6 (14.9 – 23.0)	1,427,000
Non-Hispanic Blacks	1,247	19.9 (17.9 – 22.1)	2,140,000
Non-Hispanic Whites	1,673	11.3 (9.2 – 13.9)	5,805,000

Table 3.1.c.3. Serum ferritin: Prevalence

Prevalence (in percent) of high serum ferritin concentration (> 150 ng/mL) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years	4,530	5.2 (4.2 – 6.4)	4,086,000
Age group			
12–19 years	1,991	0.9‡ (0.5 – 1.8)	149,000‡
20–49 years	2,539	6.2 (5.0 – 7.7)	3,900,000
Race/ethnicity			
Mexican Americans	1,236	4.2 (2.5 – 7.2)	324,000
Non-Hispanic Blacks	1,247	7.1 (5.0 – 9.9)	759,000
Non-Hispanic Whites	1,673	4.9 (3.7 – 6.3)	2,495,000

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

Table 3.1.d.1. Serum ferritin: Prevalence by survey cycle

Prevalence (in percent) of low serum ferritin concentration (< 12 ng/mL) for children in the U.S. population aged 1–5 years, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Children, 1–5 years			
1999–2000	680	5.7 (3.3 – 9.6)	1,133,000
2001–2002	843	10.0 (7.0 – 13.9)	1,935,000
2003–2004	796	9.0 (6.6 – 12.3)	1,828,000
2005–2006	686	8.8 (6.0 – 12.8)	1,782,000
Gender			
Males			
1999–2000	377	5.9 (3.3 – 10.4)	599,000
2001–2002	428	13.3 (8.6 – 20.1)	1,326,000
2003–2004	415	9.4 (6.6 – 13.3)	970,000
2005–2006	342	9.0 (5.8 – 13.8)	933,000
Females			
1999–2000	303	5.5‡ (2.4 – 12.0)	530,000‡
2001–2002	415	6.5 (4.3 – 9.6)	613,000
2003–2004	381	8.6 (5.6 – 12.8)	854,000
2005–2006	344	8.6 (4.8 – 14.9)	849,000
Race/ethnicity			
Mexican Americans			
1999–2000	269	11.7 (7.7 – 17.4)	305,000
2001–2002	246	10.1 (7.4 – 13.6)	283,000
2003–2004	230	12.5 (7.6 – 19.8)	380,000
2005–2006	238	10.2 (8.1 – 12.8)	329,000
Non-Hispanic Blacks			
1999–2000	168	4.7 (2.6 – 8.4)	142,000
2001–2002	247	§	§
2003–2004	252	6.0 (3.1 – 11.3)	180,000
2005–2006	177	3.4‡ (1.7 – 6.9)	100,000‡
Non-Hispanic Whites			
1999–2000	161	2.9‡ (1.3 – 6.1)	346,000‡
2001–2002	259	11.9 (7.1 – 19.2)	1,357,000
2003–2004	230	9.4 (5.5 – 15.5)	1,088,000
2005–2006	186	10.3 (6.1 – 16.7)	1,157,000

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

Table 3.1.d.2. Serum ferritin: Prevalence by survey cycle

Prevalence (in percent) of low serum ferritin concentration (< 15 ng/mL) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years			
1999–2000	2,239	11.4 (9.4 – 13.9)	8,767,000
2001–2002	2,522	13.9 (12.2 – 15.8)	10,821,000
2003–2004	2,185	13.2 (10.7 – 16.3)	10,460,000
2005–2006	2,345	14.0 (12.6 – 15.5)	11,069,000
Age group			
12–19 years			
1999–2000	1,048	11.5 (8.5 – 15.3)	1,781,000
2001–2002	1,120	13.9 (11.2 – 17.1)	2,201,000
2003–2004	998	17.4 (12.8 – 23.3)	2,825,000
2005–2006	993	12.9 (10.0 – 16.5)	2,119,000
20–49 years			
1999–2000	1,191	11.4 (9.2 – 14.2)	6,986,000
2001–2002	1,402	13.9 (12.0 – 16.0)	8,620,000
2003–2004	1,187	12.2 (9.7 – 15.2)	7,670,000
2005–2006	1,352	14.2 (12.8 – 15.7)	8,938,000
Race/ethnicity			
Mexican Americans			
1999–2000	808	18.8 (12.3 – 27.5)	1,140,000
2001–2002	721	21.9 (18.8 – 25.4)	1,541,000
2003–2004	563	16.7 (11.7 – 23.2)	1,276,000
2005–2006	673	20.6 (15.3 – 27.2)	1,632,000
Non-Hispanic Blacks			
1999–2000	522	16.4 (11.2 – 23.4)	1,764,000
2001–2002	608	19.5 (12.3 – 29.6)	2,091,000
2003–2004	618	19.1 (16.4 – 22.0)	2,051,000
2005–2006	629	20.7 (17.5 – 24.4)	2,256,000
Non-Hispanic Whites			
1999–2000	677	9.1 (6.7 – 12.2)	4,741,000
2001–2002	977	11.6 (9.5 – 14.2)	6,025,000
2003–2004	839	11.8 (8.3 – 16.5)	6,032,000
2005–2006	834	10.9 (8.5 – 13.8)	5,500,000

Table 3.1.d.3. Serum ferritin: Prevalence by survey cycle

Prevalence (in percent) of low serum ferritin concentration (< 15 ng/mL) for males in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Males, 6 years and older			
1999–2000	3,488	1.1 (0.6 – 2.0)	1,323,000
2001–2002	3,849	1.3 (0.9 – 1.7)	1,576,000
Age group			
6–11 years			
1999–2000	463	§	§
2001–2002	509	§	§
12–19 years			
1999–2000	1,078	2.1‡ (1.0 – 4.2)	336,000‡
2001–2002	1,094	2.8‡ (1.4 – 5.4)	463,000‡
20–39 years			
1999–2000	632	§	§
2001–2002	724	0.5‡ (0.2 – 1.0)	176,000‡
40–59 years			
1999–2000	570	§	§
2001–2002	770	§	§
60 years and older			
1999–2000	745	§	§
2001–2002	752	2.0 (1.1 – 3.4)	384,000
Race/ethnicity			
Mexican Americans			
1999–2000	1,196	1.0 (0.5 – 1.8)	91,000
2001–2002	958	0.7‡ (0.3 – 1.5)	77,000‡
Non-Hispanic Blacks			
1999–2000	781	§	§
2001–2002	921	1.3‡ (0.7 – 2.7)	187,000‡
Non-Hispanic Whites			
1999–2000	1,223	1.3‡ (0.6 – 2.7)	1,100,000‡
2001–2002	1,678	1.3 (0.9 – 1.9)	1,159,000

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

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

Table 3.1.d.4. Serum ferritin: Prevalence by survey cycle

Prevalence (in percent) of high serum ferritin concentration (> 150 ng/mL) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 1999–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years			
1999–2000	2,239	5.3 (4.0 – 7.0)	4,069,000
2001–2002	2,522	5.6 (4.5 – 7.0)	4,374,000
2003–2004	2,185	6.0 (4.7 – 7.5)	4,711,000
2005–2006	2,345	4.4 (2.9 – 6.6)	3,470,000
Age group			
12–19 years			
1999–2000	1,048	§	§
2001–2002	1,120	§	§
2003–2004	998	§	§
2005–2006	993	1.4‡ (0.6 – 3.2)	237,000‡
20–49 years			
1999–2000	1,191	6.3 (4.8 – 8.3)	3,878,000
2001–2002	1,402	6.8 (5.3 – 8.5)	4,196,000
2003–2004	1,187	7.3 (5.9 – 9.1)	4,600,000
2005–2006	1,352	5.1 (3.2 – 7.9)	3,202,000
Race/ethnicity			
Mexican Americans			
1999–2000	808	3.7‡ (1.7 – 7.9)	224,000‡
2001–2002	721	3.5 (1.8 – 6.8)	249,000
2003–2004	563	5.6‡ (2.7 – 11.3)	429,000‡
2005–2006	673	2.9‡ (1.4 – 5.7)	226,000‡
Non-Hispanic Blacks			
1999–2000	522	7.8 (5.2 – 11.6)	840,000
2001–2002	608	7.7 (5.0 – 11.8)	828,000
2003–2004	618	8.3 (4.6 – 14.7)	895,000
2005–2006	629	5.7 (4.2 – 7.9)	625,000
Non-Hispanic Whites			
1999–2000	677	5.7 (4.1 – 8.0)	3,000,000
2001–2002	977	5.0 (3.4 – 7.2)	2,579,000
2003–2004	839	5.7 (4.1 – 7.8)	2,926,000
2005–2006	834	4.0 (2.5 – 6.3)	2,026,000

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

Table 3.1.d.5. Serum ferritin: Prevalence by survey cycle

Prevalence (in percent) of high serum ferritin concentration (> 200 ng/mL) for males in the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999–2002.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Males, 12 years and older			
1999–2000	3,025	31.8 (27.7 – 36.3)	34,391,000
2001–2002	3,340	32.7 (30.1 – 35.5)	36,644,000
Age group			
12–19 years			
1999–2000	1,078	3.3 (1.8 – 6.0)	538,000
2001–2002	1,094	1.7 (1.0 – 2.9)	283,000
20–39 years			
1999–2000	632	33.1 (26.8 – 40.1)	12,720,000
2001–2002	724	31.0 (27.1 – 35.1)	12,101,000
40–59 years			
1999–2000	570	39.9 (33.0 – 47.1)	13,748,000
2001–2002	770	44.5 (39.0 – 50.2)	16,443,000
60 years and older			
1999–2000	745	39.1 (33.2 – 45.2)	7,336,000
2001–2002	752	37.2 (32.3 – 42.4)	7,219,000
Race/ethnicity			
Mexican Americans			
1999–2000	998	27.4 (23.1 – 32.1)	2,155,000
2001–2002	819	25.8 (21.3 – 31.0)	2,430,000
Non-Hispanic Blacks			
1999–2000	652	37.8 (32.8 – 43.2)	4,574,000
2001–2002	746	33.7 (28.7 – 39.2)	4,079,000
Non-Hispanic Whites			
1999–2000	1,122	32.4 (27.5 – 37.6)	25,539,000
2001–2002	1,518	33.1 (29.9 – 36.5)	26,398,000

Table 3.2.a.1. Serum soluble transferrin receptor: Concentrations

Geometric mean and selected percentiles of serum concentrations (in mg/L) for children aged 1–5 years and women aged 12–49 years in the U.S. population, 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	3.57 (3.51 – 3.63)	1.94 (1.91 – 1.96)	2.11 (1.99 – 2.20)	3.46 (3.37 – 3.55)	6.04 (5.90 – 6.36)	7.06 (6.78 – 7.62)	5,856
(Children 1–5 years, women 12–49 years)							
Age group							
1–5 years (Children)	4.30 (4.24 – 4.37)	2.84 (2.73 – 2.90)	2.98 (2.91 – 3.06)	4.21 (4.11 – 4.29)	6.00 (5.91 – 6.42)	6.67 (6.45 – 7.17)	1,375
12–19 years (Women)	3.50 (3.44 – 3.55)	2.12 (1.96 – 2.21)	2.27 (2.20 – 2.35)	3.38 (3.32 – 3.46)	5.36 (5.22 – 5.82)	6.47 (5.95 – 7.32)	1,968
20–39 years (Women)	3.42 (3.36 – 3.49)	1.91 (1.85 – 1.94)	2.02 (1.95 – 2.13)	3.23 (3.15 – 3.32)	6.00 (5.75 – 6.36)	6.97 (6.50 – 7.88)	1,761
40–49 years (Women)	3.52 (3.38 – 3.65)	1.91 (1.71 – 1.95)	1.97 (1.93 – 2.05)	3.35 (3.17 – 3.56)	6.43 (6.07 – 6.98)	7.96 (7.12 – 9.13)	752
Gender							
Males (1–5 years)	4.38 (4.28 – 4.48)	2.93 (2.75 – 2.98)	3.06 (2.95 – 3.18)	4.26 (4.13 – 4.41)	6.25 (5.94 – 6.63)	6.80 (6.48 – 7.45)	698
Females (1–5, 12–49 years)	3.51 (3.45 – 3.57)	1.93 (1.91 – 1.95)	2.07 (1.97 – 2.18)	3.37 (3.29 – 3.47)	6.02 (5.83 – 6.36)	7.19 (6.79 – 7.67)	5,158
Race/ethnicity							
(Children 1–5 years, women 12–49 years)							
Mexican Americans	3.62 (3.53 – 3.72)	1.97 (1.93 – 2.03)	2.16 (2.06 – 2.24)	3.52 (3.42 – 3.62)	6.38 (5.92 – 7.10)	7.80 (6.96 – 8.77)	1,643
Non-Hispanic Blacks	4.19 (4.10 – 4.29)	2.17 (1.97 – 2.33)	2.47 (2.31 – 2.57)	3.97 (3.91 – 4.04)	8.02 (7.31 – 9.69)	10.3 (9.78 – 12.6)	1,634
Non-Hispanic Whites	3.43 (3.35 – 3.52)	1.92 (1.89 – 1.94)	2.02 (1.94 – 2.17)	3.32 (3.22 – 3.44)	5.59 (5.28 – 6.07)	6.33 (5.96 – 7.33)	2,048

