Chapter Three

Healthy Eating Index Scores and Usual Intake of Dietary Fiber

This chapter describes the nutritional quality of diets consumed by FSP participants and nonparticipants. The analysis focuses on the Healthy Eating Index (HEI), a summary measure of overall nutritional quality developed by USDA's Center for Nutrition Policy and Promotion (CNPP) (Kennedy et al., 1995). Usual intake of dietary fiber is also examined.

The analysis excludes infants and children under the age of 2 because the HEI is designed to assess the nutritional quality of diets consumed by individuals 2 years of age and older. In addition, to maintain consistency across analyses of diet-related measures, the age groups used in this chapter are the same as those used in assessing usual intakes of food energy and nutrients and differ from those used elsewhere in the report (see Chapter Two).

Healthy Eating Index Scores

The HEI provides an overall picture of the types and quantities of food individuals consume and their compliance with recommended dietary practices (Basiotis et al., 2002). The index includes an overall score as well as 10 component scores, all of which are weighted equally in the overall score. The 10 component scores measure different aspects of a healthy diet, relative to current public health recommendations. The HEI scores used in this analysis were computed by NCHS staff, following USDA guidelines, and were included in a public-release data file (NCHS, 2000).

Six of the component scores are food-based and evaluate food consumption in comparison with Food Guide Pyramid recommendations for intake of grains, vegetables, fruits, dairy, and meat, as well as the level of variety in the diet (USDA, CNPP, 1996). Four component scores are nutrient-based and assess compliance with *Dietary Guidelines for Americans* recommendations for daily intake of fat, saturated fat, cholesterol, and sodium (USDA and U.S. DHHS, 2000).[1] The specific reference standards used for each HEI component are described in the following discussions and are listed in appendix B. The appendix also provides technical details about how food consumption data needed to estimate HEI scores were derived from the NHANES-III 24-hour recall data.

The HEI data are based on the single 24-hour recall collected in NHANES-III. It was not possible to develop HEI scores that reflect usual intakes, as was done for the nutrients assessed in the preceding chapter. There were two major impediments to such an analysis. First, the HEI scoring algorithm is applied at the *individual* level but the adjustment technique used to generate estimates of usual nutrient intakes adjusts *distributions* (see appendix C) rather than individual observations. Second, the HEI includes six food-based components and it is not possible to generate estimates of usual food intake (as opposed to usual nutrient intake) because distributions of daily food intake tend to be highly skewed and to include a large proportion of zeros (Dodd, 2001).

[1]When the HEI was first developed, the standards for cholesterol and sodium were based on recommendations made in the NRC's *Diet and Health* report (NRC, 1989b) because the version of the *Dietary Guidelines* in effect at the time did not include quantitative standards for these dietary components (USDA and U.S. DHHS, 1995). Since that time, the NRC standards for sodium and cholesterol have been incorporated into both the Nutrition Facts section of food labels and the most recent version of the *Dietary Guidelines* (USDA and U.S. DHHS, 2000).

Although it was not possible to incorporate information on usual nutrient intakes into HEI scores, usual intake distributions were estimated for the nutrients considered in the HEI. These include the percentage of food energy (calories) from fat and saturated fat as well as total intakes of cholesterol and sodium. In addition, a separate analysis was conducted to compare HEI data and usual intake data on estimates of the percentage of individuals who consumed diets consistent with the various reference standards.

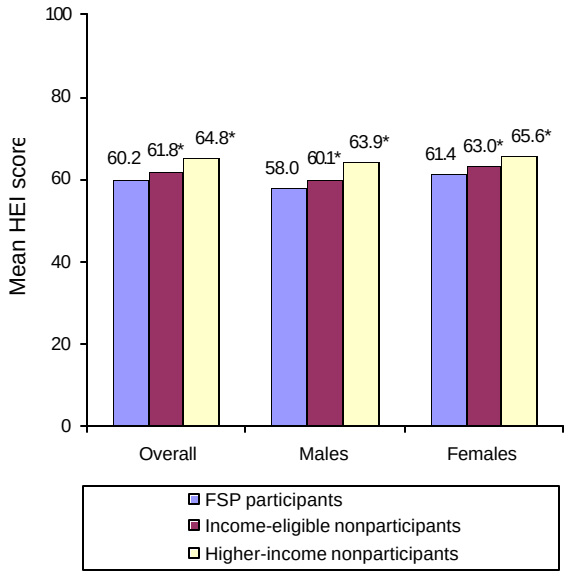
Because of the large number of variables examined and the additional comparisons presented (HEI data vs. usual intake data) in this chapter, the text discussion focuses on significant findings for the aggregate analysis (total population) and the gender-specific analyses. Information about significant between-group differences that may have been observed only for specific gender- and/or age-groups may be found in the detailed appendix tables referenced throughout the text.

