Chapter Four

Other Measures of Nutritional Status

This chapter focuses on non-dietary measures of nutritional status, namely, body weight, nutrition-related biochemistries, and bone density. For adults, information on weight status is supplemented with information on reported weight gain over time, self-perceived weight status, interest in losing weight, and weight loss attempts over the past year. The section on nutrition-related biochemistries provides information on the prevalence of iron deficiency, iron-deficiency anemia, anemia, low levels of red blood cell folate and serum vitamin B_{12}, and abnormal levels of total cholesterol and related measures. The last section in the chapter presents data on the prevalence of reduced and severely reduced bone mass. The latter condition is indicative of osteoporosis. Because of age-based variations in NHANES-III data collection protocols, all measures were not available for all individuals.

Weight Status

The prevalence of overweight and obesity has increased dramatically since the time the first Health Examination Survey (a precursor to the present NHANES survey) was conducted in 1963-65 (Flegal et al., 1998). This is especially true among children and adolescents, for whom the prevalence of overweight has more than doubled (Troiano and Flegal, 1998). Being overweight or obese significantly increases the chances of developing many diseases, including type 2 diabetes, high blood pressure, coronary heart disease, stroke, gallbladder disease, respiratory problems, osteoarthritis, sleep apnea, and some types of cancer (U.S. DHHS, 2000a). *Healthy People 2010* includes goals to decrease the proportion of children and adolescents who are overweight, to increase the proportion

of adults who are at a healthy weight, and to decrease the proportion of adults who are obese (U.S. DHHS, 2000a).

The approach to defining overweight and obesity differs for children and adults. Therefore, the following sections present data separately for children ages 2 to 19 and adults aged 20 and older. The section on children also includes information on the percentage of children who were underweight and the percentage with retarded linear growth (short stature).

Children 2-19 Years

Classifying children as overweight is fundamentally different from classifying adults as overweight (Cole, 2001). Adults have traditionally been classified as overweight on the basis of life insurance mortality data and data relating weight status to morbidity and mortality (Troiano and Flegal, 1998). Such criteria cannot be used to define overweight in childhood, however, because childhood mortality is not associated with weight and weight-related morbidity in childhood is too low to define meaningful cutoffs (Barlow and Dietz, 1998). Therefore, the approach used to classify children as overweight relies on comparing children's weights and heights to appropriate reference populations.

A series of growth charts has been developed by the CDC for different anthropometric measures and different age groups (Kuczmarski et al., 2002). Three different growth charts can be used to assess weight status in children: the Body Mass Index (BMI)-for-age chart (designed for ages 2 and over), the weight-for-length chart (birth through 3 years), and the

weight-for-height chart (2-5 years). Because this analysis included children up to 19 years of age, the BMI-for-age chart was used. Consequently, children under the age of 2 were excluded from the analysis.[1] BMI is a measure of the relationship between height and weight that is the commonly accepted index for classifying adiposity (or fatness) (CDC, 2003).[2]

In assessing children's weight status, use of the word "obesity" is avoided because of potential negative connotations (CDC, 2003). Instead, assessment of weight status focuses on the prevalence of overweight (defined as BMI-for-age at or above the 95th percentile), the prevalence of being at risk of overweight (defined as BMI-for-age between the 85th and 95th percentiles), and the prevalence of underweight (defined as BMI-for-age below the 5th percentile) (see appendix B).

Prevalence of Overweight and Being at Risk of Overweight

Overall, 10 percent of children 2 to 19 years of age were overweight, based on BMI-for-age, and 13 percent were at risk of overweight (table D-77). The prevalence of both conditions was comparable for males and females, overall, and generally increased with age.

There were no statistically significant differences between FSP participants and income-eligible nonparticipants in mean BMI, the prevalence of overweight, or the percentage of children at risk of being overweight (tables D-76 and D-77). In comparison with higher-income children, however, FSP children had a significantly greater mean BMI (19.8 vs. 19.2) and were significantly more likely to be overweight (12% vs. 9%). These differences were concentrated among 12-19-year-old females. FSP females in this age group had a significantly

greater mean BMI than comparably aged higher-income females (23.7 vs. 21.8). In addition, they were almost twice as likely to be overweight (13% vs. 7%) and almost twice as likely to be at risk of overweight (22% vs. 12%) (figure 27).

Prevalence of Underweight

Overall, only 4 percent of children between 2 and 19 years were underweight (BMI-for-age below the 5th percentile) (table D-78). This prevalence is within the expected range given that, by definition, 5 percent of healthy children would be expected to fall below the 5th percentile due to normal biological variation (U.S. DHHS, 2000a).