Figure 3.2.a. Serum soluble transferrin receptor: Concentrations by age group

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

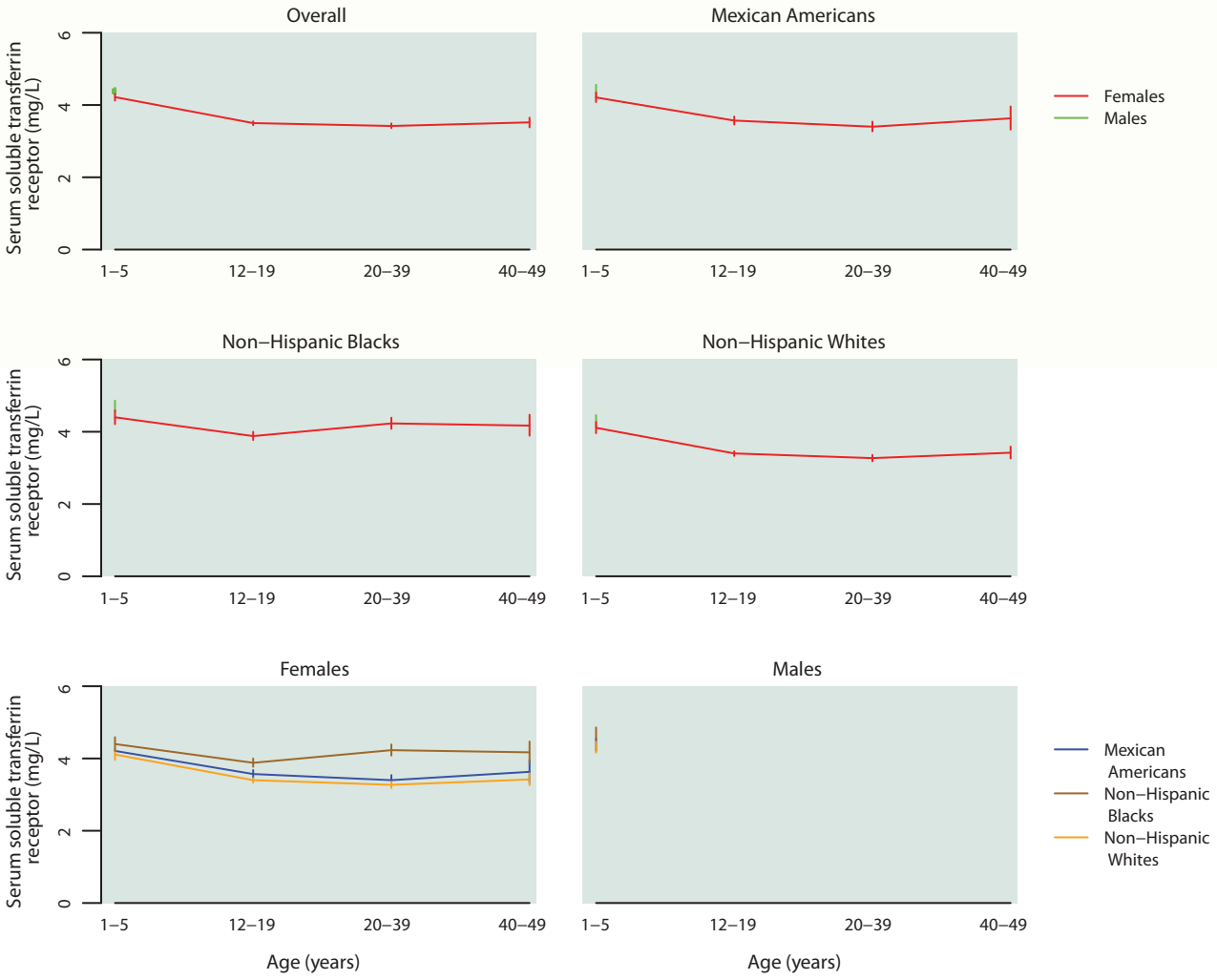

Table 3.2.a.2. Serum soluble transferrin receptor: Total population

Geometric mean and selected percentiles of serum concentrations (in mg/L) for children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	3.57 (3.51 – 3.63)	2.11 (1.99 – 2.20)	3.46 (3.37 – 3.55)	6.04 (5.90 – 6.36)	5,856
1–5 years	4.30 (4.24 – 4.37)	2.98 (2.91 – 3.06)	4.21 (4.11 – 4.29)	6.00 (5.91 – 6.42)	1,375
Males					
1–5 years	4.38 (4.28 – 4.48)	3.06 (2.95 – 3.18)	4.26 (4.13 – 4.41)	6.25 (5.94 – 6.63)	698
Females					
Total, 1–5, 12–49 years	3.51 (3.45 – 3.57)	2.07 (1.97 – 2.18)	3.37 (3.29 – 3.47)	6.02 (5.83 – 6.36)	5,158
1–5 years	4.22 (4.12 – 4.31)	2.90 (2.83 – 3.00)	4.10 (3.99 – 4.27)	5.91 (5.68 – 6.16)	677
12–19 years	3.50 (3.44 – 3.55)	2.27 (2.20 – 2.35)	3.38 (3.32 – 3.46)	5.36 (5.22 – 5.82)	1,968
20–39 years	3.42 (3.36 – 3.49)	2.02 (1.95 – 2.13)	3.23 (3.15 – 3.32)	6.00 (5.75 – 6.36)	1,761
40–49 years	3.52 (3.38 – 3.65)	1.97 (1.93 – 2.05)	3.35 (3.17 – 3.56)	6.43 (6.07 – 6.98)	752

Table 3.2.a.3. Serum soluble transferrin receptor: Mexican Americans

Geometric mean and selected percentiles of serum concentrations (in mg/L) for Mexican-American children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	3.62 (3.53 – 3.72)	2.16 (2.06 – 2.24)	3.52 (3.42 – 3.62)	6.38 (5.92 – 7.10)	1,643
1–5 years	4.30 (4.17 – 4.43)	2.99 (2.94 – 3.07)	4.15 (3.99 – 4.32)	6.40 (6.06 – 7.18)	422
Males					
1–5 years	4.38 (4.21 – 4.56)	3.09† (2.90 – 3.21)	4.18 (4.00 – 4.36)	6.89† (6.00 – 8.30)	203
Females					
Total, 1–5, 12–49 years	3.55 (3.45 – 3.65)	2.13 (2.01 – 2.22)	3.41 (3.27 – 3.54)	6.32 (5.85 – 7.25)	1,440
1–5 years	4.21 (4.08 – 4.35)	2.93† (2.58 – 3.07)	4.10 (3.94 – 4.31)	6.01† (5.66 – 7.53)	219
12–19 years	3.57 (3.46 – 3.68)	2.26 (2.18 – 2.36)	3.44 (3.33 – 3.59)	5.92 (5.27 – 6.92)	637
20–39 years	3.40 (3.27 – 3.54)	2.02 (1.93 – 2.12)	3.19 (3.01 – 3.40)	5.99 (5.62 – 7.63)	430
40–49 years	3.63 (3.32 – 3.96)	2.22† (1.80 – 2.30)	3.34 (3.02 – 3.71)	7.75† (6.29 – 11.7)	154

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

Table 3.2.a.4. Serum soluble transferrin receptor: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in mg/L) for non-Hispanic black children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	4.19 (4.10 – 4.29)	2.47 (2.31 – 2.57)	3.97 (3.91 – 4.04)	8.02 (7.31 – 9.69)	1,634
1–5 years	4.55 (4.43 – 4.67)	3.11 (3.02 – 3.29)	4.37 (4.26 – 4.56)	6.68 (6.31 – 7.16)	401
Males					
1–5 years	4.70 (4.56 – 4.86)	3.24† (3.06 – 3.37)	4.58 (4.30 – 4.89)	6.76† (6.42 – 7.77)	199
Females					
Total, 1–5, 12–49 years	4.15 (4.05 – 4.26)	2.43 (2.27 – 2.55)	3.94 (3.86 – 4.00)	8.49 (7.37 – 9.87)	1,435
1–5 years	4.40 (4.21 – 4.59)	3.05† (2.73 – 3.23)	4.26 (4.00 – 4.47)	6.49† (5.96 – 7.16)	202
12–19 years	3.88 (3.77 – 4.00)	2.42 (2.25 – 2.52)	3.76 (3.66 – 3.87)	6.46 (6.14 – 7.07)	668
20–39 years	4.23 (4.08 – 4.39)	2.41 (2.06 – 2.58)	3.97 (3.85 – 4.15)	9.70 (7.33 – 10.5)	368
40–49 years	4.17 (3.89 – 4.47)	2.34† (1.94 – 2.61)	3.87 (3.51 – 4.08)	9.72† (8.28 – 13.2)	197

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

Table 3.2.a.5. Serum soluble transferrin receptor: Non-Hispanic whites

Geometric mean and selected percentiles of serum concentrations (in mg/L) for non-Hispanic white children aged 1–5 years and women aged 12–49 years in the U.S. population, 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, Children 1–5 years, women 12–49 years	3.43 (3.35 – 3.52)	2.02 (1.94 – 2.17)	3.32 (3.22 – 3.44)	5.59 (5.28 – 6.07)	2,048
1–5 years	4.22 (4.11 – 4.32)	2.91 (2.78 – 3.04)	4.15 (4.01 – 4.28)	5.90 (5.63 – 6.19)	391
Males					
1–5 years	4.31 (4.16 – 4.46)	2.98† (2.91 – 3.15)	4.22 (3.99 – 4.48)	5.95† (5.67 – 6.83)	215
Females					
Total, 1–5, 12–49 years	3.38 (3.30 – 3.47)	2.00 (1.97 – 2.05)	3.25 (3.14 – 3.37)	5.53 (5.18 – 6.08)	1,833
1–5 years	4.11 (3.96 – 4.27)	2.85† (2.64 – 2.97)	4.05 (3.88 – 4.27)	5.64† (5.36 – 6.64)	176
12–19 years	3.40 (3.33 – 3.46)	2.25 (2.12 – 2.35)	3.29 (3.20 – 3.37)	4.98 (4.78 – 5.49)	514
20–39 years	3.27 (3.18 – 3.36)	1.97 (1.94 – 2.01)	3.10 (3.00 – 3.20)	5.44 (4.96 – 6.01)	806
40–49 years	3.42 (3.26 – 3.59)	1.96 (1.92 – 2.01)	3.31 (3.03 – 3.57)	6.02 (5.41 – 6.76)	337

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

Table 3.2.b. Serum soluble transferrin receptor: Concentrations by survey cycle

Geometric mean and selected percentiles of serum concentrations (in mg/L) for children aged 1–5 and women aged 12–49 years in the U.S. population, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total (Children 1–5 years, women 12–49 years)					
2003–2004	3.63 (3.54 – 3.71)	2.06 (1.94 – 2.36)	3.55 (3.43 – 3.66)	5.96 (5.75 – 6.41)	2,831
2005–2006	3.51 (3.42 – 3.60)	2.13 (2.00 – 2.20)	3.36 (3.28 – 3.47)	6.16 (5.77 – 6.63)	3,025
Age group					
1–5 years (Children)					
2003–2004	4.44 (4.34 – 4.55)	3.28 (3.13 – 3.38)	4.33 (4.21 – 4.45)	5.99 (5.83 – 6.83)	696
2005–2006	4.16 (4.04 – 4.27)	2.86 (2.79 – 2.93)	4.06 (3.89 – 4.21)	6.08 (5.79 – 6.48)	679
12–19 years (Women)					
2003–2004	3.57 (3.48 – 3.66)	2.29 (2.15 – 2.46)	3.49 (3.32 – 3.62)	5.72 (5.26 – 6.39)	975
2005–2006	3.43 (3.36 – 3.49)	2.26 (2.13 – 2.35)	3.33 (3.25 – 3.38)	5.23 (5.01 – 5.81)	993
20–39 years (Women)					
2003–2004	3.49 (3.43 – 3.56)	2.02 (1.93 – 2.27)	3.33 (3.23 – 3.41)	5.96 (5.73 – 6.32)	803
2005–2006	3.35 (3.24 – 3.47)	2.02 (1.90 – 2.13)	3.16 (3.04 – 3.31)	6.07 (5.54 – 6.57)	958
40–49 years (Women)					
2003–2004	3.49 (3.28 – 3.71)	1.96 (1.94 – 1.99)	3.33 (2.98 – 3.63)	6.01 (5.39 – 7.56)	357
2005–2006	3.54 (3.36 – 3.74)	2.05 (1.66 – 2.23)	3.37 (3.19 – 3.65)	6.86 (6.22 – 7.89)	395
Gender					
Males (1–5 years)					
2003–2004	4.54 (4.39 – 4.70)	3.32 (3.20 – 3.41)	4.40 (4.23 – 4.56)	6.38 (5.94 – 7.23)	358
2005–2006	4.21 (4.05 – 4.38)	2.94 (2.74 – 3.02)	4.16 (3.90 – 4.34)	6.04 (5.69 – 6.52)	340
Females (1–5, 12–49 years)					
2003–2004	3.56 (3.47 – 3.65)	2.03 (1.93 – 2.32)	3.45 (3.31 – 3.59)	5.94 (5.64 – 6.37)	2,473
2005–2006	3.46 (3.37 – 3.55)	2.11 (1.96 – 2.19)	3.31 (3.22 – 3.39)	6.17 (5.77 – 6.69)	2,685
Race/ethnicity (Children 1–5 years, women 12–49 years)					
Mexican Americans					
2003–2004	3.63 (3.53 – 3.73)	2.18 (1.99 – 2.37)	3.59 (3.44 – 3.80)	5.88 (5.49 – 6.42)	734
2005–2006	3.62 (3.46 – 3.79)	2.15 (2.02 – 2.24)	3.46 (3.28 – 3.62)	7.32 (6.16 – 8.70)	909
Non-Hispanic Blacks					
2003–2004	4.18 (4.04 – 4.33)	2.54 (2.33 – 2.65)	3.96 (3.89 – 4.06)	7.97 (6.94 – 9.88)	832
2005–2006	4.20 (4.08 – 4.33)	2.36 (2.19 – 2.56)	4.00 (3.86 – 4.13)	8.17 (7.15 – 10.4)	802
Non-Hispanic Whites					
2003–2004	3.51 (3.37 – 3.65)	1.99 (1.98 – 2.03)	3.44 (3.22 – 3.63)	5.68 (5.16 – 6.38)	1,026
2005–2006	3.36 (3.27 – 3.45)	2.09 (1.91 – 2.19)	3.24 (3.15 – 3.33)	5.55 (5.11 – 6.40)	1,022

Figure 3.2.b. Serum soluble transferrin receptor: Concentrations by survey cycle

Selected percentiles in mg/L (95% confidence intervals), National Health and Nutrition Examination Survey, 2003–2006

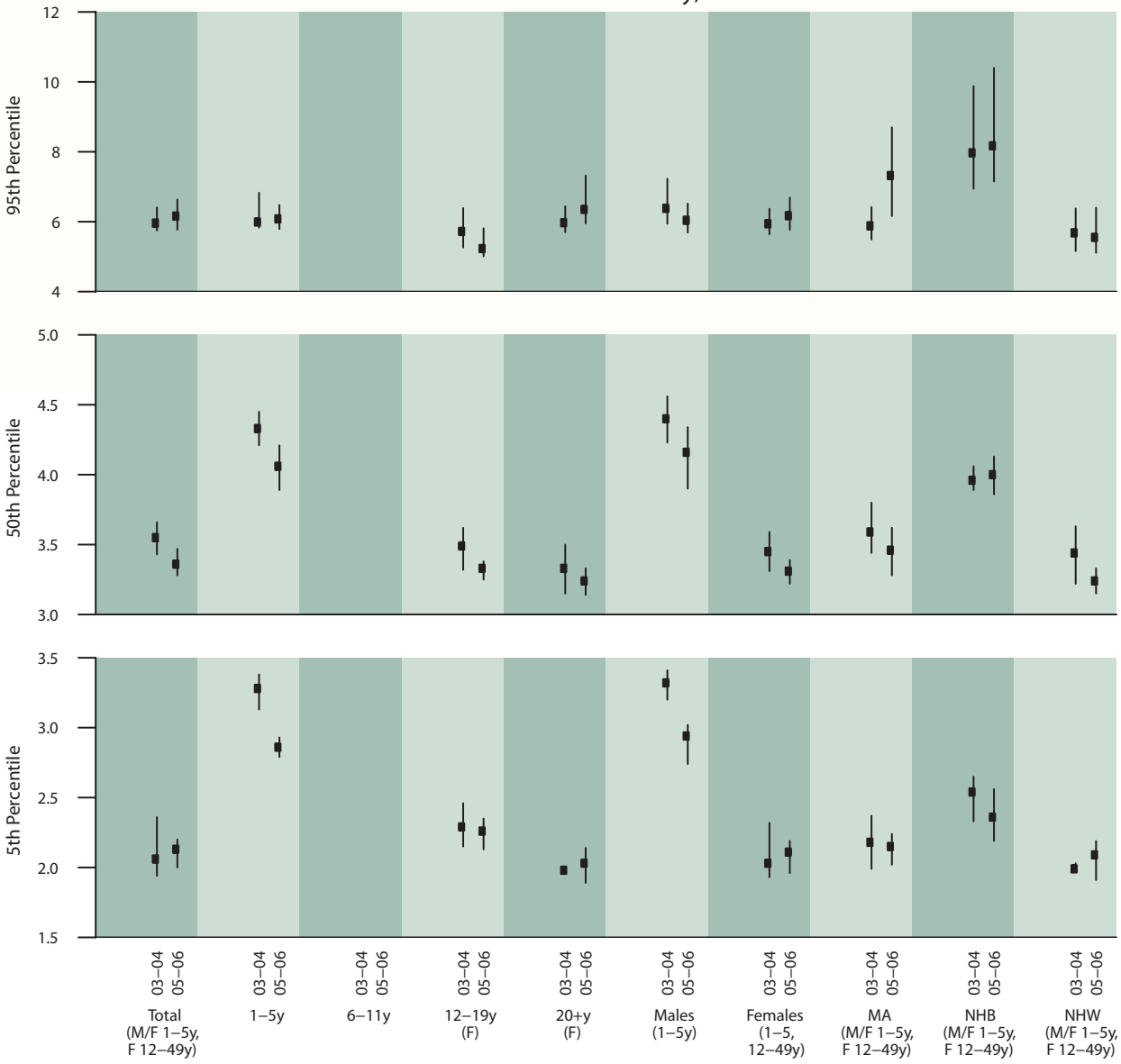

Table 3.2.c. Serum soluble transferrin receptor: Prevalence

Prevalence (in percent) of high serum soluble transferrin receptor concentration (> 4.4 mg/L) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years	4,481	18.9 (17.0 – 20.9)	14,918,000
Age group			
12–19 years	1,968	16.9 (14.7 – 19.3)	2,741,000
20–49 years	2,513	19.4 (17.3 – 21.6)	12,159,000
Race/ethnicity			
Mexican Americans	1,221	19.0 (15.5 – 23.0)	1,451,000
Non-Hispanic Blacks	1,233	34.9 (31.6 – 38.4)	3,756,000
Non-Hispanic Whites	1,657	16.0 (13.6 – 18.7)	8,177,000