Total HEI Scores

For all persons 2 years and older, the mean HEI score was 64.0, out of a possible 100 (table D-37). Females had slightly higher mean HEI scores than males (64.8 vs. 63.1) (significance of gender-based difference not tested). On average, FSP participants scored lower on the HEI than either income-eligible or higher-income nonparticipants (60.2 vs. 61.8 and 64.8) (figure 16). This pattern was observed for both males and females.

Researchers at CNPP have defined cutoffs that can be used to interpret what HEI scores say about overall diet quality (Basiotis et al., 2002). Total HEI scores over 80 imply a "good" diet. Scores between 51 and 80 indicate a "need for improvement." And scores below 51 are indicative of a "poor" diet. Based on these criteria, the majority of FSP participants and nonparticipants

Figure 16—Mean Healthy Eating Index (HEI) scores



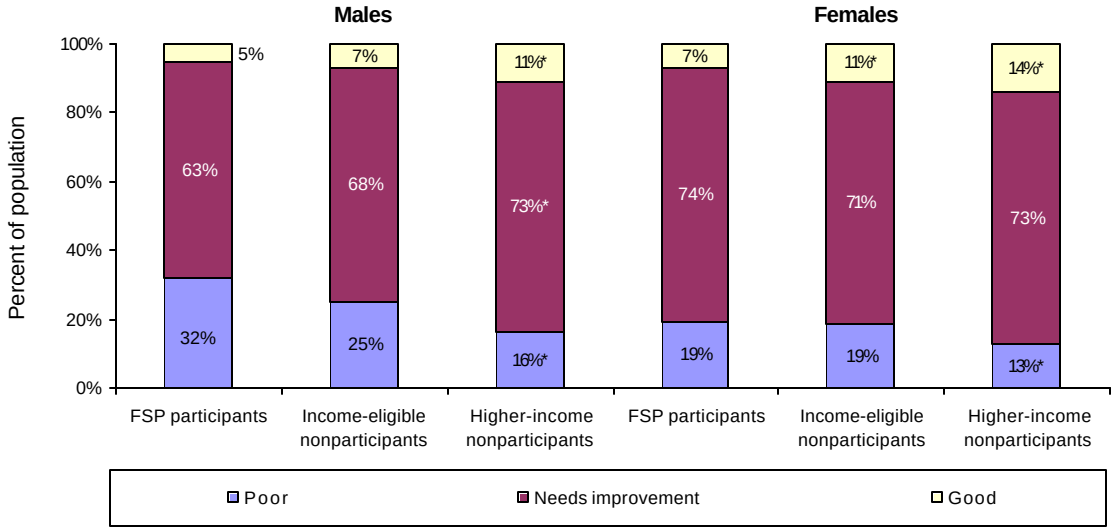
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

needed to make improvements in their diets. Overall, 72 percent of persons showed a need for improvement (table D-38). Twelve percent of individuals were consuming "good" diets and 16 percent were consuming "poor" diets.

Based on mean HEI scores, the nutritional quality of diets consumed by FSP participants and income-eligible nonparticipants were generally similar. The only significant difference noted for these two groups was a lower percentage of individuals with "good" diets in the FSP participant group (6% vs. 9%). In comparison with higher-income nonparticipants, however, FSP participants were more likely to consume "poor" diets (24% vs. 15%) and less likely to consume "good" diets (6% vs. 12%).

This general pattern of differences was noted for both males and females. Among males, however, the difference between FSP participants and income-eligible nonparticipants in the percentage consuming "good" diets was not significant (figure 17). In addition, male FSP participants were less likely than higher-income males to have diets that "need improvement." This is

Figure 17—Distribution of total HEI scores



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

because of differences between the two groups in the percentage of individuals with "good" and "poor" diets.