There was no statistically significant difference between FSP participants and income-eligible nonparticipants in the percentage of children who were underweight. In comparison with higher-income children, however, FSP children were significantly less likely to be underweight (3% vs. 4%). This difference was concentrated among 3-5-year-old males. In this subgroup, the

Figure 27—Percent of females 12-19 years who were overweight or at risk of overweight
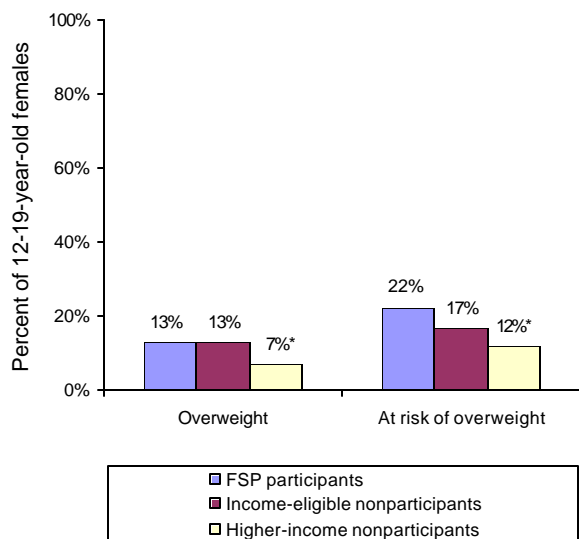
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

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[1]The second volume in this series (Cole and Fox, 2004a) includes data for 1-year-old children.

[2]BMI is equal to [weight in kilograms] $\div$ [height in meters]^2.

prevalence of underweight among FSP participants was less than half that of higher-income nonparticipants (3% vs. 7%).

Prevalence of Growth Retardation

Young children are susceptible to growth problems that can affect stature. Retardation of linear growth (short stature) in preschool children may indicate inadequate maternal weight gain or other prenatal problems, dietary inadequacy, infectious or chronic disease, or poor healthcare (U.S. DHHS, 2000a). The *Healthy People 2010* objectives include a goal to decrease the prevalence of linear growth retardation among low-income children under the age of 5. Retarded growth is defined as height-for-age below the 5th percentile (U.S. DHHS, 2000a).

Growth retardation occurred with roughly the same frequency as underweight (4% overall) (table D-78). This is within the realm of normal variation, as discussed above. There was no significant difference between FSP participants and income-eligible nonparticipants in the prevalence of growth retardation. However, FSP children were twice as likely as higher-income nonparticipant children to have retarded linear growth (6% vs. 3%). This pattern was observed for both males and females and was concentrated among 3-5-year-olds and 12-19-year-olds.

Adults 20 Years and Older

For adults, overweight and obesity are defined on the basis of BMI, with no differentiation for different age groups. A healthy weight is defined as a BMI that is at least 18.5 but less than 25. Overweight is defined as a BMI of 25.0 to 29.9, and obesity is defined as a BMI of 30 or more. A BMI below 18.5 indicates underweight.

Mean Body Mass Index

Overall, adults had a mean BMI of 26.6 (table D-79). This indicates that, on average, adults

were overweight. Mean BMIs were similar for males and females (26.7 and 26.5). In addition, for both males and females, mean BMI tended to increase with age between ages 20 and 59 and then decrease with age after age 60 (statistical significance of age-based differences not tested).

Adult FSP participants had a significantly greater mean BMI than either income-eligible nonparticipants or higher-income nonparticipants (28.3 vs. 26.9 and 26.4) (figure 28 and table D-79). The differences between groups were entirely attributable to differences among females (29.3 vs. 27.4 and 26.1). In gender-and-age-specific analyses, differences between FSP females and income-eligible females were observed for three specific age groups. Differences between FSP females and higher-income females were statistically significant for all but the oldest age group (80 and older) (table D-79).

Distribution of Body Weight

In keeping with their greater mean BMI, female FSP participants were significantly *less* likely

Figure 28—Mean Body Mass Index: Adults
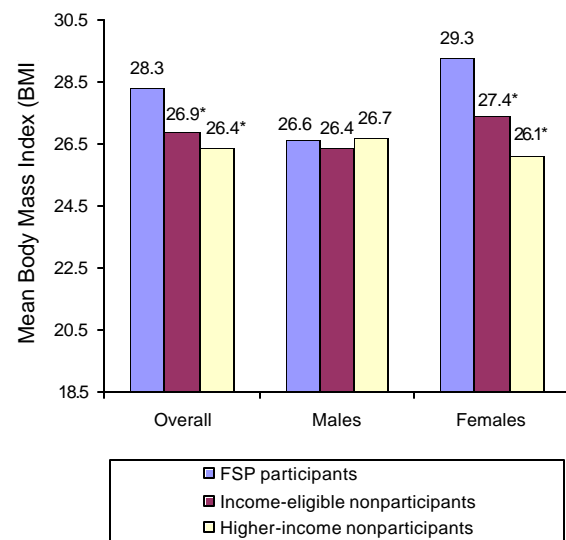
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

than either income-eligible females or higher-income females to be at a healthy weight and significantly *more* likely to be obese (figure 29 and tables D-80 and D-81). Only 28 percent of adult female FSP participants were at a healthy weight, compared with 36 percent of income-eligible females and 49 percent of higher-income females. Moreover, 42 percent of adult female FSP participants were obese, compared with 30 percent of income-eligible females and 22 percent of higher-income females.

The pattern observed for adult males was notably different. Among males, there were no statistically significant differences between FSP participants and income-eligible nonparticipants in the distribution of body weight (figure 30 and tables D-80 to D-83). In comparison with higher-income adult males, however, FSP adult males were *more* likely to be at a healthy weight (44% vs. 37%) and *less* likely to overweight (29% vs. 42%).