Table 3.2.d. Serum soluble transferrin receptor: Prevalence by survey cycle

Prevalence (in percent) of high serum soluble transferrin receptor concentration (> 4.4 mg/L) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years			
2003–2004	2,135	18.8 (16.3 – 21.6)	14,862,000
2005–2006	2,346	18.9 (16.0 – 22.3)	15,017,000
Age group			
12–19 years			
2003–2004	975	17.4 (14.0 – 21.3)	2,818,000
2005–2006	993	16.4 (13.5 – 19.8)	2,694,000
20–49 years			
2003–2004	1,160	19.2 (16.3 – 22.4)	12,031,000
2005–2006	1,353	19.6 (16.4 – 23.2)	12,296,000
Race/ethnicity			
Mexican Americans			
2003–2004	547	18.7 (13.3 – 25.7)	1,435,000
2005–2006	674	19.2 (14.6 – 24.7)	1,516,000
Non-Hispanic Blacks			
2003–2004	604	33.2 (28.9 – 37.7)	3,568,000
2005–2006	629	36.7 (31.6 – 42.1)	3,988,000
Non-Hispanic Whites			
2003–2004	823	16.1 (12.5 – 20.5)	8,258,000
2005–2006	834	15.8 (12.6 – 19.6)	7,991,000

Table 3.3.a.1. Body iron

Arithmetic mean and selected percentiles of body iron (in mg/kg) for children aged 1–5 years and women aged 12–49 years in the U.S. population, 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	5.16 (5.01 – 5.31)	-3.75 (-4.05 – -3.41)	-1.83 (-2.60 – -1.41)	5.43 (5.32 – 5.58)	10.8 (10.6 – 11.2)	12.0 (11.5 – 12.5)	5,845
(Children 1–5 years, women 12–49 years)							
Age group							
1–5 years (Children)	3.47 (3.31 – 3.63)	-2.00 (-3.06 – -1.34)	-.648 (-1.26 – -.159)	3.64 (3.44 – 3.79)	6.89 (6.72 – 7.06)	7.36 (7.17 – 7.87)	1,369
12–19 years (Women)	4.49 (4.26 – 4.72)	-3.37 (-4.28 – -2.61)	-1.59 (-2.69 – -.763)	4.96 (4.71 – 5.16)	8.84 (8.35 – 9.34)	9.61 (9.23 – 10.2)	1,967
20–39 years (Women)	5.51 (5.29 – 5.73)	-3.76 (-4.09 – -3.12)	-1.75 (-2.81 – -1.22)	5.88 (5.69 – 6.17)	10.7 (10.2 – 11.1)	11.6 (11.0 – 12.4)	1,758
40–49 years (Women)	5.88 (5.46 – 6.30)	-4.43 (-5.33 – -3.76)	-2.85 (-3.78 – -1.84)	6.37 (5.86 – 6.82)	12.4 (11.7 – 12.9)	13.1 (12.7 – 14.2)	751
Gender							
Males (1–5 years)	3.38 (3.17 – 3.59)	-1.69 (-3.30 – -1.25)	-.715 (-1.36 – -.262)	3.52 (3.32 – 3.80)	6.91 (6.65 – 7.30)	7.33 (6.93 – 8.12)	695
Females (1–5, 12–49 years)	5.30 (5.13 – 5.46)	-3.78 (-4.06 – -3.50)	-2.01 (-2.70 – -1.43)	5.65 (5.49 – 5.76)	11.0 (10.7 – 11.4)	12.1 (11.6 – 12.6)	5,150
Race/ethnicity							
(Children 1–5 years, women 12–49 years)							
Mexican Americans	4.49 (4.10 – 4.88)	-4.49 (-5.27 – -3.69)	-3.16 (-3.81 – -2.03)	4.75 (4.44 – 5.12)	10.4 (9.73 – 11.2)	11.4 (10.8 – 12.9)	1,641
Non-Hispanic Blacks	4.37 (4.10 – 4.64)	-5.79 (-6.99 – -4.66)	-3.79 (-4.61 – -2.88)	4.66 (4.30 – 5.05)	11.0 (10.3 – 11.6)	12.1 (11.3 – 13.2)	1,633
Non-Hispanic Whites	5.46 (5.24 – 5.69)	-3.17 (-3.99 – -2.25)	-1.21 (-2.34 – -.516)	5.66 (5.49 – 5.81)	10.9 (10.5 – 11.5)	12.0 (11.5 – 12.7)	2,041

Figure 3.3.a. Body iron: by age group

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

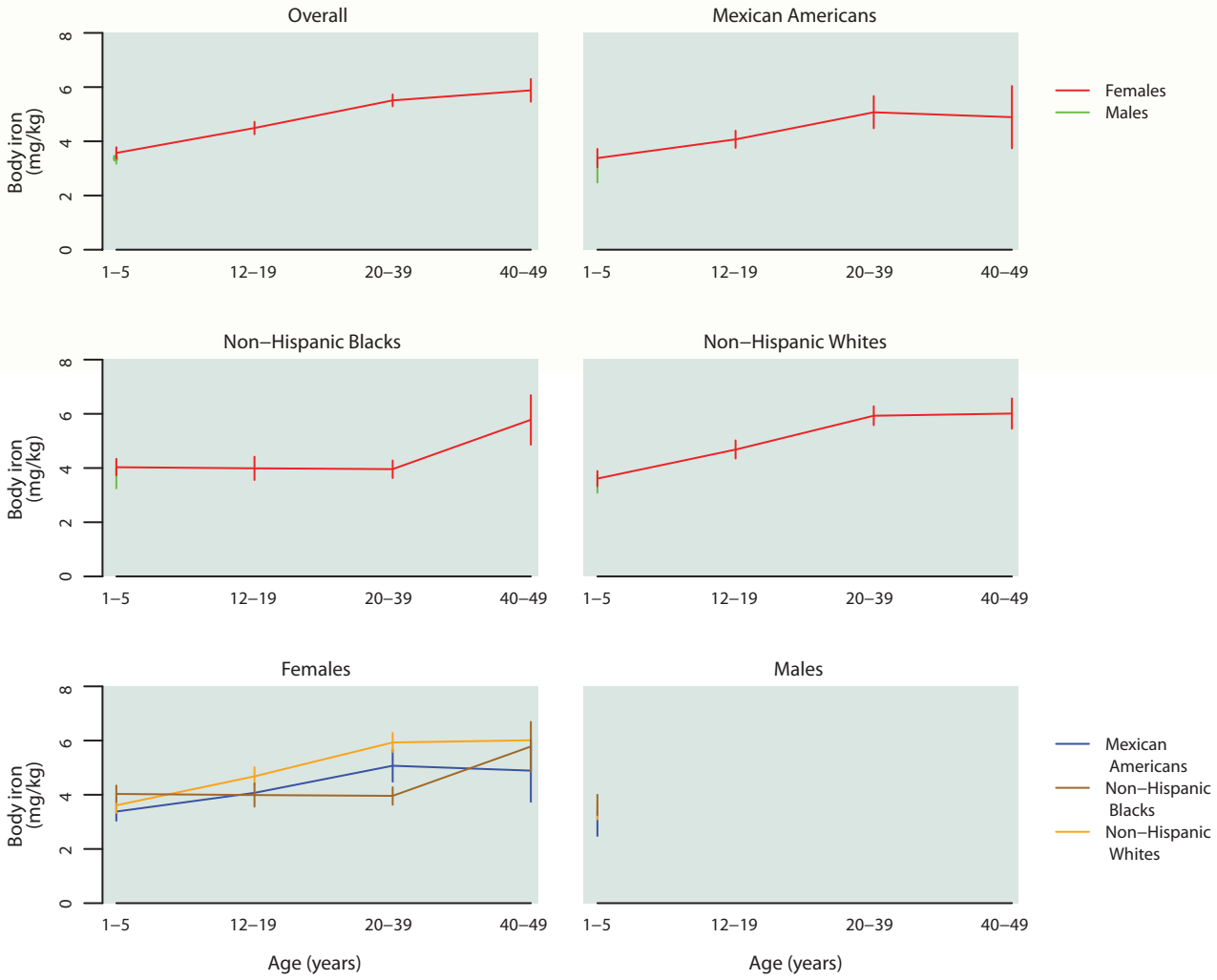

Table 3.3.a.2. Body iron: Total population

Arithmetic mean and selected percentiles of body iron (in mg/kg) for children aged 1–5 years and women aged 12–49 years in 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	
Males and Females					
Total, Children 1–5 years, women 12–49 years	5.16 (5.01 – 5.31)	-1.83 (-2.60 – -1.41)	5.43 (5.32 – 5.58)	10.8 (10.6 – 11.2)	5,845
1–5 years	3.47 (3.31 – 3.63)	-.648 (-1.26 – -.159)	3.64 (3.44 – 3.79)	6.89 (6.72 – 7.06)	1,369
Males					
1–5 years	3.38 (3.17 – 3.59)	-.715 (-1.36 – -.262)	3.52 (3.32 – 3.80)	6.91 (6.65 – 7.30)	695
Females					
Total, Children 1–5 years, women 12–49 years	5.30 (5.13 – 5.46)	-2.01 (-2.70 – -1.43)	5.65 (5.49 – 5.76)	11.0 (10.7 – 11.4)	5,150
1–5 years	3.57 (3.36 – 3.78)	-.196 (-2.11 – .411)	3.70 (3.41 – 4.04)	6.89 (6.67 – 7.27)	674
12–19 years	4.49 (4.26 – 4.72)	-1.59 (-2.69 – -.763)	4.96 (4.71 – 5.16)	8.84 (8.35 – 9.34)	1,967
20–39 years	5.51 (5.29 – 5.73)	-1.75 (-2.81 – -1.22)	5.88 (5.69 – 6.17)	10.7 (10.2 – 11.1)	1,758
40–49 years	5.88 (5.46 – 6.30)	-2.85 (-3.78 – -1.84)	6.37 (5.86 – 6.82)	12.4 (11.7 – 12.9)	751

Table 3.3.a.3. Body iron: Mexican Americans

Arithmetic mean and selected percentiles of body iron (in mg/kg) for Mexican American children aged 1–5 years and women aged 12–49 years in 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	
Males and Females					
Total, Children 1–5 years, women 12–49 years	4.49 (4.10 – 4.88)	-3.16 (-3.81 – -2.03)	4.75 (4.44 – 5.12)	10.4 (9.73 – 11.2)	1,641
1–5 years	3.16 (2.84 – 3.48)	-2.09 (-3.35 – -1.36)	3.48 (3.13 – 3.78)	6.99 (6.57 – 7.93)	422
Males					
1–5 years	2.95 (2.48 – 3.41)	-2.71† (-4.72 – -1.59)	3.34 (2.99 – 3.77)	6.92† (5.95 – 9.30)	203
Females					
Total, Children 1–5 years, women 12–49 years	4.66 (4.23 – 5.10)	-3.17 (-3.82 – -1.90)	5.02 (4.60 – 5.44)	10.6 (9.79 – 11.4)	1,438
1–5 years	3.38 (3.04 – 3.72)	-1.88† (-2.87 – -.828)	3.55 (3.22 – 4.15)	6.99† (6.78 – 8.13)	219
12–19 years	4.07 (3.76 – 4.39)	-1.76 (-3.29 – -.981)	4.46 (4.26 – 4.68)	8.99 (8.51 – 9.69)	637
20–39 years	5.07 (4.48 – 5.67)	-3.15 (-4.31 – -1.66)	5.72 (4.93 – 6.28)	10.7 (9.89 – 12.0)	429
40–49 years	4.89 (3.74 – 6.04)	-4.89† (-6.96 – -3.40)	5.33 (4.42 – 6.59)	11.1† (10.4 – 15.1)	153

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

Table 3.3.a.4. Body iron: Non-Hispanic blacks

Arithmetic mean and selected percentiles of body iron (in mg/kg) for non-Hispanic black children aged 1–5 years and women aged 12–49 years in 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		
Males and Females								
Total, Children 1–5 years, women 12–49 years	4.37	(4.10 – 4.64)	-3.79	(-4.61 – -2.88)	4.66	(4.30 – 5.05)	11.0	(10.3 – 11.6)	1,633
1–5 years	3.83	(3.56 – 4.09)	-.115	(-.906 – .776)	3.95	(3.78 – 4.25)	7.51	(6.80 – 8.03)	401
Males									
1–5 years	3.63	(3.25 – 4.00)	-.328†	(-2.15 – .070)	3.77	(3.17 – 4.19)	6.90†	(6.55 – 8.03)	199
Females									
Total, Children 1–5 years, women 12–49 years	4.43	(4.14 – 4.72)	-3.94	(-4.87 – -3.04)	4.80	(4.35 – 5.16)	11.0	(10.4 – 11.9)	1,434
1–5 years	4.03	(3.73 – 4.34)	.658†	(-.541 – .981)	4.17	(3.92 – 4.35)	7.71†	(6.93 – 8.09)	202
12–19 years	3.99	(3.56 – 4.42)	-2.53	(-3.91 – -1.71)	4.46	(4.09 – 4.79)	8.91	(8.38 – 9.43)	667
20–39 years	3.96	(3.63 – 4.28)	-4.12	(-5.73 – -3.46)	4.35	(4.08 – 4.86)	9.96	(9.46 – 11.2)	368
40–49 years	5.78	(4.86 – 6.69)	-5.62†	(-9.51 – -2.80)	6.68	(5.78 – 7.32)	12.9†	(11.9 – 15.4)	197

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

Table 3.3.a.5. Body iron: Non-Hispanic whites

Arithmetic mean and selected percentiles of body iron (in mg/kg) for non-Hispanic white children aged 1–5 years and women aged 12–49 years in 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		
Males and Females								
Total, Children 1–5 years, women 12–49 years	5.46	(5.24 – 5.69)	-1.21	(-2.34 – -.516)	5.66	(5.49 – 5.81)	10.9	(10.5 – 11.5)	2,041
1–5 years	3.51	(3.27 – 3.74)	-.264	(-1.28 – .300)	3.56	(3.34 – 3.92)	6.89	(6.64 – 7.00)	385
Males									
1–5 years	3.42	(3.09 – 3.75)	-.571†	(-1.39 – .140)	3.50	(3.06 – 4.01)	6.91†	(6.45 – 7.33)	212
Females									
Total, Children 1–5 years, women 12–49 years	5.60	(5.36 – 5.84)	-1.27	(-2.60 – -.546)	5.81	(5.66 – 6.02)	11.0	(10.7 – 11.5)	1,829
1–5 years	3.61	(3.33 – 3.89)	.062†	(-3.13 – .791)	3.67	(3.35 – 4.03)	6.70†	(6.45 – 7.27)	173
12–19 years	4.68	(4.35 – 5.02)	-1.48	(-3.15 – -.417)	5.17	(4.86 – 5.50)	8.84	(8.29 – 9.62)	514
20–39 years	5.93	(5.58 – 6.28)	-.640	(-2.73 – .779)	6.16	(5.82 – 6.59)	10.7	(10.2 – 11.4)	805
40–49 years	6.01	(5.45 – 6.57)	-2.26	(-3.78 – -1.01)	6.36	(5.77 – 6.99)	12.4	(11.6 – 13.0)	337

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

Table 3.3.b. Body iron: By survey cycle

Arithmetic mean and selected percentiles of body iron (in mg/kg) for children aged 1–5 years and women aged 12–49 years in the U.S. population, National Health and Nutrition Examination Survey, 2003–2006.