Between-group differences in diet quality were more dramatic for males than for females. FSP males were twice as likely as higher-income males to be consuming "poor" diets (32% vs. 16%). Comparable percentages for FSP females and higher-income females were 19 percent and 13 percent.

Across all three particpant/nonparticipant groups, the percentage of females who consumed "good" diets was consistently greater than the percentage of males. Similarly, the percentage of females with "poor" diets was consistently lower than the percentage of males. This difference was most pronounced in the FSP participant group, where 32 percent of males had "poor" diets, compared with 19 percent of females (statistical significance of gender-based differences not tested).

Food-based Component Scores

Standards for the food-based HEI component scores reflect daily goals for consumption of foods from each of the five good groups specified in the Food Guide Pyramid (USDA/CNPP, 1996). Serving guidelines are associated with recommended energy intake and vary by gender and age. Appendix B provides a detailed summary of the recommended numbers of daily servings from each group, by gender and age.

The HEI also includes a food-based score for dietary variety. Although the need for variety in the diet is a theme in all major public health nutrition guidelines, there are no specific quantitative recommendations. For purposes of the HEI, dietary variety is assessed by totaling the number of different types of food a person consumes in a day. Similar foods are grouped together and tabulations consider only food components that contribute at least one-half serving toward any food group. Fats, sweets, seasonings, and similar foods are not included (NCHS, 2000). A perfect score of 10 is assigned when a person consumes at least one-half serving of eight different foods.

Examination of the individual food-based HEI component scores provides information about specific shortcomings in the diets consumed by

FSP participants and nonparticipants. The following discussion reviews scores for each of the six food-based HEI components and presents summary data for both males and females.

Males

Data on food-based HEI component scores (tables D-40 to D-50) indicate that the food consumption goal that presented the most difficulty for males was the goal for fruit. Mean scores for the fruit component ranged from 2.7 to 3.8, compared with a perfect score of 10, and less than 20 percent of males in each group satisfied the HEI standard for fruit (or consumed the recommended number of fruit servings) (figures 18 and 19 and table D-44).

Although there was still room for improvement, the food consumption goals that were least problematic for males were the goals for meat and variety. Mean scores ranged from 7.2 to 7.5 for the meat component and from 6.6 to 8.2 for the variety component (figure 18 and tables D-48 and D-50). Moreover, for both components, more than 40 percent of the males in each group satisfied the HEI standard (figure 19 and tables D-48 and D-50).

Significant differences were noted between FSP males and income-eligible males for the grain and variety components of the HEI. In both cases, FSP males had significantly lower mean scores than income-eligible males (6.3 vs. 6.9 for the grain component and 6.6 vs. 7.2 for the variety component) (figure 18 and tables D-40 and D-50). In addition, for both of these components, significantly fewer FSP males than income-eligible males satisfied the HEI standard (23% vs. 28% for the grain component and 42% vs. 48% for the variety component) (figure 19 and tables D-40 and D-50).

Differences between FSP males and higher-income males were more widespread. FSP males had significantly lower mean scores than higher-income males on all of the food-based HEI components except meat (figure 18). The same pattern was observed for the percentage of males meeting HEI standards for the food-based components (figure 19).

Data on the mean number of servings consumed from each food group (tables D-40 to D-50) reveal that, in comparison with income-eligible males, FSP males consumed almost three-quarters (0.7) of a serving less grains per day. In addition, although there was no significant difference between the two groups in mean scores on the HEI meat component, FSP males consumed about a third of a serving more meat per day than income-eligible males.