Weight Change Since Age 25 and in the Past 10 Years

To assess patterns of weight change during adulthood, NHANES-III respondents 25 and older were asked to report how much they weighed at age 25. Respondents 36 and older were asked how much they weighed 10 years ago, and all respondents 17 and older were asked to report their maximum lifetime weight. These responses were compared to reports of current weight to obtain a self-reported history of weight gain/loss for each individual.

Weight Change Since Age 25

Adults 26 and older reported an average weight gain of 20.5 pounds since age 25 (table D-84). The reported mean weight gain was greater for women than for men (22.3 pounds vs. 18.5). For both genders, weight gain increased with age through age 59 and then decreased with age (statistical significance of gender- and age-based differences not tested).

Figure 29—Distribution of body weight: Adult females
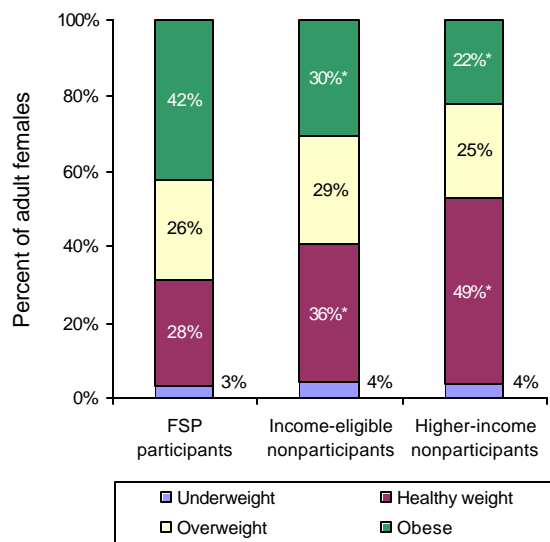
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

Figure 30—Distribution of body weight: Adult males
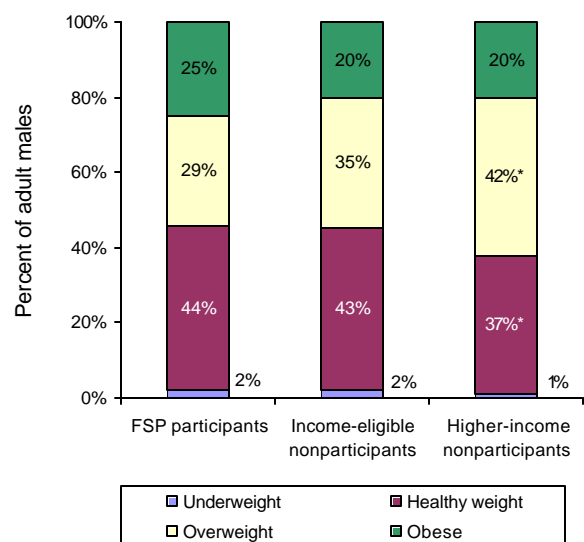
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

FSP participants reported a greater mean weight gain since age 25 than either income-eligible nonparticipants or higher-income nonparticipants. Overall, FSP participants reported gaining an average of 29.2 pounds, compared with 22.4 pounds for income-eligible nonparticipants and 19.7 pounds for higher- income nonparticipants (figure 31 and table D-84). Moreover, 23 percent of FSP adults reported gaining more than 50 pounds since age 25 (table D-85). The same was true for only 14 percent of income-eligible nonparticipants and 10 percent of higher-income nonparticipants. All of these between-group differences were statistically significant. These general patterns were observed for both males and females; however, disparities between FSP participants and nonparticipants were greatest among females.

Weight Change in the Past 10 Years Among Adults 36 and Older

Overall, adults 36 and older gained weight over the past 10 years, with an average increase of 8.1 pounds (table D-86). Females reported a greater mean weight gain than males (10.4

Figure 31—Mean weight gain since age 25

*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

pounds vs. 5.6 pounds), and reported mean weight gain decreased with age. Among adults 70 and older, the mean weight change in the past 10 years was negative rather than positive, indicating weight loss rather than gain (statistical significance of gender- and age-based differences not tested).

There was no significant difference between FSP participants and income-eligible nonparticipants in reported mean weight change over 10 years. However, the difference between FSP participants and higher-income nonparticipants was statistically significant, with FSP participants reporting a significantly greater weight gain (12.7 pounds vs. 7.5 pounds). This difference was attributable to a difference among females, particularly females between 40 and 49 years. Overall, the mean reported ten-year-weight-gain for FSP females was 14.8 pounds, compared with 9.7 pounds for higher-income females. Among 40-49-year-olds, the difference was 28.2 pounds vs. 13.4 pounds.

Additional information about patterns of adult weight change are available in table D-87, which shows the full distribution of reported 10-year weight change, and in tables D-88 and D-89, which show means and distributions of differences between current weight and lifetime maximum weight.

Accuracy of Perceptions about Body Weight

All NHANES-III respondents 17 and older were asked how they felt about their current body weight: "Do you consider yourself now to be overweight, underweight, or about the right weight?" These data were analyzed for all adults as well as separately for adults who were at a healthy weight and adults who were overweight or obese, based on actual BMIs.