	Arithmetic mean (95% conf. interval)	Selected percentiles (95% conf. interval) 5th	50th	95th	Sample size
Total (Children 1–5 years, women 12–49 years)					
2003–2004	5.21 (5.03 – 5.39)	-1.60 (-2.96 – -.854)	5.43 (5.32 – 5.55)	10.9 (10.7 – 11.3)	2,826
2005–2006	5.11 (4.85 – 5.38)	-2.04 (-2.73 – -1.43)	5.43 (5.08 – 5.71)	10.8 (10.2 – 11.5)	3,019
Age group					
1–5 years (Children)					
2003–2004	3.25 (3.01 – 3.50)	-.651 (-1.73 – .144)	3.34 (2.99 – 3.66)	6.55 (6.39 – 6.73)	694
2005–2006	3.70 (3.47 – 3.94)	-.642 (-1.65 – -.080)	3.91 (3.70 – 4.14)	7.00 (6.92 – 7.33)	675
12–19 years (Women)					
2003–2004	4.27 (3.89 – 4.66)	-2.23 (-3.93 – -.653)	4.71 (4.27 – 5.11)	8.89 (8.29 – 9.73)	974
2005–2006	4.71 (4.45 – 4.96)	-1.45 (-2.64 – -.527)	5.10 (4.85 – 5.33)	8.53 (8.31 – 9.55)	993
20–39 years (Women)					
2003–2004	5.61 (5.33 – 5.89)	-1.21 (-2.14 – -.835)	6.07 (5.69 – 6.25)	10.4 (9.92 – 11.1)	801
2005–2006	5.42 (5.04 – 5.79)	-2.55 (-3.91 – -1.41)	5.83 (5.44 – 6.27)	10.8 (10.2 – 11.9)	957
40–49 years (Women)					
2003–2004	6.22 (5.61 – 6.82)	-3.28 (-3.80 – -1.85)	6.85 (6.21 – 7.33)	12.7 (12.0 – 13.4)	357
2005–2006	5.55 (4.89 – 6.21)	-2.47 (-4.61 – -1.59)	5.96 (5.33 – 6.66)	11.8 (11.1 – 13.1)	394
Gender					
Males (1–5 years)					
2003–2004	3.11 (2.76 – 3.46)	-.719 (-1.89 – -.152)	3.13 (2.70 – 3.65)	6.21 (5.74 – 6.92)	358
2005–2006	3.68 (3.41 – 3.95)	-.746 (-1.32 – -.268)	3.91 (3.48 – 4.41)	7.24 (6.81 – 8.27)	337
Females (1–5, 12–49 years)					
2003–2004	5.38 (5.18 – 5.58)	-1.76 (-3.18 – -.854)	5.66 (5.50 – 5.80)	11.0 (10.7 – 11.5)	2,468
2005–2006	5.22 (4.94 – 5.49)	-2.20 (-2.98 – -1.52)	5.60 (5.32 – 5.84)	10.9 (10.2 – 11.6)	2,682
Race/ethnicity (Children 1–5 years, women 12–49 years)					
Mexican Americans					
2003–2004	4.74 (4.13 – 5.35)	-2.05 (-3.57 – -1.13)	4.94 (4.28 – 5.64)	10.6 (9.69 – 12.5)	734
2005–2006	4.26 (3.78 – 4.73)	-3.70 (-5.21 – -2.73)	4.71 (4.31 – 5.05)	9.91 (9.73 – 10.8)	907
Non-Hispanic Blacks					
2003–2004	4.48 (4.02 – 4.94)	-3.79 (-5.06 – -2.47)	4.68 (4.15 – 5.24)	11.1 (9.95 – 12.7)	831
2005–2006	4.26 (3.94 – 4.58)	-3.96 (-4.99 – -2.62)	4.66 (4.16 – 5.17)	10.6 (9.86 – 11.4)	802
Non-Hispanic Whites					
2003–2004	5.45 (5.14 – 5.75)	-.903 (-3.69 – .285)	5.57 (5.43 – 5.76)	11.0 (10.5 – 11.6)	1,023
2005–2006	5.48 (5.12 – 5.85)	-1.39 (-2.45 – -.593)	5.70 (5.42 – 6.01)	10.9 (10.2 – 12.0)	1,018

Figure 3.3.b. Body iron: By Survey Cycle

Selected percentiles in mg/kg (95% confidence intervals), National Health and Nutrition Examination Survey, 2003–2006

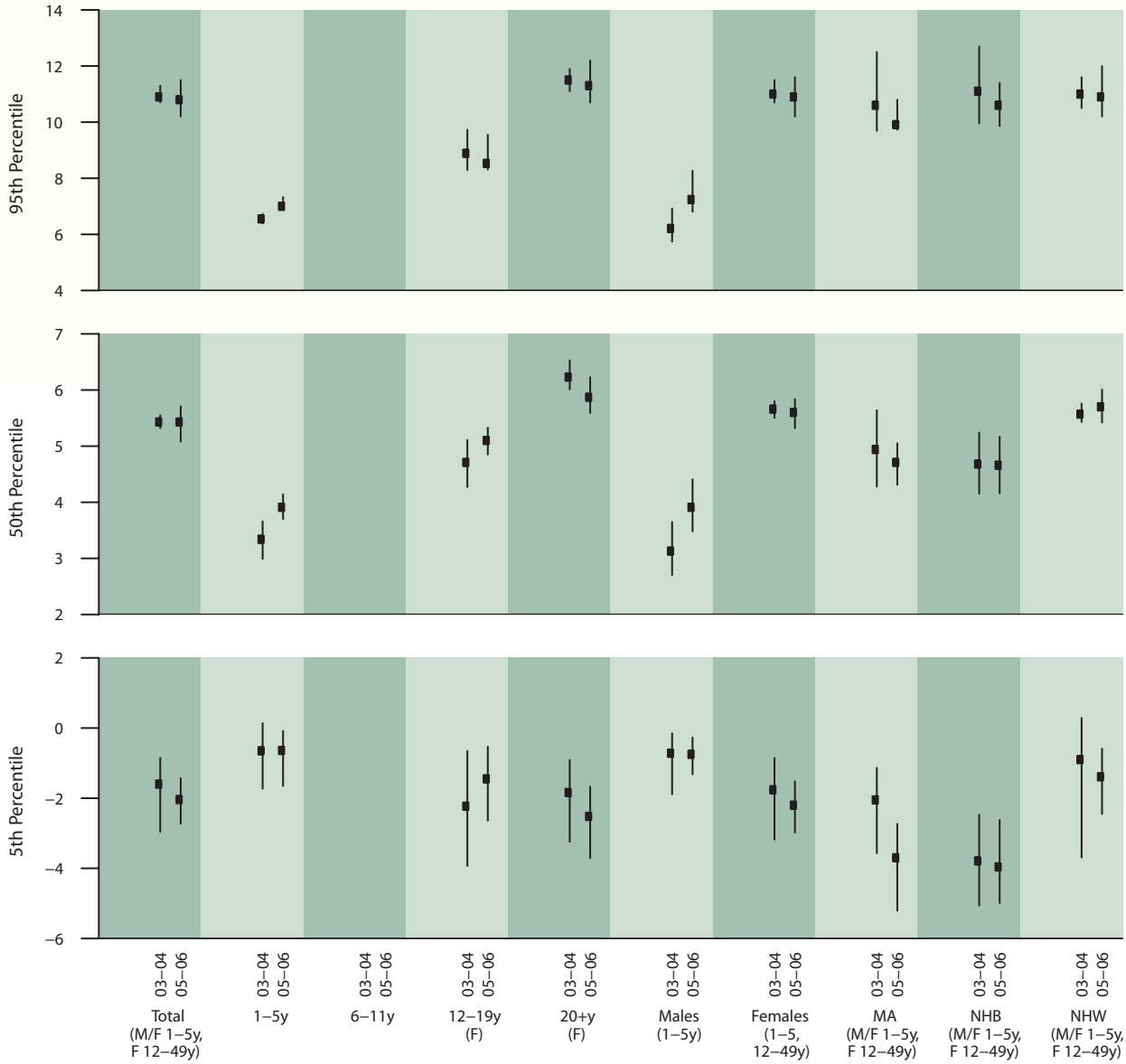

Table 3.3.c.1. Body iron: Prevalence

Prevalence (in percent) of low body iron (< 0 mg/kg) for children in the U.S. population aged 1–5 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Children, 1–5 years	1,369	6.7 (5.0 – 8.8)	1,350,000
Gender			
Males	695	7.8 (5.6 – 10.8)	807,000
Females	674	5.4 (3.4 – 8.3)	534,000
Race/ethnicity			
Mexican Americans	422	10.9 (8.1 – 14.6)	333,000
Non-Hispanic Blacks	401	5.1 (3.0 – 8.6)	154,000
Non-Hispanic Whites	385	5.8 (3.6 – 9.1)	670,000

Table 3.3.c.2. Body iron: Prevalence

Prevalence (in percent) of low body iron (< 0 mg/kg) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years	4,476	9.5 (8.6 – 10.5)	7,515,000
Age group			
12–19 years	1,967	9.3 (7.4 – 11.6)	1,508,000
20–49 years	2,509	9.6 (8.6 – 10.7)	6,006,000
Race/ethnicity			
Mexican Americans	1,219	13.2 (10.2 – 16.9)	1,007,000
Non-Hispanic Blacks	1,232	16.2 (13.9 – 18.7)	1,739,000
Non-Hispanic Whites	1,656	7.4 (5.8 – 9.4)	3,803,000

Table 3.3.d.1. Body iron: Prevalence by survey cycle

Prevalence (in percent) of low body iron (< 0 mg/kg) for children in the U.S. population aged 1–5 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Children, 1–5 years			
2003–2004	694	6.5 (4.3 – 9.8)	1,321,000
2005–2006	675	6.8 (4.5 – 10.2)	1,377,000
Gender			
Males			
2003–2004	358	8.3 (4.9 – 13.7)	854,000
2005–2006	337	7.3 (4.7 – 11.1)	755,000
Females			
2003–2004	336	4.5 (2.7 – 7.4)	449,000
2005–2006	338	6.3‡ (3.1 – 12.4)	620,000‡
Race/ethnicity			
Mexican Americans			
2003–2004	187	13.3 (8.4 – 20.5)	405,000
2005–2006	235	8.6 (6.0 – 12.1)	275,000
Non-Hispanic Blacks			
2003–2004	228	6.1‡ (3.1 – 11.8)	183,000‡
2005–2006	173	§	§
Non-Hispanic Whites			
2003–2004	201	4.6‡ (2.1 – 10.0)	538,000‡
2005–2006	184	7.0 (3.8 – 12.5)	792,000

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

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

Table 3.3.d.2. Body iron: Prevalence by survey cycle

Prevalence (in percent) of low body iron (< 0 mg/kg) for women in the U.S. population aged 12–49 years, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
Women, 12–49 years			
2003–2004	2,132	8.6 (7.0 – 10.4)	6,773,000
2005–2006	2,344	10.4 (9.3 – 11.7)	8,266,000
Age group			
12–19 years			
2003–2004	974	9.0 (6.3 – 12.6)	1,455,000
2005–2006	993	9.6 (6.9 – 13.2)	1,576,000
20–49 years			
2003–2004	1,158	8.5 (6.8 – 10.5)	5,322,000
2005–2006	1,351	10.6 (9.5 – 11.9)	6,681,000
Race/ethnicity			
Mexican Americans			
2003–2004	547	11.2 (7.6 – 16.2)	857,000
2005–2006	672	15.1 (10.5 – 21.2)	1,193,000
Non-Hispanic Blacks			
2003–2004	603	16.0 (12.8 – 19.8)	1,720,000
2005–2006	629	16.3 (13.1 – 20.1)	1,777,000
Non-Hispanic Whites			
2003–2004	822	6.9 (4.4 – 10.6)	3,530,000
2005–2006	834	8.0 (6.0 – 10.5)	4,023,000

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Iodine

Background Information

Sources and Physiological Functions. Iodine, a trace element found in soil, is an essential component of the thyroid hormones involved in regulating the body's metabolic processes related to normal growth and development. Across the world, iodized salt and seafood are the major dietary sources of iodine. In the United States, where the addition of iodine to salt is not mandatory, most people get their iodine from dairy products and grains (bread) (Murray 2008). In the United States, salt is iodized with potassium iodide at 100 parts per million (76 milligram [mg] of iodine per kilogram [kg] of salt). Iodized salt is chosen by about 50–60% of the U.S. population (Institute of Medicine 2001). Still, most ingested salt comes from processed food (approximately 70%), which is typically not iodized in either the United States or in Canada (The Public Health Committee of the American Thyroid Association 2006). Dairy products have been identified as another important contributor to iodine status among reproductive-age women in the United States (Perrine 2010).

Health Effects. Iodine deficiency disorders include mental retardation, hypothyroidism, goiter, cretinism, and varying degrees of other growth and developmental abnormalities. Iodine deficiency is the most preventable cause of mental retardation in the world (World Health Organization 2007). Thyroid enlargement (goiter) is usually the earliest clinical feature of iodine deficiency. Thyroid hormone is particularly important in the development of the central nervous system during the fetal and early postnatal periods. In areas where iodized salt is common, iodine deficiency is rare. The most critical period for iodine sufficiency is in utero through the first two years of life, when thyroid hormones are required for normal brain development (World Health Organization 2007).

Excess iodine intake may also result in goiter, as well as in hyper- or hypothyroidism. High iodine intake has also been associated with increased risk for thyroid papillary cancer (Institute of Medicine 2001). For most people, iodine intake from usual foods and supplements is unlikely to exceed the tolerable upper intake level (1100 µg/day) (Institute of Medicine 2001).