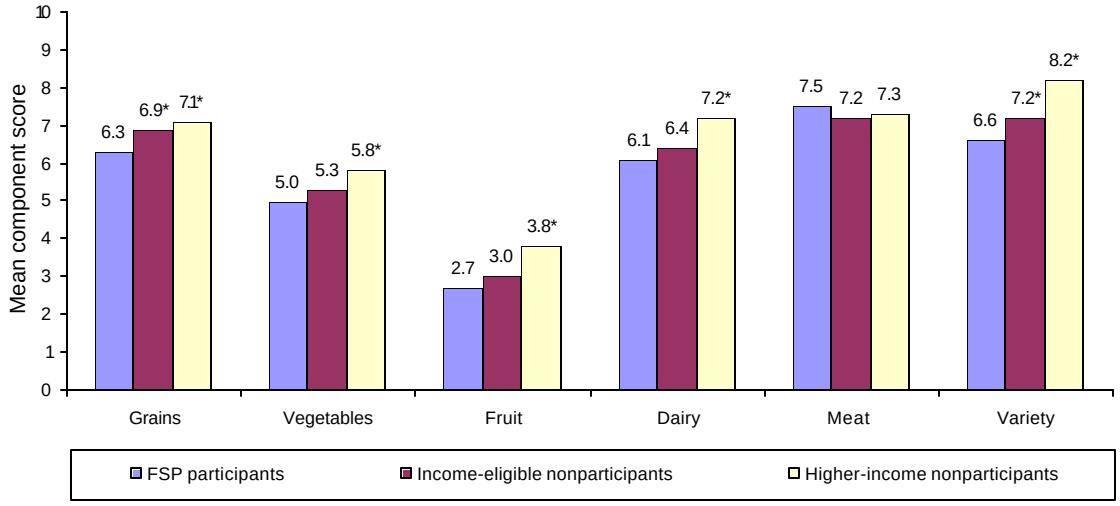
In comparison with higher-income males, FSP males consumed, on average, 1 less serving of grains, almost half (0.4) a serving less vegetables, and almost half (0.4) a serving less dairy foods per day. In addition, FSP males consumed about a third of a serving *more* meat per day than higher-income males.

Females

The food consumption goals that were most challenging for females were the goals for fruit and grains (figures 20 and 21 and tables D-40 and D-44). Mean scores for the fruit component ranged from 3.1 to 4.3 and only 13 to 22 percent of females consumed the recommended number of fruit servings per day. Mean scores for the grain component were notably higher (6.2 to 6.4); however, 20 percent or less of the females in each group consumed the recommended number of grain servings.

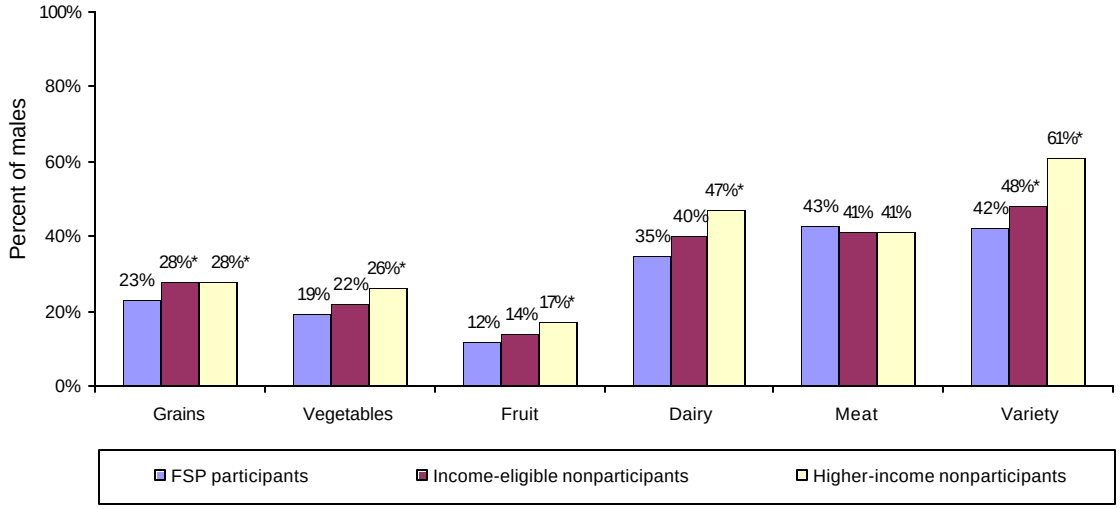
Like males, females did best in satisfying the HEI standard for variety. Mean scores for this component ranged from 6.5 to 7.7 and approximately 40 percent or more of the females in each group met the HEI standard for variety (figures 20 and 21 and table D-50).