More than three-quarters (77%) of adults who were overweight or obese had an accurate perception of their body weight (table D-90).
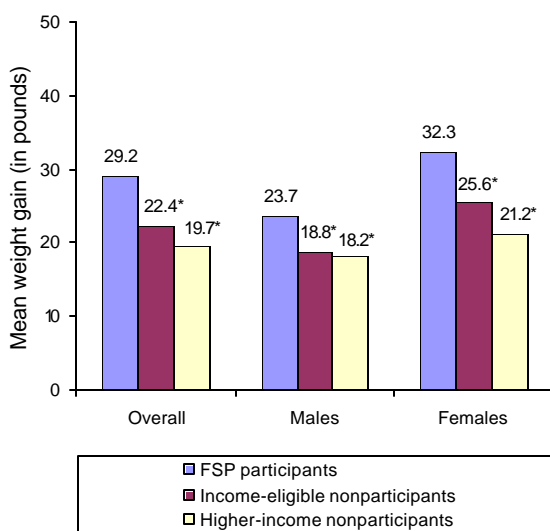
Overweight and obese females tended to have more accurate perceptions than overweight and obese males. Almost 90 percent of overweight and obese females perceived themselves to be overweight, compared with only 66 percent of overweight and obese males (tables D-91 and D-92) (statistical significance of gender-based difference not tested).

FSP females who were overweight and obese had a less accurate perception of their body weight than comparable females in the income-eligible and higher-income nonparticipant groups. Seventy-nine percent of FSP females who were overweight or obese perceived themselves this way, compared with 85 percent of comparable income-eligible females and 92 percent of comparable higher-income females (figure 32 and table D-92). There were no significant between-group differences in the percentage of overweight/obese males who described themselves as overweight. On average, about two-thirds of overweight/obese males had an appropriate perception of their body weight.

Figure 32—Percent of adult females who perceived themselves to be overweight
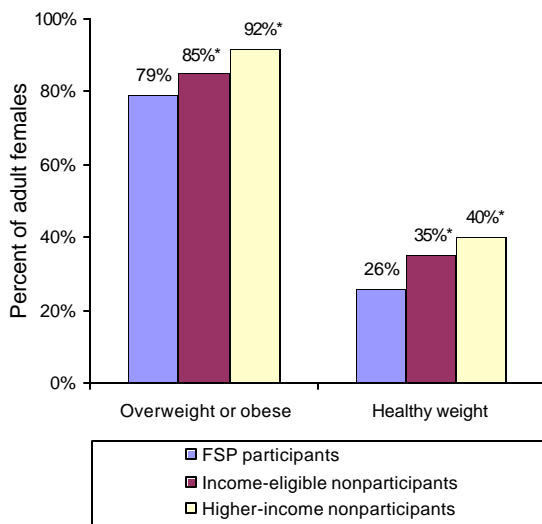
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

Overall, 25 percent of adults who were at a healthy weight perceived themselves to be overweight (table D-90). Healthy weight males were less likely to perceive themselves to be overweight than healthy weight females (11% vs. 38%) (tables D-91 and D-92) (statistical significance of gender-based difference not tested).
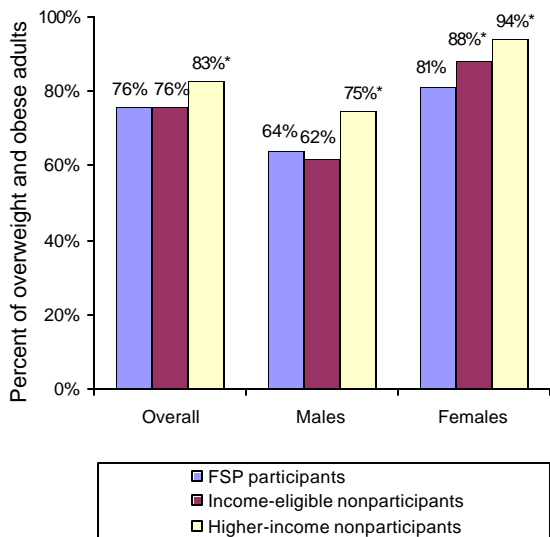
FSP participants who were at a healthy weight were less likely than higher-income nonparticipants to perceive themselves as overweight (14% vs. 27%) (table D-90). This pattern was observed for both males and females (tables D-91 and D-92). Among healthy weight females, FSP participants were also less likely than income-eligible nonparticipants to describe themselves as being overweight (figure 32).

Desire to Lose Weight

In response to the question "Would you like to weigh more, less, or stay about the same?" more than 8 out of 10 adults who were overweight or obese indicated that they would like to weigh less (table D-93). The percentage of overweight/obese males who expressed a desire to lose weight was less than the percentage of overweight/obese females who reported this desire (73% vs. 91%) (tables D-94 and D-95) (statistical significance of gender- and age-based differences not tested).

Overall, there was no significant difference between FSP participants and income-eligible nonparticipants in the percentage of overweight and obese adults who reported wanting to lose weight (figure 33 and table D-93). However, in comparison with higher-income nonparticipants, FSP participants who were overweight or obese were less likely to want to lose weight (76% vs. 83%). This pattern was observed for both males and females (figure 33 and tables D-94 and D-95). In addition, among females, overweight and obese FSP participants were significantly less

Figure 33—Percent of overweight and obese adults who expressed a desire to lose weight

*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

likely than income-eligible nonparticipants to want to lose weight (81% vs. 88%).