Intake Recommendations. The Institute of Medicine recommends the following daily intake of iodine: 90 µg for children 1 to 8 years, 120 µg for children 9 to 13 years, 150 µg for adolescents (14 to 18 years) and for nonpregnant adults, 220 µg per day for pregnant women, and 290 µg per day during lactation (Institute of Medicine 2001). Dietary iodine requirements are higher in pregnancy because of increased thyroid hormone production, increased renal iodine excretion, and fetal iodine requirements (Glinoer 2007).

The World Health Organization (WHO) recommends the following daily intake of iodine: 90 µg for preschool children (0 to 59 months); 120 µg for schoolchildren (6 to 12 years); 150 µg for adolescents (above 12 years) and adults; and 250 µg for pregnant and lactating women (World Health Organization 2007). The American Thyroid Association recommends that North American women receive dietary supplements containing 150 µg iodine daily during pregnancy and lactation and that all prenatal vitamins contain 150 µg of iodine (Becker 2006). An Endocrine Society Clinical Practice Guideline on the management of thyroid dysfunction during

pregnancy and postpartum recommends an average daily intake of 250 µg iodine for pregnant women (Abalovich 2007). These recommendations have not yet been widely adopted. A current survey of prenatal multivitamins marketed in the United States showed that 49% did not contain iodine (Leung 2009). Furthermore, the majority of women of childbearing age (> 80%) are not consuming supplements containing iodine (Gregory 2009).

Biochemical Indicators. Iodine deficiency develops when iodide intake is less than 20 µg/day (Beers 2006). Most dietary iodine absorbed in the body eventually appears in the urine; thus, urinary iodine excretion is recommended for assessing recent dietary iodine intake worldwide (World Health Organization 2007).

WHO categories for median urinary iodine concentrations in school-age children and adults (excluding pregnant and lactating women) are widely used to define iodine intake and nutrition status for populations (World Health Organization 2007). An additional adequacy criterion is that not more than 20% of samples from children and non-pregnant women be below 50 nanograms per milliliter (ng/mL) of iodine. These categories are useful for classifying population risk, but they are not categories to define individual risk for adverse health outcomes. The large day-to-day variations in urine iodine excretion, even among individuals with stable iodine intake, tend to offset one another when the sample includes an adequately large number (100–500 spot urine samples per group or subgroup) of representative individuals (Andersen 2008).

Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations of school-age children (≥ 6 years)* (World Health Organization 2007)

Median Urinary Iodine (ng/mL)	Iodine Intake	Iodine Status
< 20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Adequate iodine nutrition
200–299	Above requirements	Likely to provide adequate intake for pregnant/lactating women but may pose a slight risk of more than adequate intake in the overall population
≥ 300	Excessive	Risk for adverse health consequences (e.g., iodine-induced hyperthyroidism, autoimmune thyroid diseases)

* Applies to adults but not to pregnant and lactating women.

For pregnant women, median urinary iodine concentrations of 150–249 ng/mL represent adequate iodine intake (World Health Organization 2007; Andersson 2007). Median urinary iodine concentrations of < 150 ng/mL represent insufficient intake; 250–499 ng/mL represent an intake above requirements, and ≥ 500 ng/mL represent an excessive intake. For lactating women and children less than 2 years of age, median urinary iodine concentrations of 100 ng/mL represent adequate iodine intake, but no other categories of iodine intake are defined (World Health Organization 2007; Andersson 2007).

Data in NHANES. NHANES has measured urinary iodine since 1971. The NHANES III survey (1988–1994) showed a sizable decrease in urinary iodine concentrations compared to concentrations measured during NHANES I (1971–1974) (Hollowell 1998). This decline may have been due to the dairy industry's effort in the mid-1980s to reduce the iodine residue in milk from feed supplements and iodophor sanitizing agents (Pennington 1996). Decreased concentrations of iodine in fruit-flavored breakfast cereals resulted from a ban on erythrosine (an iodine-containing food

dye) and could also have contributed to the decline in urinary iodine concentrations (Pennington 1996). Since 2000, urinary iodine has been measured in the continuous NHANES survey. Starting with NHANES 2000, CDC used a new method, inductively coupled plasma mass spectrometry (ICP-MS), to make these measurements (Caldwell 2003). This method produced comparable data to the established Sandell-Kolthoff spectrophotometric method used in NHANES III (Pino 1998). When CDC laboratory scientists measured urinary iodine concentrations in NHANES 2001–2002 Caldwell 2005 , 2003–2004 (Caldwell 2008 , and 2005–2006 and 2007–2008 (Caldwell 2011), they found that the U.S. median urinary iodine concentration had stabilized since the initial drop that had occurred from NHANES I to NHANES III and that it represented adequate iodine intake for the overall population 6 years and older. The median (95% confidence interval) urinary iodine concentration for pregnant women [125 (86–198) ng/mL] was below the cutoff value of 150 ng/mL indicating iodine deficiency, however the sample was small (n = 184) (Caldwell 2011). Continued monitoring of the population for iodine sufficiency is warranted because of groups at risk for iodine deficiency disorders.

For more information about iodine, see the Institute of Medicine's Dietary Reference Intake report (Institute of Medicine 2001 .

Highlights

Urinary iodine concentrations in the U.S. population showed the following demographic patterns and characteristics:

- The lowest concentrations were observed in young women, while the highest concentrations were observed in children.
- No consistent pattern was observed with regard to race/ethnicity.
- Concentrations have been relatively stable since the late 1980's.

The iodine intake of the U.S. population appeared to be adequate on the basis of median urinary iodine concentrations. However, women aged 20–39 years had the lowest iodine intake, just slightly above insufficient intake (Figure H.3.e). Young women merit special attention to ensure the best possible brain development of the fetus during pregnancy. While no age group had a median urinary iodine concentration that represented excessive iodine intake, boys 6–11 years of age had the highest intake, and the upper confidence limit of the median was just slightly within the range of excessive intake (Figure H.3.e .

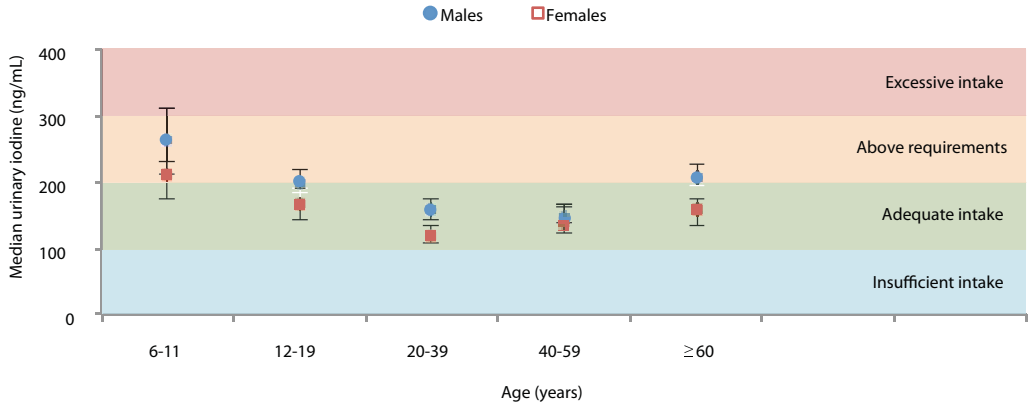


Figure H.3.e. *Median concentrations of urinary iodine in the U.S. population aged 6 years and older by age group and gender associated with estimated iodine intake, National Health and Nutrition Examination Survey, 2001–2006.*

Error bars represent 95% confidence intervals.

Urinary iodine concentrations have been relatively stable over almost two decades between 1988–2006 (Figure H.3.f). They increased slightly (< 20%) between 1988–1994 and 2001–2002 in the total population, in males, in females, and in non-Hispanic whites. However, they remained unchanged in non-Hispanic blacks and Mexican Americans.

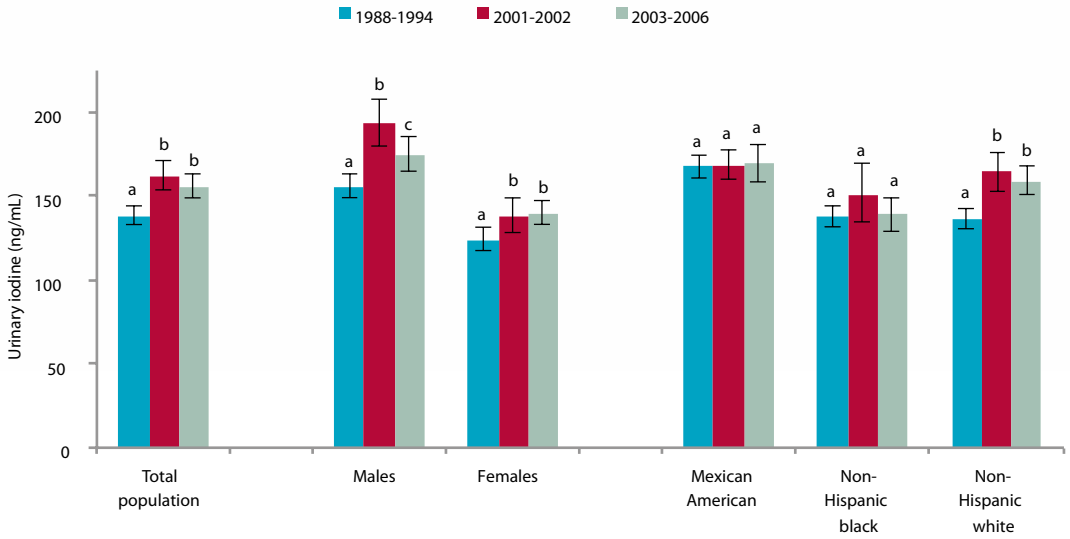


Figure H.3.f. *Age-adjusted geometric mean concentrations of urinary iodine in the U.S. population aged 6 years and older by gender or race/ethnicity, National Health and Nutrition Examination Survey, 1988–2006.*

Error bars represent 95% confidence intervals. Within a demographic group, bars not sharing a common letter differ ($p < 0.05$).

Detailed Observations

The selected observations mentioned below are derived from the uncorrected tables and figures presented next. The NHANES population is of sufficient size to allow group comparisons based on uncorrected data. Statements about categorical differences between demographic groups noted below are based on non-overlapping confidence limits from univariate analysis without adjusting for demographic variables (i.e., age, sex, race/ethnicity) or other determinants of these urine concentrations (i.e., 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):

- Urinary iodine concentrations followed a U-shaped age pattern, with the lowest concentrations seen in young and middle-aged adults (Table 3.4.a.1 and Figure 3.4.a).
- Females had lower urinary iodine concentrations than males (Table 3.4.a.1 and Figure 3.4.a).
- Non-Hispanic blacks had lower urinary iodine concentrations than either non-Hispanic whites or Mexican Americans (Table 3.4.a.1 and Figure 3.4.a).

Changes in geometric mean concentrations across survey cycles:

- We observed no change in urinary iodine concentrations between 2001 and 2006 (Table 3.4.b).

Table 3.4.a.1. Urinary iodine: Concentrations

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for the total U.S. population aged 6 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	156 (148 – 163)	23.3 (19.4 – 26.0)	33.0 (29.0 – 36.5)	162 (154 – 170)	603 (565 – 676)	816 (719 – 1,040)	5,175
(Children 1–5 years, women 12–49 years)							
Age group							
6–11 years	222 (201 – 245)	36.4 (25.8 – 43.0)	51.6 (37.5 – 55.9)	232 (208 – 270)	764 (631 – 1,080)	1,040 (756 – 6,960)	666
12–19 years	179 (161 – 199)	24.9 (18.0 – 30.8)	36.7 (25.0 – 45.7)	186 (171 – 203)	741 (644 – 903)	936 (808 – 1,240)	1,443
20–39 years	135 (126 – 144)	20.0 (17.6 – 23.8)	29.4 (22.5 – 33.6)	140 (129 – 149)	515 (453 – 614)	679 (599 – 872)	1,134
40–59 years	137 (128 – 147)	20.0 (13.2 – 26.0)	28.4 (21.5 – 35.2)	145 (136 – 156)	489 (457 – 574)	674 (556 – 906)	919
60 years and older	187 (170 – 205)	30.3 (25.9 – 37.7)	41.9 (36.9 – 49.0)	181 (168 – 202)	707 (616 – 1,080)	1,530 (1,050 – 4,320)	1,013
Gender							
Males	174 (164 – 185)	28.0 (22.4 – 32.9)	38.1 (34.9 – 42.5)	180 (172 – 189)	673 (581 – 760)	935 (743 – 1,260)	2,477
Females	140 (133 – 147)	20.0 (17.5 – 24.0)	28.5 (24.0 – 32.0)	144 (137 – 153)	571 (541 – 606)	762 (664 – 953)	2,698
Race/ethnicity							
(Children 1–5 years, women 12–49 years)							
Mexican Americans	173 (161 – 185)	30.7 (19.0 – 38.6)	40.2 (34.0 – 49.4)	186 (173 – 195)	591 (539 – 730)	768 (687 – 1,130)	1,320
Non-Hispanic Blacks	141 (131 – 151)	28.7 (25.7 – 30.8)	38.2 (31.1 – 44.0)	141 (128 – 152)	482 (442 – 554)	606 (535 – 770)	1,363
Non-Hispanic Whites	159 (151 – 168)	22.5 (18.9 – 25.8)	32.0 (27.9 – 36.6)	166 (156 – 176)	634 (570 – 714)	835 (731 – 1,170)	2,085