Figure 18—Mean scores for HEI food-based components: Males



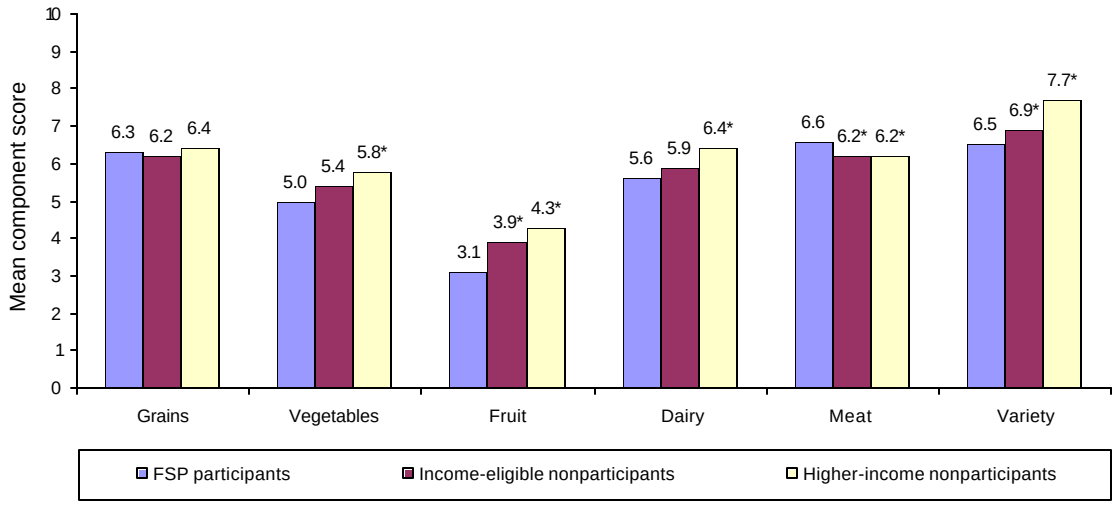
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

Figure 19—Percent of persons meeting HEI standards for food-based components: Males



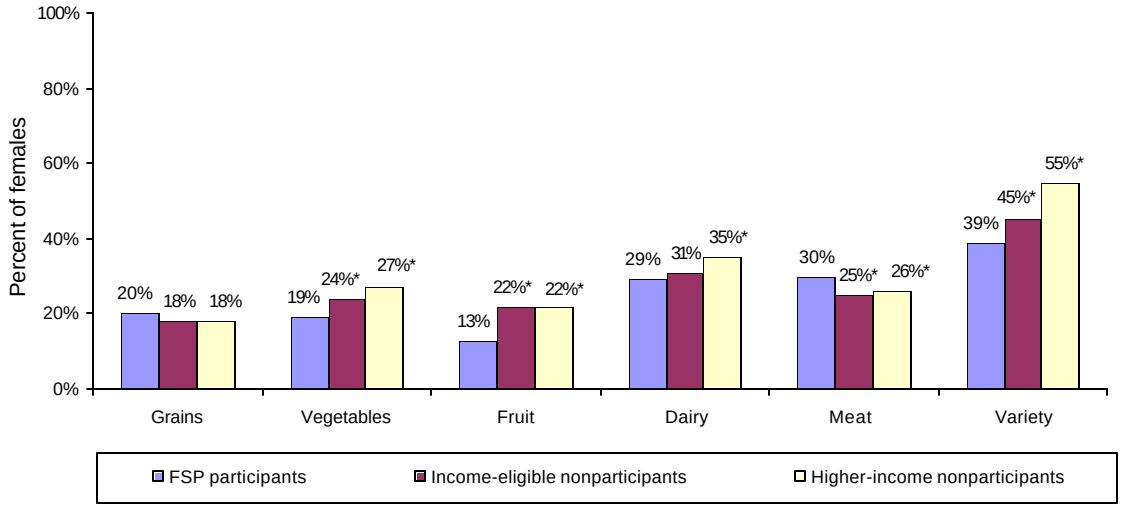
*Statistically significant difference from FSP participants at the .05 level or better.
Source: NHANES-III, 1988-94.

Figure 20—Mean scores for HEI food-based components: Females



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

Figure 21—Percent of persons meeting HEI standards for food-based components: Females



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

Mean scores for female FSP participants and income-eligible females were significantly different for three of the six food-based HEI components: fruit, meat, and variety. For the fruit and variety components, FSP females had significantly lower mean scores than income-eligible females (3.1 vs. 3.9 for the fruit component and 6.5 vs. 6.9 for the variety component) (figure 20 and tables D-44 and D-50). In addition, for both of these components, significantly fewer FSP females than income-eligible females satisfied the HEI standard (13% vs. 22% for the fruit component and 39% vs. 45% for the variety component) (figure 21).