Substantial numbers of adults (37%) who were at a healthy weight also expressed a desire to lose weight (table D-93). However, the percentage of healthy weight males who reported this desire was substantially lower than the percentage of healthy weight females (16% vs. 54%) (tables D-94 and D-95) (statistical significance of gender-based difference not tested).

Overall, FSP participants who were at a healthy weight were significantly less likely than their counterparts in either of the nonparticipant groups to want to lose weight (17% vs. 25% and 40%) (table D-93). This pattern was observed for both males and females; however, among females, the difference between FSP participants and income-eligible nonparticipants was not statistically significant (tables D-94 and D-95).

Attempts to Lose Weight During the Past 12 Months

Finally, all adults were asked whether they made any attempt to lose weight during the preceding 12 months. Overall, 40 percent of all adults reported attempting to lose weight sometime during this time period (table D-96). Both healthy weight and overweight/obese adults reported attempts to lose weight, although the proportion of overweight and obese adults who reported such attempts was substantially larger than the proportion of healthy weight adults (53% vs. 26%). In addition, the proportion of females who attempted to lose weight, whether they were at a healthy weight or were overweight/obese, was consistently greater than the proportion of males (tables D-97 and D-98) (statistical significance of weight- and gender-based differences not tested).

Overall, overweight and obese FSP adults were no more likely than comparable adults in the two nonparticipant groups to have tried to lose weight during the preceding 12 months (figure 34 and table D-96). The same was true for

Figure 34—Percent of overweight and obese adults who tried to lose weight in the past 12 months
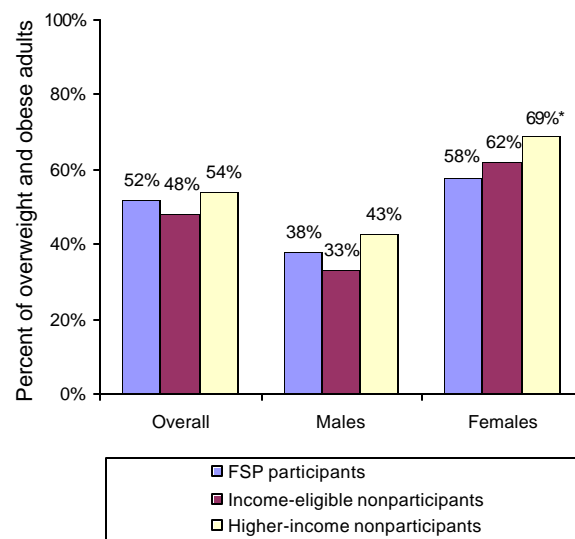
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

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overweight and obese males analyzed separately (table D-97). Among overweight and obese females, however, FSP participants were less likely than comparable higher-income females to have attempted to lose weight (table D-98).

Among healthy weight persons, FSP participants were significantly less likely than higher-income nonparticipants to have attempted weight loss during the preceding 12 months (table D-96). This pattern was noted for both males and females; however, among females, the difference between FSP participants and income-eligible nonparticipants was also statistically significant (tables D-97 and D-98).

Nutritional Biochemistries

Iron Deficiency, Iron-Deficiency Anemia, and Anemia

Iron deficiency is the most common known form of nutritional deficiency (CDC, 1998). Iron deficiency can lead to developmental delays, behavioral problems, and decreases in verbal learning and memory. It can also affect immune function, energy metabolism, and work performance (U.S. DHHS, 2000a, CDC, 1998, and Looker et al., 1997). The prevalence of iron deficiency has decreased dramatically over the past three decades, in part because of increased iron intake among infants and young children and the influence of the WIC program (Yip et al., 1987). Nonetheless, iron deficiency remains a problem for young children, particularly low-income children. *Healthy People 2010* includes a goal to decrease the prevalence of iron deficiency among preschool children (ages 1 to 4) and among women of childbearing age (U.S. DHHS, 2000a).

The terms anemia, iron deficiency, and iron-deficiency anemia are often used interchangeably, however, they are not equivalent (U.S. DHHS, 2000a). Although iron deficiency can contribute to anemia, anemia can also be caused by other factors, including other nutrient deficiencies, infection, inflammation, and hereditary anemias. When the prevalence of iron deficiency is high, anemia is a good predictor of iron deficiency. However, when the prevalence of iron deficiency is low, the majority of anemia is due to other causes (U.S. DHHS, 2000a).

This analysis assessed the prevalence of iron deficiency using the criterion defined in *Healthy People 2010* (U.S. DHHS, 2000a). This criterion defines iron deficiency as abnormal results on two or more of the following measures of iron status: serum transferrin saturation, erythrocyte protoporphorin, and serum ferritin. Iron-deficiency anemia was defined as documented iron deficiency (as defined above) plus an abnormally low hemoglobin (Looker et al., 1997). Cutoff values used in the analysis are shown in appendix B. The analysis sample was limited to sample members with data for all relevant variables.