Figure 3.4.a. Urinary iodine: Concentrations by age group

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

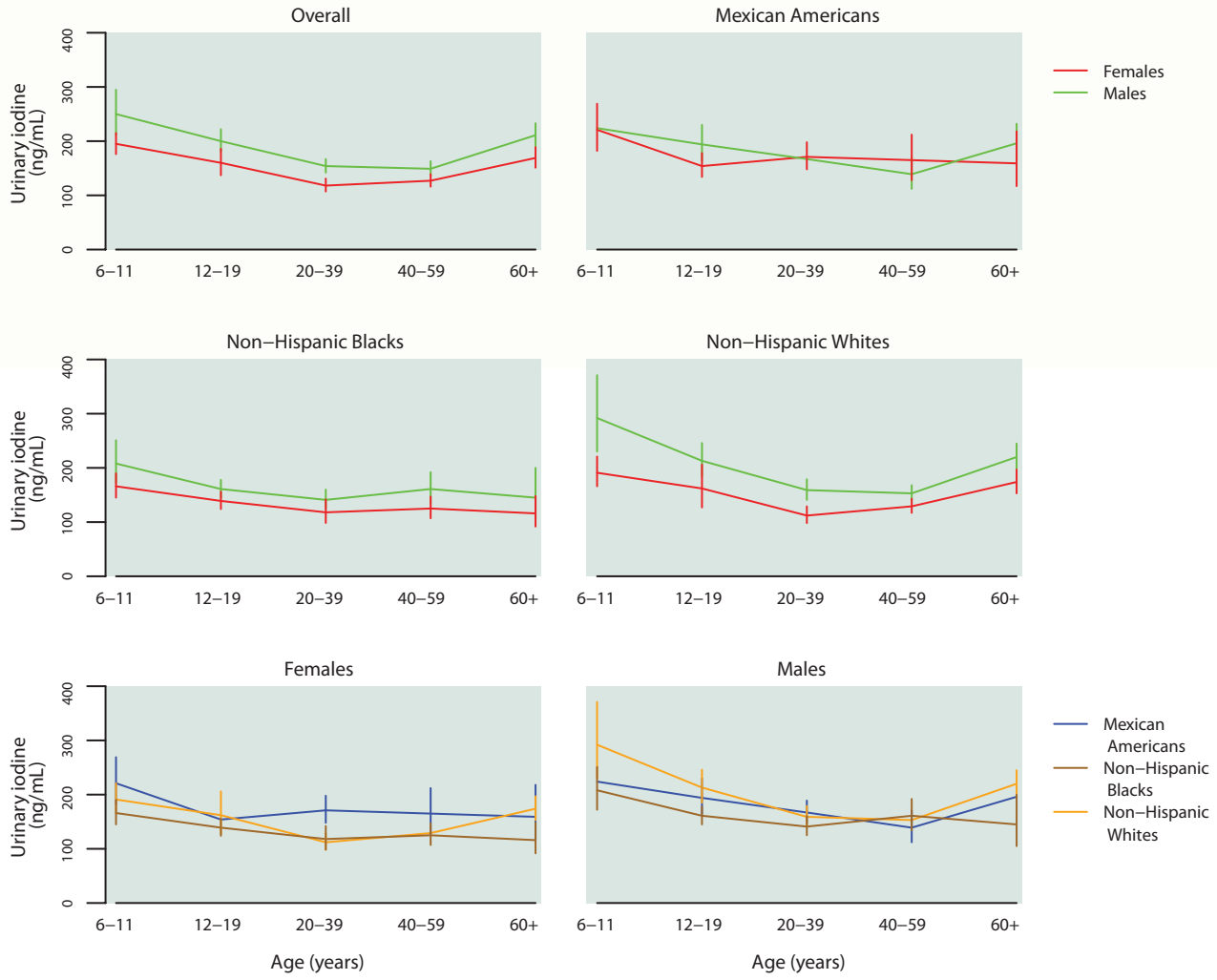


Table 3.4.a.2. Urinary iodine: Total population

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for the total U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	156 (148 – 163)	47.9 (42.9 – 53.9)	162 (154 – 170)	444 (422 – 467)	5,175
6–11 years	222 (201 – 245)	77.6 (55.8 – 94.7)	232 (208 – 270)	581 (515 – 754)	666
12–19 years	179 (161 – 199)	55.5 (44.3 – 68.0)	186 (171 – 203)	518 (465 – 658)	1,443
20–39 years	135 (126 – 144)	42.0 (33.9 – 52.9)	140 (129 – 149)	368 (323 – 416)	1,134
40–59 years	137 (128 – 147)	40.4 (36.9 – 45.7)	145 (136 – 156)	388 (359 – 423)	919
60 years and older	187 (170 – 205)	61.3 (52.0 – 68.5)	181 (168 – 202)	523 (463 – 580)	1,013
Males					
Total, 6 years and older	174 (164 – 185)	56.4 (48.0 – 65.2)	180 (172 – 189)	465 (441 – 500)	2,477
6–11 years	250 (212 – 295)	94.3 (55.4 – 115)	264 (212 – 313)	653 (498 – 1,080)	307
12–19 years	200 (181 – 222)	73.1 (54.8 – 87.7)	198 (184 – 220)	525 (479 – 707)	693
20–39 years	154 (142 – 167)	53.6 (38.8 – 65.1)	160 (143 – 174)	408 (327 – 478)	512
40–59 years	149 (137 – 163)	48.3 (38.6 – 59.5)	148 (138 – 166)	395 (363 – 458)	454
60 years and older	211 (191 – 233)	65.1 (46.9 – 88.2)	205 (193 – 228)	538 (469 – 652)	511
Females					
Total, 6 years and older	140 (133 – 147)	41.4 (37.7 – 46.8)	144 (137 – 153)	412 (389 – 453)	2,698
6–11 years	195 (176 – 215)	61.8 (45.8 – 81.5)	210 (174 – 232)	549 (423 – 718)	359
12–19 years	160 (137 – 186)	46.1 (29.2 – 59.0)	166 (143 – 191)	487 (421 – 633)	750
20–39 years	118 (107 – 131)	35.4 (30.4 – 43.8)	119 (108 – 136)	333 (300 – 406)	622
40–59 years	127 (116 – 139)	36.4 (28.2 – 40.1)	140 (123 – 161)	368 (333 – 418)	465
60 years and older	169 (151 – 189)	60.2 (48.9 – 67.7)	157 (134 – 176)	483 (413 – 590)	502

Table 3.4.a.3. Urinary iodine: Mexican Americans

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for Mexican Americans in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	173 (161 – 185)	59.9 (52.3 – 68.3)	186 (173 – 195)	450 (404 – 518)	1,320
6–11 years	223 (196 – 253)	80.8 (54.8 – 98.9)	235 (208 – 265)	544 (469 – 713)	217
12–19 years	174 (155 – 194)	56.6 (44.9 – 62.7)	176 (163 – 203)	488 (414 – 596)	466
20–39 years	169 (153 – 186)	65.7 (55.6 – 78.5)	187 (165 – 198)	401 (352 – 547)	283
40–59 years	151 (124 – 184)	45.4 (33.9 – 59.5)	158 (123 – 196)	382 (305 – 699)	165
60 years and older	175 (148 – 207)	57.2 (43.7 – 69.2)	159 (128 – 193)	444 (377 – 690)	189
Males					
Total, 6 years and older	173 (162 – 185)	61.8 (56.1 – 71.9)	184 (165 – 199)	454 (404 – 510)	623
6–11 years	224 (187 – 269)	85.2† (41.0 – 133)	236 (209 – 271)	519† (422 – 836)	96
12–19 years	194 (164 – 230)	60.8 (46.1 – 78.1)	199 (169 – 234)	549 (432 – 747)	221
20–39 years	167 (148 – 189)	62.3 (58.5 – 78.1)	184 (146 – 202)	386 (334 – 591)	134
40–59 years	139 (112 – 171)	45.1† (31.2 – 61.1)	122 (107 – 168)	369† (298 – 1,260)	77
60 years and older	196 (166 – 232)	70.5† (30.1 – 92.3)	196 (155 – 243)	495† (365 – 6,920)	95
Females					
Total, 6 years and older	172 (159 – 187)	57.0 (45.9 – 67.4)	190 (164 – 205)	444 (373 – 566)	697
6–11 years	221 (182 – 269)	75.9 (47.0 – 94.8)	226 (180 – 270)	584 (456 – 1,110)	121
12–19 years	154 (134 – 178)	49.4 (34.7 – 61.1)	163 (142 – 188)	428 (338 – 695)	245
20–39 years	171 (148 – 198)	68.9 (39.1 – 81.4)	187 (145 – 219)	402 (348 – 569)	149
40–59 years	165 (128 – 212)	45.9† (20.2 – 64.8)	199 (145 – 218)	385† (295 – 1,150)	88
60 years and older	159 (117 – 218)	52.5† (34.2 – 61.4)	128 (107 – 163)	425† (283 – 1,010,900)	94

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

Table 3.4.a.4. Urinary iodine: Non-Hispanic blacks

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for non-Hispanic blacks in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	141 (131 – 151)	51.7 (47.6 – 57.0)	141 (128 – 152)	374 (322 – 423)	1,363
6–11 years	186 (163 – 213)	62.4 (45.7 – 76.1)	190 (168 – 217)	459 (387 – 682)	221
12–19 years	149 (137 – 163)	55.0 (47.9 – 61.0)	148 (138 – 168)	394 (351 – 475)	515
20–39 years	128 (113 – 145)	57.3 (47.2 – 66.3)	125 (116 – 160)	283 (242 – 310)	238
40–59 years	140 (124 – 160)	48.3 (35.7 – 59.1)	134 (122 – 144)	428 (337 – 485)	219
60 years and older	128 (108 – 151)	42.1 (35.0 – 50.6)	128 (102 – 146)	326 (259 – 529)	170
Males					
Total, 6 years and older	158 (145 – 172)	58.1 (51.7 – 69.8)	159 (142 – 176)	408 (335 – 456)	663
6–11 years	208 (172 – 251)	75.9† (48.1 – 102)	205 (172 – 284)	500† (393 – 952)	106
12–19 years	161 (145 – 178)	61.4 (47.3 – 76.3)	155 (141 – 177)	409 (342 – 588)	260
20–39 years	141 (125 – 160)	61.0† (46.8 – 72.0)	154 (117 – 185)	292† (259 – 398)	108
40–59 years	161 (134 – 192)	55.5† (34.1 – 77.7)	145 (125 – 198)	429† (329 – 518)	104
60 years and older	145 (105 – 200)	42.6† (31.1 – 55.9)	141 (93.6 – 204)	414† (249 – 8,300)	85
Females					
Total, 6 years and older	127 (117 – 138)	49.0 (41.9 – 53.8)	128 (121 – 136)	329 (307 – 380)	700
6–11 years	166 (145 – 190)	44.7 (39.2 – 67.1)	168 (151 – 211)	409 (381 – 581)	115
12–19 years	139 (124 – 156)	50.9 (36.2 – 59.2)	139 (125 – 164)	387 (312 – 475)	255
20–39 years	118 (98.4 – 142)	54.2 (27.1 – 66.6)	123 (105 – 148)	237 (212 – 342)	130
40–59 years	125 (107 – 147)	44.8 (30.9 – 53.4)	122 (103 – 137)	390 (290 – 516)	115
60 years and older	116 (91.7 – 148)	42.0† (12.9 – 50.6)	115 (83.6 – 146)	271† (244 – 466)	85

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

Table 3.4.a.5. Urinary iodine: Non-Hispanic whites

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for non-Hispanic whites in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	159 (151 – 168)	47.0 (41.1 – 54.3)	166 (156 – 176)	461 (427 – 489)	2,085
6–11 years	237 (208 – 271)	81.0 (55.0 – 103)	267 (202 – 315)	620 (536 – 978)	169
12–19 years	187 (160 – 218)	48.9 (36.7 – 73.4)	194 (172 – 224)	561 (481 – 744)	365
20–39 years	133 (122 – 145)	39.9 (32.0 – 49.0)	139 (125 – 150)	378 (318 – 461)	494
40–59 years	140 (131 – 151)	40.3 (35.6 – 48.7)	153 (139 – 167)	389 (361 – 424)	453
60 years and older	193 (175 – 214)	65.3 (55.5 – 74.1)	193 (172 – 211)	538 (460 – 598)	604
Males					
Total, 6 years and older	182 (170 – 195)	58.0 (47.5 – 69.5)	187 (176 – 199)	481 (450 – 548)	996
6–11 years	292 (230 – 371)	112† (46.9 – 132)	315 (229 – 381)	741† (503 – 1,600)	76
12–19 years	213 (185 – 246)	77.2 (38.8 – 102)	208 (187 – 242)	564 (483 – 770)	174
20–39 years	159 (141 – 179)	51.0 (36.9 – 71.6)	163 (139 – 186)	413 (322 – 516)	211
40–59 years	153 (140 – 168)	49.7 (38.4 – 65.5)	153 (137 – 173)	396 (355 – 464)	229
60 years and older	220 (198 – 245)	66.6 (45.4 – 93.4)	218 (197 – 249)	548 (483 – 666)	306
Females					
Total, 6 years and older	141 (132 – 149)	39.6 (33.9 – 44.0)	148 (137 – 157)	423 (390 – 471)	1,089
6–11 years	191 (166 – 221)	58.9† (38.5 – 81.6)	194 (150 – 251)	554† (423 – 855)	93
12–19 years	162 (127 – 206)	36.9 (18.6 – 58.0)	171 (138 – 227)	538 (431 – 793)	191
20–39 years	112 (98.2 – 129)	32.3 (22.5 – 41.6)	115 (102 – 130)	327 (278 – 461)	283
40–59 years	129 (117 – 143)	33.6 (24.7 – 40.7)	150 (123 – 178)	368 (334 – 425)	224
60 years and older	174 (153 – 197)	63.3 (50.0 – 72.8)	166 (137 – 191)	482 (401 – 613)	298

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

Table 3.4.b. Urinary iodine: Concentrations by survey cycle

Geometric mean and selected percentiles of urine concentrations (in ng/mL) for the U.S. population, National Health and Nutrition Examination Survey, 2001–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 6 years and older					
2001–2002	162 (152 – 172)	30.1 (24.9 – 35.5)	168 (158 – 177)	713 (627 – 809)	2,837
2003–2004	150 (141 – 160)	28.9 (24.9 – 33.7)	160 (146 – 172)	569 (493 – 660)	2,526
2005–2006	161 (150 – 174)	36.0 (29.0 – 39.1)	164 (154 – 174)	665 (580 – 762)	2,649
Age group					
6–11 years					
2001–2002	235 (208 – 266)	51.8 (25.5 – 65.9)	249 (220 – 288)	771 (700 – 918)	374
2003–2004	209 (183 – 239)	45.7 (37.4 – 54.0)	229 (187 – 279)	613 (553 – 1,180)	315
2005–2006	235 (201 – 276)	60.2 (28.0 – 80.9)	238 (197 – 279)	967 (673 – 2,950)	351
12–19 years					
2001–2002	192 (178 – 207)	38.3 (23.5 – 47.2)	205 (189 – 214)	803 (710 – 968)	831
2003–2004	166 (141 – 195)	33.5 (17.9 – 46.4)	178 (144 – 203)	645 (503 – 924)	721
2005–2006	193 (167 – 224)	38.2 (25.1 – 51.8)	194 (177 – 224)	797 (713 – 1,160)	722
20–39 years					
2001–2002	148 (132 – 166)	27.8 (22.0 – 40.6)	153 (136 – 173)	536 (473 – 762)	627
2003–2004	138 (125 – 151)	23.8 (18.5 – 32.3)	146 (123 – 165)	564 (446 – 746)	517
2005–2006	132 (120 – 145)	31.9 (22.3 – 40.0)	134 (124 – 143)	483 (412 – 601)	617
40–59 years					
2001–2002	140 (121 – 162)	24.5 (21.1 – 30.0)	141 (119 – 169)	689 (525 – 1,330)	496
2003–2004	132 (119 – 147)	24.9 (13.1 – 35.0)	142 (128 – 161)	478 (422 – 690)	434
2005–2006	143 (129 – 158)	34.6 (20.1 – 38.3)	148 (131 – 173)	519 (431 – 640)	485
60 years and older					
2001–2002	177 (156 – 200)	40.7 (30.1 – 48.7)	171 (152 – 198)	744 (617 – 1,250)	509
2003–2004	169 (152 – 189)	39.7 (29.9 – 45.9)	170 (148 – 196)	635 (518 – 776)	539
2005–2006	205 (175 – 240)	47.9 (35.6 – 59.7)	195 (172 – 223)	826 (620 – 4,220)	474
Gender					
Males					
2001–2002	192 (178 – 208)	41.7 (35.0 – 48.0)	196 (179 – 209)	769 (630 – 981)	1,333
2003–2004	169 (156 – 183)	38.8 (25.9 – 44.3)	178 (164 – 193)	584 (475 – 786)	1,229
2005–2006	179 (163 – 197)	38.0 (32.9 – 44.8)	182 (172 – 195)	702 (595 – 960)	1,248
Females					
2001–2002	137 (127 – 148)	24.6 (21.3 – 29.2)	140 (126 – 156)	653 (576 – 736)	1,504
2003–2004	134 (125 – 145)	25.0 (23.0 – 29.0)	141 (127 – 155)	559 (493 – 584)	1,297
2005–2006	146 (136 – 158)	31.2 (20.6 – 39.0)	147 (137 – 155)	592 (544 – 693)	1,401
Race/ethnicity					
Mexican Americans					
2001–2002	176 (163 – 189)	33.7 (29.0 – 42.3)	187 (168 – 206)	673 (527 – 883)	720
2003–2004	168 (152 – 187)	38.7 (19.9 – 52.0)	186 (166 – 194)	568 (444 – 1,020)	617
2005–2006	177 (161 – 195)	44.6 (34.7 – 54.0)	184 (165 – 210)	640 (531 – 1,030)	703
Non-Hispanic Blacks					
2001–2002	156 (137 – 178)	38.6 (30.6 – 45.7)	143 (124 – 172)	716 (608 – 918)	670
2003–2004	134 (120 – 149)	42.3 (33.6 – 44.9)	131 (121 – 146)	456 (386 – 599)	634
2005–2006	147 (133 – 163)	34.3 (27.8 – 42.0)	149 (137 – 164)	510 (440 – 678)	729
Non-Hispanic Whites					
2001–2002	163 (150 – 176)	29.2 (22.7 – 35.6)	169 (160 – 181)	734 (604 – 875)	1,222
2003–2004	154 (144 – 164)	28.8 (23.9 – 33.8)	166 (151 – 181)	572 (486 – 684)	1,080
2005–2006	165 (151 – 180)	35.3 (26.3 – 39.1)	166 (154 – 179)	678 (583 – 831)	1,005