For the meat component, the difference between FSP females and income-eligible females ran in the opposite direction. That is, in comparison with income-eligible females, FSP females scored *higher*, on average, on the meat component (6.6 vs. 6.2) and were *more* likely to consume the recommended number of meat servings per day (30% vs. 25%) (figures 20 and 21 and table D-48).

Although there was no difference between FSP females and income-eligible females in mean score for the vegetable component of the HEI, the percentage of FSP females who met the HEI standard for vegetables was significantly lower than the percentage of income-eligible females (19% vs. 24%) (figure 21 and table D-42).

Mean HEI scores for FSP females and higher-income females were significantly different for all food-based components except grains (figure 20 and tables D-40 to D-50). The same pattern was observed for the percentage of females meeting HEI standards for food-based components (figure 21). With the exception of the meat component, mean scores were significantly lower for FSP females than for higher-income females, and FSP females were significantly less likely than higher-income females to satisfy HEI standards.

As noted in the preceding discussion of differences between FSP females and income-eligible females, the between-group difference for the meat component ran in the opposite direction. In comparison with higher-income females, FSP females scored *higher*, on average, on this component of the HEI (6.6 vs. 6.2) and were *more* likely to consume the recommended number of meat servings per day (30% vs. 26%) (figures 20 and 21).

Data on the mean number of servings consumed from each food group (tables D-40 to D-50) reveal that, in comparison with income-eligible females, FSP females consumed about a third of a serving less fruit per day and almost a quarter (0.2) of a serving *more* meat. In comparison with higher-income females, FSP females consumed almost half (0.4) a serving less vegetables, half a serving less fruit, and almost a quarter (0.2) of a serving less dairy foods per day. FSP females also consumed about a quarter (0.2) of a serving *more* meat per day than higher-income females.

Nutrient-based Component Scores

The four nutrient-based component scores of the HEI assess nutritional quality on the basis of how well individuals' diets conform to recommendations for intake of total fat, saturated fat, cholesterol, and sodium. The standards used in making these assessments are based on recommendations included in the *Dietary Guidelines for Americans* (USDA and U.S. DHHS, 2000).[2] The standards for total fat, saturated fat, and sodium are also included in the *Healthy People 2010* objectives (U.S. DHHS, 2000a). Standards for total fat and saturated fat are no more than 30 percent of total energy and less than 10

[2]As noted previously, HEI standards for cholesterol and sodium were initially based on recommendations made in the NRC's *Diet and Health* report (NRC, 1989b). These recommendations have subsequently been incorporated into the Nutrition Facts section on food labels and the most recent version of the *Dietary Guidelines*.

percent of total energy, respectively. The standard for cholesterol is no more than 300 mg. and the standard for sodium is no more than 2,400 mg.

Since the time HEI scores were computed by NCHS staff and the tabulations presented in this report were prepared, new reference standards have been established for fat (IOM, 2002b) and sodium (IOM, 2004) intake. These new standards are discussed in the text that follows. The IOM report in which the new standard for fat intake is defined also discusses intake of saturated fat and cholesterol, but does not define specific standards for these dietary components.

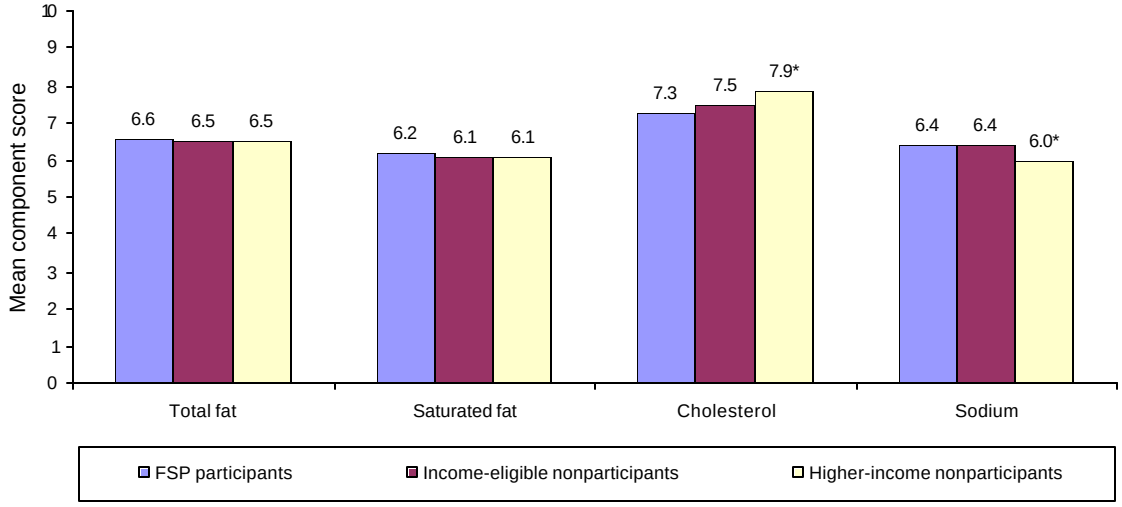
There were relatively few significant differences between FSP participants and nonparticipants in mean scores for the nutrient-based HEI components (figure 22 and tables D-52 to D-58). There were no significant differences between FSP participants and income-eligible nonparticipants on any of these measures. Significant differences were observed between FSP participants and higher-income nonparticipants for the cholesterol and sodium components. FSP participants had a significantly *lower* mean score for cholesterol (7.3 vs. 7.9) and a significantly *higher* mean score for sodium (6.4 vs. 6.0).