The prevalence of iron deficiency for the population as a whole was about 6 percent (table D-99).[3] Prevalence was greatest among 1-2-year-old children (9%), females of childbearing age (12-49 years) (8% to 15%), and females 80 and older (9%).
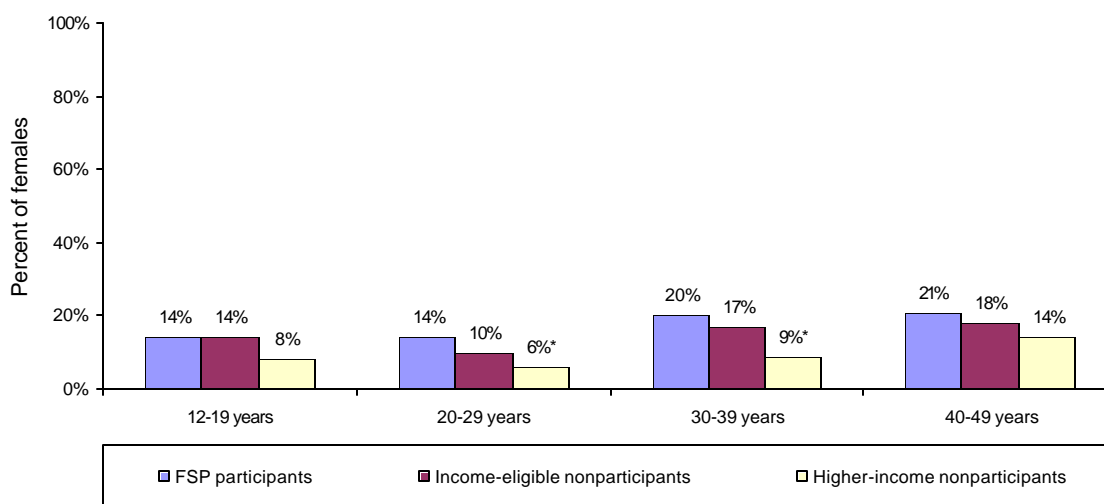
Overall, the prevalence of iron deficiency among FSP participants and income-eligible nonparticipants was not significantly different. However, FSP participants were twice as likely as higher-income nonparticipants to be iron deficient (10% vs. 5%). This difference was concentrated among females of childbearing age, particularly among women between 20 and 39 (figure 35). Among 20-29-year-old females, 14 percent of FSP participants were iron deficient, compared with 6 percent of higher-income nonparticipants.

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[3]Results for each of the three measures of iron status considered in defining iron deficiency (serum ferritin, free erythrocyte protoporphorin, and transferrin saturation) are presented in tables D-100 to D-102.

Figure 35—Percent of females of childbearing age with iron deficiency

Chart showing percent of females with iron deficiency by age group:

- 12-19 years: FSP participants 14%, Income-eligible nonparticipants 14%, Higher-income nonparticipants 8%
- 20-29 years: FSP participants 14%, Income-eligible nonparticipants 10%, Higher-income nonparticipants 6%*
- 30-39 years: FSP participants 20%, Income-eligible nonparticipants 17%, Higher-income nonparticipants 9%*
- 40-49 years: FSP participants 21%, Income-eligible nonparticipants 18%, Higher-income nonparticipants 14%

Y-axis: Percent of females (0% to 100%)

Legend: ■ FSP participants ■ Income-eligible nonparticipants □ Higher-income nonparticipants

*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

Comparable statistics for 30-39-year-old females were 20 percent vs. 9 percent.

Iron-deficiency anemia was observed in 2 percent of the population (table D-103). Overall, there was no significant difference between FSP participants and income-eligible nonparticipants in the prevalence of this condition. In comparison with higher-income nonparticipants, however, FSP participants were twice as likely to have iron-deficiency anemia (4% vs. 2%). Differences between the two groups were concentrated among 1-2-year-olds (5% vs. 1%) and among females (5% vs. 3%).

The prevalence of anemia, defined on the basis of low levels of hemoglobin or hematocrit, was substantially greater than the prevalence of iron-deficiency anemia as assessed in this analysis (tables D-104 and D-105). Overall, 8 percent of the population had a low hemoglobin level (table D-104). Prevalence of anemia (low hemoglobin) was greatest among 1-2-year-olds (11%) and among adults 60 years and older (10% to 23%) (statistical significance of age-based differences not tested). Given the relatively low prevalence of iron-deficiency anemia, as discussed above, a substantial proportion of the anemia observed is likely to be due to other causes (other nutrient deficiencies, infection, inflammation, and hereditary anemias).

Based on hemoglobin levels, the overall prevalence of anemia was comparable for FSP participants and income-eligible nonparticipants. However, the prevalence of anemia among FSP participants was double that of higher-income nonparticipants (14% vs. 7%). This general pattern was observed for both males and females.

When the data were examined by age group, several differences emerged that were significant for both of the between-group comparisons. Specifically, among 1-2-year-olds, 20-29-year-olds, and adults 70 and older, FSP participants were significantly more likely than either income-eligible nonparticipants or higher-income nonparticipants to have anemia (low hemoglobin) (figure 36). A comparable pattern was observed for 3-5-year-olds; however, this data is not presented in figure 36 because the point estimate for income-eligible nonparticipants is statistically unreliable.