Figure 3.4.b. Urinary iodine: Concentrations by survey cycle

Selected percentiles in ng/mL (95% confidence intervals), National Health and Nutrition Examination Survey, 2001–2006

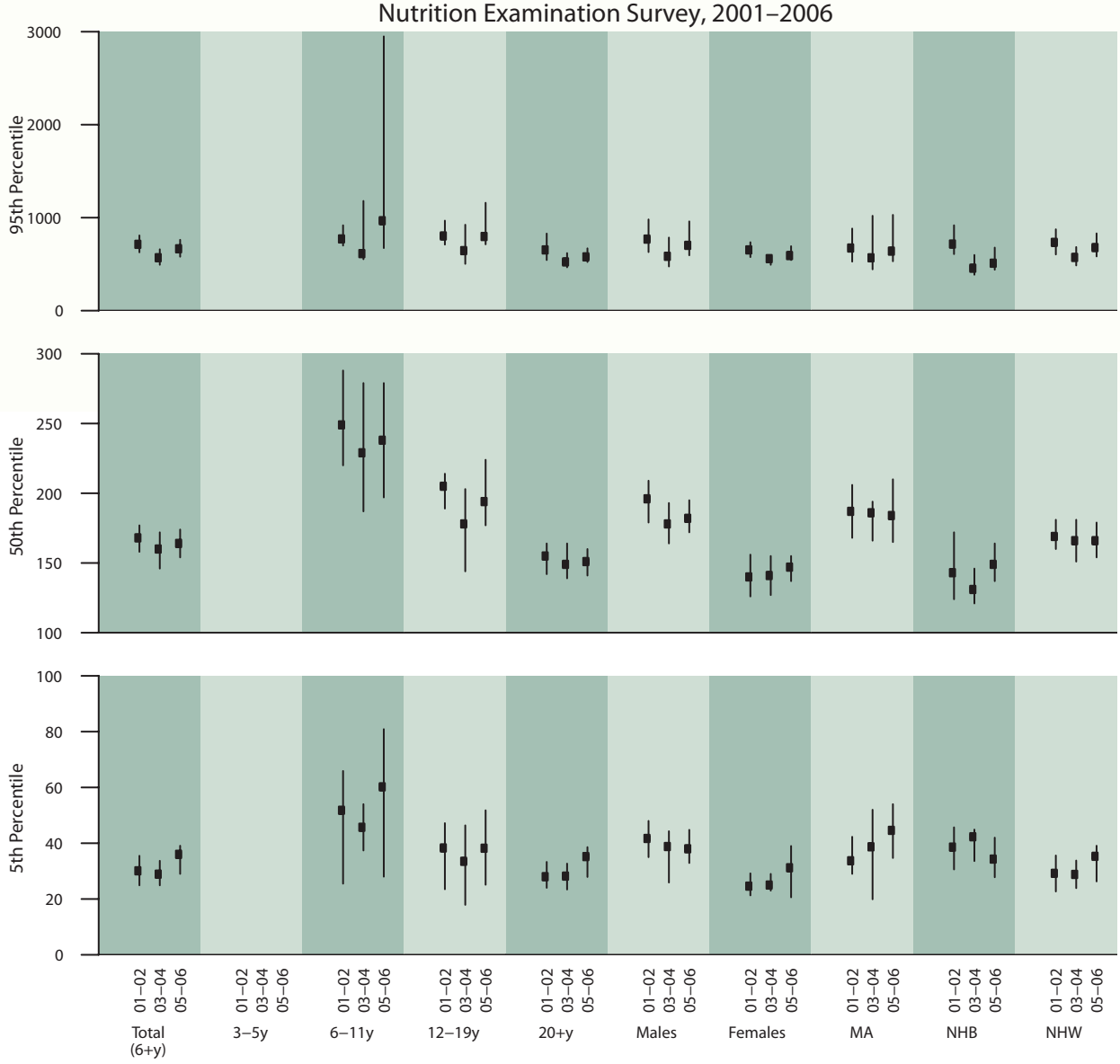


Table 3.5.a.1. Urinary iodine (creatinine corrected): Concentrations

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for the total U.S. population aged 6 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, 6 years and older	155 (147 – 163)	39.3 (37.1 – 41.7)	46.7 (44.7 – 50.0)	149 (140 – 156)	572 (525 – 628)	763 (663 – 932)	5,174
Age group							
6–11 years	269 (244 – 297)	73.3 (56.4 – 81.6)	84.3 (77.6 – 92.2)	266 (240 – 293)	840 (653 – 1,190)	1,150 (827 – 7,820)	666
12–19 years	134 (124 – 145)	38.4 (35.1 – 42.1)	45.4 (41.0 – 49.7)	125 (115 – 137)	473 (406 – 555)	616 (528 – 835)	1,442
20–39 years	119 (111 – 127)	35.2 (32.5 – 38.8)	40.4 (37.5 – 44.9)	111 (103 – 119)	392 (347 – 485)	557 (450 – 903)	1,134
40–59 years	145 (136 – 156)	39.9 (34.1 – 42.0)	45.7 (41.2 – 50.6)	146 (132 – 158)	482 (421 – 526)	600 (519 – 738)	919
60 years and older	224 (209 – 241)	60.9 (53.6 – 65.5)	67.9 (65.6 – 71.0)	214 (191 – 237)	727 (660 – 891)	1,320 (863 – 5,710)	1,013
Gender							
Males	145 (137 – 153)	37.5 (35.0 – 39.6)	44.9 (41.2 – 47.7)	138 (129 – 149)	523 (479 – 591)	642 (584 – 1,140)	2,477
Females	165 (156 – 174)	42.1 (37.8 – 45.4)	49.7 (45.4 – 55.6)	157 (148 – 169)	617 (558 – 693)	807 (716 – 944)	2,697
Race/ethnicity							
Mexican Americans	160 (151 – 170)	46.2 (42.1 – 49.9)	54.1 (50.2 – 58.7)	156 (146 – 163)	494 (470 – 617)	695 (588 – 1,060)	1,319
Non-Hispanic Blacks	98.6 (91.2 – 106)	29.1 (25.8 – 30.7)	33.1 (30.4 – 34.6)	90.4 (83.4 – 99.1)	360 (325 – 395)	493 (437 – 588)	1,363
Non-Hispanic Whites	167 (161 – 174)	45.0 (41.4 – 46.9)	53.2 (48.7 – 57.4)	158 (151 – 169)	602 (539 – 669)	819 (697 – 1,060)	2,085

Figure 3.5.a. Urinary iodine (creatinine corrected): Concentrations by age group

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

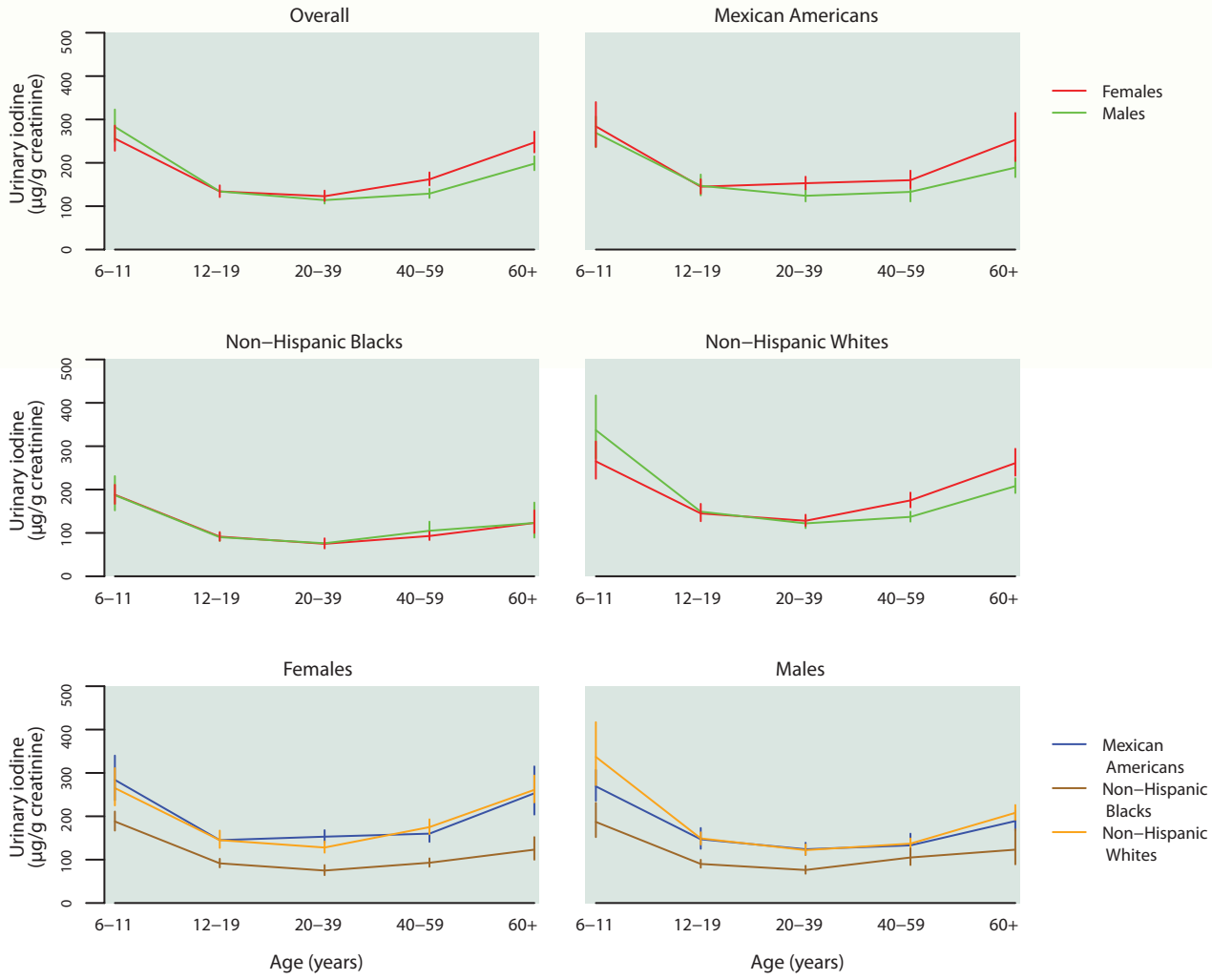


Table 3.5.a.2. Urinary iodine (creatinine corrected): Total population

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for the total U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	155 (147 – 163)	59.8 (56.4 – 64.0)	149 (140 – 156)	410 (391 – 438)	5,174
6–11 years	269 (244 – 297)	105 (92.1 – 115)	266 (240 – 293)	631 (590 – 820)	666
12–19 years	134 (124 – 145)	55.9 (49.7 – 61.9)	125 (115 – 137)	346 (301 – 386)	1,442
20–39 years	119 (111 – 127)	50.5 (46.7 – 55.0)	111 (103 – 119)	289 (271 – 324)	1,134
40–59 years	145 (136 – 156)	58.4 (50.9 – 63.7)	146 (132 – 158)	357 (322 – 408)	919
60 years and older	224 (209 – 241)	83.6 (75.9 – 92.3)	214 (191 – 237)	552 (481 – 635)	1,013
Males					
Total, 6 years and older	145 (137 – 153)	56.5 (52.3 – 60.2)	138 (129 – 149)	382 (357 – 414)	2,477
6–11 years	283 (248 – 323)	108 (83.8 – 131)	280 (245 – 322)	631 (589 – 1,060)	307
12–19 years	134 (122 – 148)	52.4 (46.2 – 58.2)	132 (117 – 149)	347 (300 – 413)	693
20–39 years	114 (106 – 123)	50.3 (44.9 – 54.6)	103 (93.8 – 114)	276 (264 – 335)	512
40–59 years	129 (119 – 140)	52.1 (45.8 – 60.0)	126 (113 – 136)	311 (274 – 392)	454
60 years and older	198 (183 – 215)	73.1 (67.3 – 83.9)	180 (168 – 205)	440 (407 – 481)	511
Females					
Total, 6 years and older	165 (156 – 174)	63.9 (57.9 – 69.6)	157 (148 – 169)	439 (403 – 481)	2,697
6–11 years	256 (228 – 286)	99.9 (87.8 – 114)	247 (227 – 293)	630 (529 – 821)	359
12–19 years	134 (121 – 148)	59.3 (51.3 – 64.9)	121 (111 – 131)	332 (292 – 403)	749
20–39 years	123 (112 – 136)	51.0 (45.8 – 57.9)	118 (107 – 130)	292 (254 – 359)	622
40–59 years	162 (148 – 178)	63.8 (55.7 – 70.9)	166 (145 – 188)	408 (344 – 482)	465
60 years and older	247 (224 – 272)	92.2 (79.1 – 104)	243 (221 – 262)	617 (554 – 696)	502

Table 3.5.a.3. Urinary iodine (creatinine corrected): Mexican Americans

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for Mexican Americans in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	160 (151 – 170)	67.5 (60.4 – 70.6)	156 (146 – 163)	383 (343 – 470)	1,319
6–11 years	276 (246 – 311)	123 (103 – 138)	267 (242 – 293)	619 (468 – 925)	217
12–19 years	146 (131 – 163)	61.9 (53.6 – 72.7)	143 (128 – 157)	344 (285 – 468)	465
20–39 years	137 (125 – 149)	59.7 (53.7 – 71.1)	137 (120 – 147)	293 (261 – 384)	283
40–59 years	146 (129 – 164)	66.0 (55.3 – 69.3)	148 (124 – 161)	317 (292 – 382)	165
60 years and older	222 (193 – 255)	85.2 (67.8 – 101)	210 (167 – 247)	459 (385 – 725)	189
Males					
Total, 6 years and older	148 (137 – 159)	60.0 (56.3 – 65.7)	147 (131 – 163)	361 (319 – 428)	623
6–11 years	269 (236 – 307)	126† (81.6 – 166)	278 (226 – 318)	541† (454 – 725)	96
12–19 years	147 (125 – 173)	58.5 (46.3 – 72.5)	141 (121 – 168)	346 (282 – 519)	221
20–39 years	124 (111 – 139)	55.7 (46.1 – 64.8)	121 (109 – 146)	244 (220 – 435)	134
40–59 years	133 (111 – 160)	58.9† (40.2 – 67.6)	136 (101 – 161)	318† (285 – 383)	77
60 years and older	189 (167 – 213)	81.1† (67.3 – 99.9)	168 (144 – 204)	410† (319 – 1,020)	95
Females					
Total, 6 years and older	174 (164 – 186)	73.4 (67.6 – 78.3)	162 (156 – 177)	416 (352 – 488)	696
6–11 years	284 (237 – 340)	116 (101 – 134)	250 (224 – 299)	656 (468 – 2,530)	121
12–19 years	145 (129 – 162)	67.1 (55.5 – 74.4)	144 (123 – 157)	333 (267 – 492)	244
20–39 years	153 (139 – 168)	73.4 (51.7 – 84.7)	143 (125 – 162)	344 (293 – 446)	149
40–59 years	160 (141 – 182)	68.0† (59.1 – 82.3)	160 (141 – 181)	308† (264 – 434)	88
60 years and older	253 (204 – 315)	86.1† (23.2 – 124)	232 (196 – 265)	502† (415 – 2,790)	94