There was some variation in between-group differences by gender. Among males, the significant difference in mean scores for the cholesterol component was also observed for the FSP participant vs. income-eligible nonparticipant comparison (6.0 vs. 6.7) (table D-56). Among females, FSP participants had a *lower* mean score for the sodium component than either group of nonparticipants; the difference between FSP females and income-eligible females was statistically significant (7.1 vs. 7.6) (table D-58).

Percentage of Persons Meeting Standards for HEI Nutrients: Usual Intakes vs. 24-hour Intakes

As noted in the introduction to this chapter, usual intakes of fat, saturated fat, cholesterol, and sodium were estimated, as described in Chapter Two and appendix C, even though these data could not be incorporated into HEI scores. The following sections describe findings from

Figure 22—Mean scores for HEI nutrient-based components



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

the usual intake analyses, particularly with respect to estimates of the percentages of persons who satisfied the *Dietary Guidelines* recommendations considered in the HEI. These findings are contrasted with those from the HEI analysis. Estimates based on the usual intake analyses are more reliable than those available from the HEI because the former have been adjusted to remove within-person variation (see appendix C).

Percent of Energy from Total Fat

For all persons 2 years and older, mean usual intake of fat was high in comparison with the *Dietary Guidelines* recommendation that fat provide no more than 30 percent of food energy (calories). On average, fat contributed about 34 percent of usual energy intake (table D-60).[3]

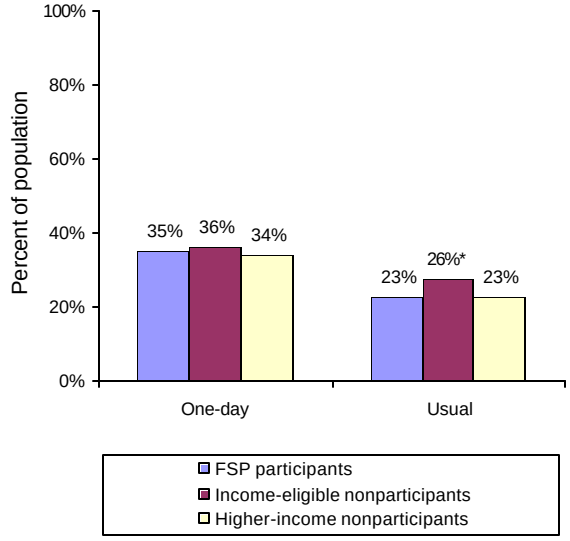
There was no significant difference between FSP participants and income-eligible nonparticipants in usual fat intake. FSP participants did, however, have a lower usual fat intake, overall, than higher-income nonparticipants (33.1% of total energy vs. 33.6%). This difference was concentrated among females.

According to the HEI data, which are based on a single 24-hour recall, 34 percent or more of individuals in each of the participant/nonparticipant groups satisfied the *Dietary Guidelines* recommendation for fat intake (figure 23 and table D-52). Moreover, the HEI data suggest that there were no statistically significant differences between FSP participants and either of the nonparticipant groups in this regard.