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Figure 36—Percent of specific population groups with anemia/low hemoglobin
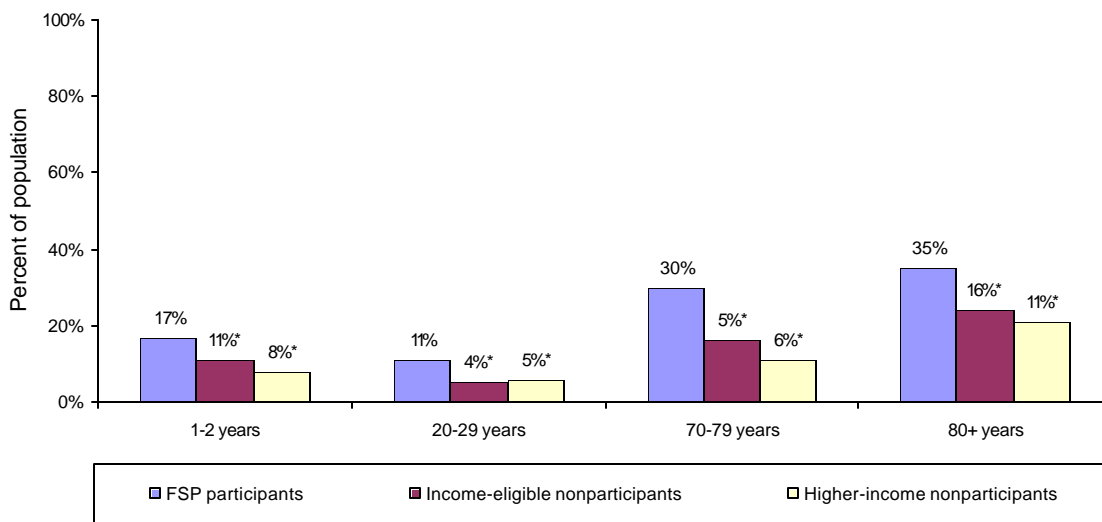
## Red Blood Cell (RBC) Folate

Overall, 7 percent of the population had low levels of red blood cell (RBC) folate, an indicator of long-term folate status (Wright et al., 1998) (table D-106). Prevalence of low RBC folate was greatest among females between 12 and 29 years of age (13-15%). Adequate RBC folate levels are particularly important for women of childbearing age, because inadequate maternal folate has been associated with neural tube defects in newborns.

The prevalence of abnormally low RBC folate levels was comparable for FSP participants and nonparticipants (figure 37). In comparison with higher-income nonparticipants, however, FSP participants were significantly more likely to have low levels of RBC folate (11% vs. 6%). This pattern was noted for both males and females.

Among women of childbearing age, only one significant difference was noted between FSP participants and higher-income nonparticipants in the prevalence of low RBC folate levels. Among

women 30-39 years, FSP participants were significantly more likely than higher-income nonparticipants to have low levels of RBC folate (16% vs. 7%) (table D-106).

Figure 37—Percent of persons with low levels of RBC folate
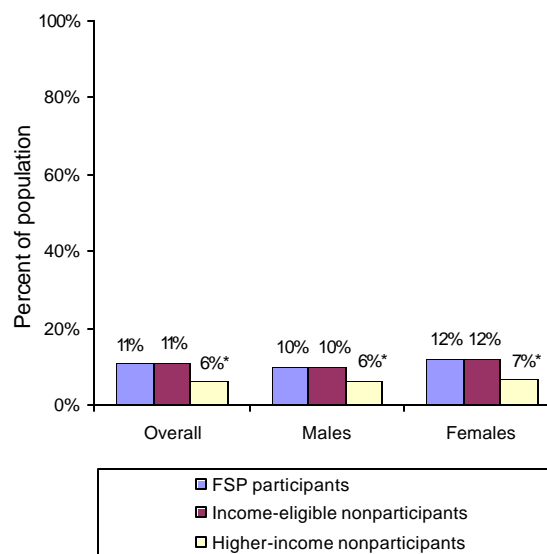
Serum Vitamin B$_{12}$

Vitamin B$_{12}$ deficiency is observed more often among older adults than among other population groups. This is due to age-related gastrointestinal changes, including decreased levels of hydrochloric acid, which impede absorption of the vitamin (IOM, 2000a). Low levels of vitamin B$_{12}$ may contribute to anemia.

Overall, 3 percent of the population had low serum levels of vitamin B$_{12}$ (table D-107). The observed prevalence of this condition was slightly lower for FSP participants than either group of nonparticipants (2% vs. 3% for both groups of nonparticipants); however, only the difference between FSP participants and higher-income nonparticipants was statistically significant. This difference was largely attributable to a difference among the oldest adults (80 and older), particularly males.

Serum Cholesterol and Related Measures

Elevated serum cholesterol levels have been associated with increased risk of coronary heart disease in adults. Further, there is evidence that the process of atherosclerosis, or the build-up of fatty deposits in the arteries, begins early in childhood. For children up to the age of 19, the National Cholesterol Education Program (NCEP) considers a serum cholesterol level of 200 mg/dL or more to be high and levels between 170 mg/dL and 199 mg/dL to be border-line high (National Institutes of Health (NIH), 1991). For adults, a serum cholesterol of 240 mg/dL or more is considered high, and levels of 200-239 mg/dL are considered borderline high (NIH, 2001).