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

Table 3.5.a.4. Urinary iodine (creatinine corrected): Non-Hispanic blacks

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for non-Hispanic blacks in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	98.6 (91.2 – 106)	39.0 (35.8 – 41.7)	90.4 (83.4 – 99.1)	264 (248 – 293)	1,363
6–11 years	188 (164 – 214)	80.2 (67.6 – 87.6)	180 (152 – 221)	448 (376 – 558)	221
12–19 years	90.8 (83.6 – 98.6)	40.5 (36.5 – 42.5)	87.0 (78.8 – 95.5)	223 (191 – 258)	515
20–39 years	75.5 (67.9 – 83.9)	35.6 (31.1 – 38.6)	72.6 (63.6 – 80.4)	209 (137 – 254)	238
40–59 years	98.3 (88.0 – 110)	38.1 (32.9 – 45.4)	90.5 (78.2 – 103)	257 (217 – 296)	219
60 years and older	123 (106 – 143)	46.0 (40.3 – 50.9)	108 (98.4 – 129)	337 (251 – 498)	170
Males					
Total, 6 years and older	101 (90.7 – 112)	37.6 (33.7 – 41.2)	92.1 (80.8 – 103)	294 (254 – 360)	663
6–11 years	187 (152 – 231)	73.7† (52.4 – 87.7)	178 (142 – 244)	447† (360 – 898)	106
12–19 years	90.1 (81.4 – 99.7)	37.4 (31.5 – 41.8)	84.8 (75.5 – 97.0)	224 (196 – 264)	260
20–39 years	76.2 (67.5 – 85.9)	35.3† (27.7 – 38.4)	71.7 (62.5 – 78.5)	215† (127 – 285)	108
40–59 years	105 (87.6 – 126)	34.3† (29.7 – 47.5)	93.8 (73.4 – 130)	286† (239 – 559)	104
60 years and older	123 (89.2 – 170)	41.0† (34.7 – 49.6)	103 (78.5 – 159)	365† (242 – 4,440)	85
Females					
Total, 6 years and older	96.5 (89.3 – 104)	39.3 (35.7 – 44.7)	89.3 (84.3 – 97.6)	247 (218 – 285)	700
6–11 years	188 (167 – 211)	83.8 (68.1 – 98.7)	185 (152 – 220)	442 (375 – 548)	115
12–19 years	91.5 (82.1 – 102)	42.8 (36.5 – 46.2)	88.5 (76.0 – 99.7)	205 (164 – 311)	255
20–39 years	74.9 (64.2 – 87.5)	36.1 (30.0 – 39.1)	72.7 (60.5 – 84.3)	196 (130 – 248)	130
40–59 years	92.9 (83.6 – 103)	39.5 (29.3 – 47.1)	88.5 (73.7 – 99.0)	217 (196 – 284)	115
60 years and older	123 (99.9 – 152)	50.2† (30.9 – 61.9)	111 (97.1 – 134)	255† (229 – 540)	85

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

Table 3.5.a.5. Urinary iodine (creatinine corrected): Non-Hispanic whites

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for non-Hispanic whites in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2003–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
Males and Females					
Total, 6 years and older	167 (161 – 174)	67.2 (63.6 – 69.2)	158 (151 – 169)	430 (404 – 472)	2,085
6–11 years	299 (261 – 342)	114 (92.8 – 132)	289 (259 – 348)	663 (616 – 1,050)	169
12–19 years	147 (134 – 161)	63.3 (54.3 – 69.8)	135 (122 – 155)	374 (311 – 447)	365
20–39 years	125 (118 – 133)	55.5 (47.8 – 62.1)	115 (107 – 124)	298 (274 – 345)	494
40–59 years	155 (145 – 166)	62.7 (56.4 – 69.7)	155 (140 – 174)	364 (327 – 419)	453
60 years and older	236 (218 – 256)	94.3 (82.5 – 102)	233 (196 – 248)	559 (481 – 657)	604
Males					
Total, 6 years and older	157 (149 – 165)	64.0 (61.1 – 67.2)	150 (140 – 156)	396 (368 – 428)	996
6–11 years	337 (272 – 417)	131† (63.9 – 170)	326 (268 – 429)	811† (610 – 2,040)	76
12–19 years	149 (135 – 163)	59.4 (49.6 – 67.3)	143 (129 – 170)	378 (301 – 455)	174
20–39 years	122 (111 – 135)	57.5 (46.5 – 65.4)	104 (93.8 – 122)	292 (265 – 349)	211
40–59 years	137 (126 – 149)	59.3 (48.9 – 64.1)	136 (120 – 152)	313 (274 – 414)	229
60 years and older	208 (192 – 226)	82.9 (70.7 – 95.2)	189 (173 – 215)	440 (402 – 522)	306
Females					
Total, 6 years and older	178 (169 – 188)	70.6 (64.9 – 74.3)	169 (156 – 183)	464 (431 – 514)	1,089
6–11 years	265 (225 – 311)	99.1† (84.0 – 118)	262 (227 – 315)	640† (474 – 1,020)	93
12–19 years	145 (127 – 167)	65.0 (56.0 – 74.0)	127 (112 – 152)	368 (292 – 499)	191
20–39 years	128 (116 – 142)	51.3 (45.4 – 62.5)	123 (110 – 141)	295 (242 – 391)	283
40–59 years	175 (159 – 193)	70.6 (58.0 – 79.3)	179 (152 – 202)	433 (362 – 496)	224
60 years and older	261 (232 – 294)	104 (81.2 – 119)	255 (236 – 280)	630 (556 – 697)	298

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

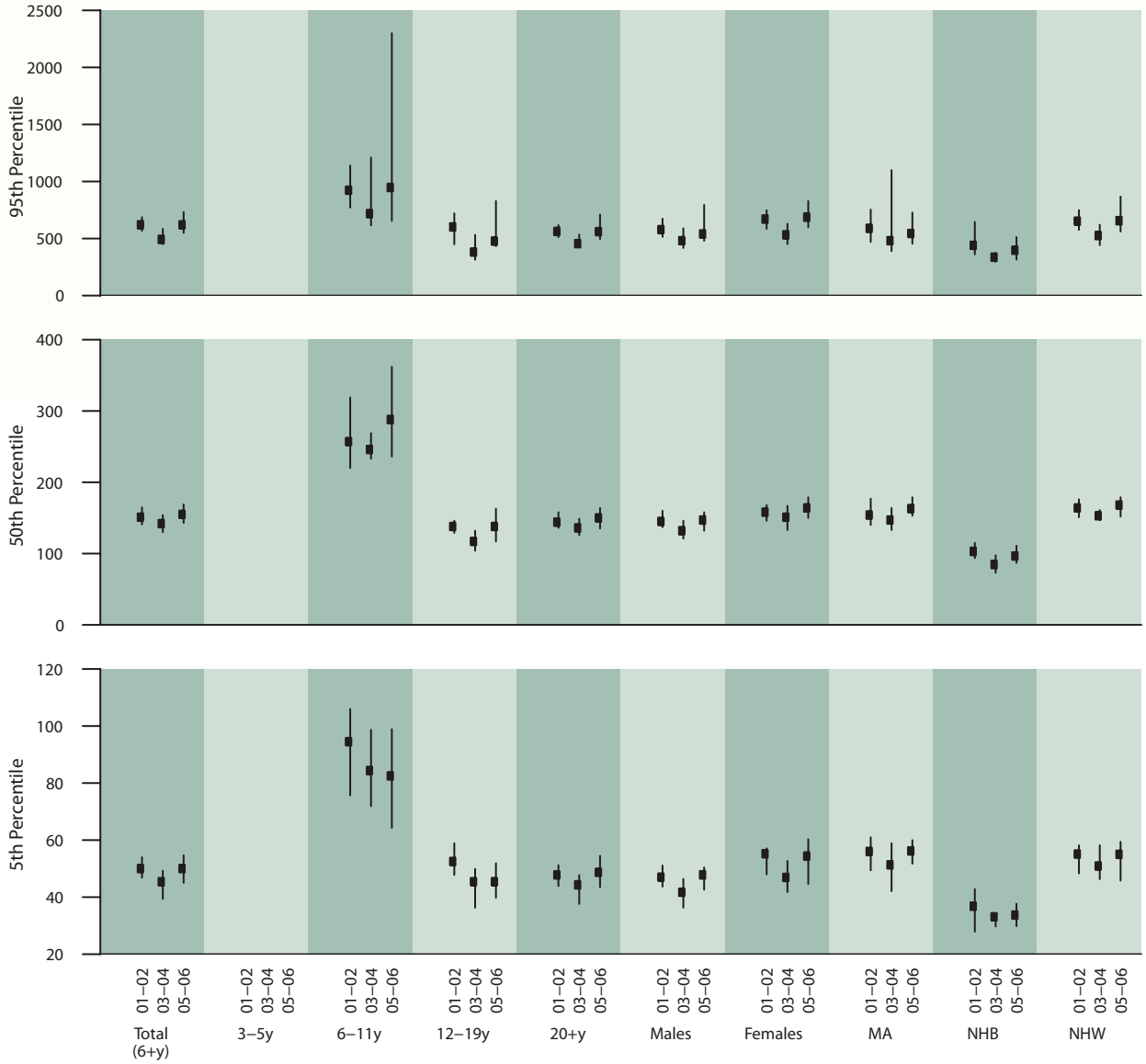
Table 3.5.b. Urinary iodine (creatinine corrected): Concentrations by survey cycle

Geometric mean and selected percentiles of urine concentrations (in µg/g creatinine) for the U.S. population, National Health and Nutrition Examination Survey, 2001–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		5th	50th	95th	
Total, 6 years and older					
2001–2002	163 (153 – 173)	50.0 (46.8 – 54.0)	151 (141 – 165)	620 (567 – 687)	2,835
2003–2004	146 (135 – 158)	45.4 (39.4 – 49.3)	142 (130 – 154)	492 (449 – 585)	2,525
2005–2006	163 (153 – 175)	50.0 (45.0 – 54.7)	155 (143 – 169)	620 (549 – 733)	2,649
Age group					
6–11 years					
2001–2002	273 (246 – 304)	94.5 (75.7 – 106)	257 (220 – 319)	923 (772 – 1,140)	374
2003–2004	254 (228 – 283)	84.4 (71.9 – 98.7)	246 (233 – 269)	718 (615 – 1,210)	315
2005–2006	286 (242 – 339)	82.5 (64.3 – 98.9)	288 (236 – 362)	947 (654 – 2,300)	351
12–19 years					
2001–2002	149 (137 – 161)	52.5 (47.8 – 58.9)	138 (129 – 146)	601 (450 – 721)	830
2003–2004	124 (109 – 141)	45.4 (36.3 – 49.9)	117 (104 – 132)	381 (314 – 532)	720
2005–2006	145 (130 – 162)	45.4 (39.8 – 51.9)	138 (117 – 163)	477 (434 – 829)	722
20–39 years					
2001–2002	135 (127 – 143)	46.7 (42.2 – 49.5)	128 (118 – 136)	470 (443 – 577)	627
2003–2004	115 (104 – 127)	39.2 (33.9 – 44.9)	108 (99.3 – 119)	407 (319 – 559)	517
2005–2006	123 (112 – 135)	43.9 (39.1 – 49.0)	114 (97.7 – 131)	378 (339 – 592)	617
40–59 years					
2001–2002	151 (130 – 175)	44.7 (37.9 – 54.5)	142 (120 – 176)	522 (427 – 712)	496
2003–2004	138 (126 – 152)	42.0 (34.9 – 49.9)	136 (126 – 150)	436 (392 – 561)	434
2005–2006	152 (137 – 170)	47.0 (40.9 – 56.5)	153 (126 – 179)	492 (429 – 544)	485
60 years and older					
2001–2002	216 (192 – 244)	67.1 (51.2 – 75.5)	199 (179 – 230)	751 (632 – 1,000)	508
2003–2004	204 (188 – 222)	67.2 (60.3 – 74.0)	197 (178 – 233)	595 (521 – 726)	539
2005–2006	246 (218 – 277)	68.4 (65.8 – 72.8)	235 (193 – 256)	858 (697 – 5,190)	474
Gender					
Males					
2001–2002	156 (143 – 171)	47.0 (43.7 – 51.1)	145 (137 – 160)	578 (514 – 674)	1,333
2003–2004	137 (127 – 148)	41.7 (36.3 – 46.4)	132 (121 – 146)	481 (417 – 590)	1,229
2005–2006	152 (140 – 165)	47.8 (42.6 – 50.4)	147 (132 – 158)	540 (480 – 795)	1,248
Females					
2001–2002	170 (161 – 179)	55.2 (48.0 – 57.1)	158 (146 – 168)	670 (585 – 748)	1,502
2003–2004	155 (142 – 169)	46.9 (41.8 – 52.7)	151 (133 – 167)	532 (452 – 630)	1,296
2005–2006	176 (163 – 189)	54.4 (44.6 – 60.3)	164 (150 – 179)	687 (598 – 829)	1,401
Race/ethnicity					
Mexican Americans					
2001–2002	164 (152 – 176)	56.0 (49.4 – 61.0)	154 (140 – 177)	589 (469 – 754)	720
2003–2004	152 (138 – 169)	51.3 (42.1 – 58.9)	147 (133 – 164)	481 (389 – 1,100)	616
2005–2006	167 (154 – 181)	56.2 (51.7 – 60.0)	163 (153 – 179)	544 (454 – 728)	703
Non-Hispanic Blacks					
2001–2002	113 (103 – 124)	36.8 (27.9 – 42.8)	103 (93.5 – 115)	440 (361 – 645)	669
2003–2004	92.1 (81.2 – 104)	33.1 (29.7 – 33.8)	84.6 (73.1 – 97.6)	336 (296 – 375)	634
2005–2006	105 (96.7 – 115)	33.7 (29.8 – 37.7)	96.6 (87.0 – 111)	397 (315 – 513)	729
Non-Hispanic Whites					
2001–2002	175 (163 – 188)	55.1 (48.3 – 58.2)	164 (151 – 176)	652 (576 – 749)	1,221
2003–2004	159 (150 – 168)	50.9 (46.3 – 58.2)	153 (147 – 161)	526 (442 – 621)	1,080
2005–2006	177 (166 – 188)	55.0 (45.8 – 59.4)	168 (152 – 179)	656 (561 – 868)	1,005

Figure 3.5.b. Urinary iodine (creatinine corrected): Concentrations by survey cycle

Selected percentiles in µg/g creatinine (95% confidence intervals),
National Health and Nutrition Examination Survey, 2001–2006



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