Overall, 18 percent of the population had a high cholesterol level (table D-108). The percentage of FSP participants with a high serum cholesterol level was not significantly different from that of higher-income nonparticipants (figure 38). However, FSP participants were signifi-

Figure 38—Percent of persons with high levels of total cholesterol
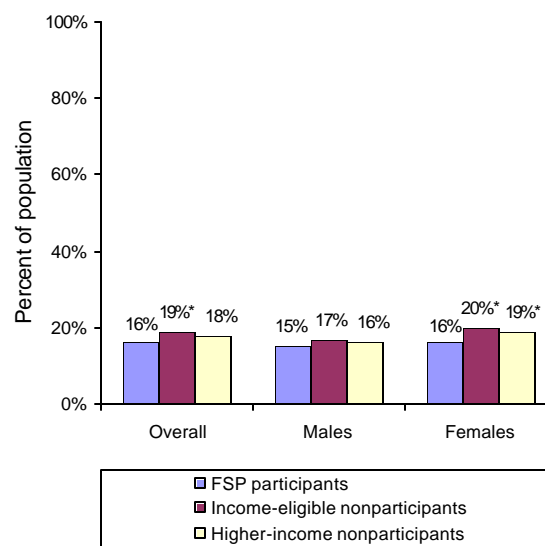
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

cantly less likely than income-eligible nonpartici-pants to have a high cholesterol (16% vs. 19%). This between-group difference was noted for females, but not for males. In fact, among females, FSP participants were significantly less likely than either group of nonparticipants to have a high serum cholesterol (16% vs. 20% and 19%). There were no significant differences, overall or by gender, between FSP participants and either group of nonparticipants in the prevalence of borderline-high cholesterol levels (table D-109).

The prevalence of high and borderline-high levels of LDL ("bad") cholesterol, low levels of HDL ("good") cholesterol, and high triglyceride levels was also examined (tables D-110 to D-113).[4] Overall, there were no statistically

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[4]LDL cholesterol levels of 130-159 mg/dL were considered borderline-high. The cutoff used to define high LDL cholesterol levels ($\geq$160 mg/dL) includes both high and very high levels as defined by the NCEP. HDL cholesterol levels of < 40 mg/dL were considered low. The cutoff used to define high triglycerides ($\geq$200 mg/dL) includes both high and very high triglycerides as defined by the NCEP (NIH, 2001).

significant between-group differences on any of these measures. In addition, only one significant difference was observed in the gender-specific analyses. Females in the FSP participant group were more likely than females in the higher-income group to have low levels of HDL cholesterol (17% vs. 10%) (table D-112). The difference was concentrated among females 20-29 years of age (24% vs. 9%) and between the ages of 40 and 59 (20% vs. 9-10%).

Bone Density

A reduction in bone mass or bone density can lead to deteriorated or fragile bones (U.S. DHHS, 2000a). Reduced bone density, or osteopenia, has been defined as bone density that is 1 to 2.5 standard deviations below the mean for non-Hispanic white women between the ages of 20 and 29, as measured in NHANES-III (NCHS, 1999). Severely reduced bone mass, or osteoporosis, is defined as bone density more than 2.5 standard deviations below this norm. The *Healthy People 2010* objectives include a goal to reduce the prevalence of osteoporosis among adults (U.S. DHHS, 2000a).
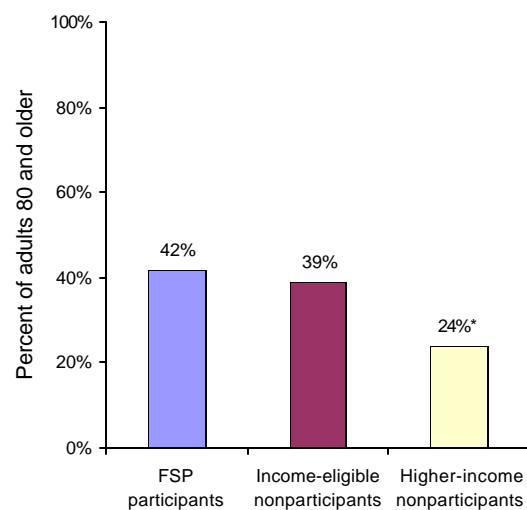
Overall, 23 percent of adults 20 years and older had reduced or severely reduced bone density and 4 percent had severely reduced bone density (osteoporosis) (tables D-114 and D-115). The prevalence of these conditions was markedly greater among females than males (33% and 6% vs. 12% and 1%) (tables D-116 to D-119). In addition, the prevalence of both conditions increased dramatically with age. For example, fewer than 10 percent of adults between 20 and 29 had reduced or severely reduced bone mass, compared with 72 percent of adults 80 and older. This pattern was noted for both males and females (statistical significance of gender- and age-based differences not tested).

There were no statistically significant differences, overall or by gender, between FSP

participants and either group of nonparticipants in the percentage of adults with reduced or severely reduced bone density, or in the percentage with severely reduced bone density (osteoporosis). However, among those most at risk of osteoporosis—adults 80 and over—FSP participants were significantly more likely than higher-income nonparticipants to have this condition (42% vs. 24%) (figure 39 and table D-115). This pattern was noted for both males and females; however the between-group difference was not statistically significant in the gender-specific analyses (sample sizes for FSP participant cells were quite small).

A notably different pattern was observed among younger adult males. FSP males were significantly *less* likely than income-eligible males (20-29 years and 40-49 years) and higher-income males (20-29 years through 40-49 years) to have reduced or severely reduced bone density (table D-116).

Figure 39—Percent of adults 80 and over with severely reduced bone density

*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

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