The more reliable estimates of usual fat intake indicate that the percentage of persons whose diets conformed to the *Dietary Guidelines* recommendation was actually lower than estimated in the HEI, ranging from 23 to 26

[3]The full distribution of usual fat intakes (as a percent of usual energy intake) is presented in table D-62.

Figure 23—Percent of persons meeting *Dietary Guidelines* recommendation for total fat: One-day (HEI) estimates vs. usual intake estimates



*Statistically significant difference from FSP participants at the .05 level or better.
Note: *Dietary Guidelines* recommendation has been replaced by AMDR (see text and appendix B).
Source: NHANES-III, 1988-94.

percent (figure 23 and table D-61). In addition, the usual intake data indicate that FSP participants were less likely than income-eligible nonparticipants to satisfy the *Dietary Guidelines* recommendation (23% vs. 26%). As noted above, this difference was primarily attributable to a difference among females (25% vs. 28%) (table D-61).

As mentioned in the introduction to this section, a new reference standard has been established for fat intake since the time HEI scores were computed by NCHS staff and the tabulations presented in this report were prepared. This standard, referred to as an Acceptable Macronutrient Distribution Range (AMDR), defines a range of acceptable intakes for different life-stage groups (IOM, 2002b). The AMDR for total fat, expressed as a percentage of total energy intake, is 30-40 percent for children 1 to 3 years, 25-35 percent for children 4 to 18 years, and 20-35 percent for all those 19 years and older. By comparison, the *Dietary Guidelines*

defines a more stringent upper bound for fat intake (no more than 30% of energy) and does not define a lower bound.

Overall, mean usual fat intakes of each of the age groups listed above fell within defined AMDRs (table D-60). This was true for all three participant/nonparticipant groups, overall, and, in general, for both males and females. The only exceptions were 4-8-year-old and 9-13-year-old males. In these age groups, males in the income-eligible nonparticipant group had mean fat intakes that exceeded the upper end of the AMDR. In the case of 4-8-year-old males, the difference between FSP participants and income-eligible nonparticipants was statistically significant and the mean for FSP participants was consistent with the AMDR (33.7% vs. 35.1%).

Distributions of usual fat intake provide some information about the percentage of persons whose usual fat intakes were consistent with the AMDR. The data suggest that usual intakes that fell outside the AMDR tended to be higher than the recommended range rather than lower. For all age groups other than 1-3-year-olds, the 5th percentile of the distribution of usual fat intake was greater than the defined lower bound, while the 75th percentile exceeded the upper bound (table D-62). This indicates that, overall, more than 25 percent of persons over the age of 3 had usual fat intakes that exceeded their AMDR. Among 1-3-year-olds, the pattern was reversed, with a greater percentage of persons having usual fat intakes that fell outside the *lower* bound of the AMDR. While few 1-3-year-olds had usual fat intakes that exceeded the AMDR (intake at the 95th percentile of the distribution was 39.8% of energy from fat), somewhere between 15 and 25 percent of 1-3-year-olds had usual fat intakes that were lower than the 30 percent lower bound of the AMDR (intakes at the 15th and 25th percentiles were, respectively, 28.5% and 30.1%).

There were a substantial number of statistically significant differences between FSP participants and the two groups of nonparticipants in the distribution of usual fat intakes. The pattern of observed differences suggests that, in several subgroups (4-8-years, 14-18-years, 31-50-years, and 71 years and older), FSP participants were more likely than one or both groups of nonparticipants to have usual fat intakes that did not exceed the upper bound of the relevant AMDR. For all of these age groups, usual fat intakes at the 95th percentile were significantly lower for FSP participants than for one or both groups of nonparticipants and FSP participant intakes fell within the AMDR while nonparticipant intakes exceeded the upper bound.

A different pattern was observed for 1-3-year-olds. Although, as noted above, the data suggest that few children in this age group had usual fat intakes that exceeded the upper end of the AMDR, the evidence suggests that this was more likely to occur for FSP participants that for either group of nonparticipants (usual intakes at the 95th percentile were 41.7% vs. 39.4% and 39.0%, compared with an AMDR of 30-40%). At the opposite end of the distribution, the evidence suggests that 1-3-year-old FSP participants were *less* likely than income-eligible nonparticipants and *more* likely than higher-income nonparticipants to have usual fat intakes that fell within the lower bound of the AMDR (usual intakes at the 15th percentile were 29.2% vs. 31.2% and 27.6%).

Percent of Energy from Saturated Fat

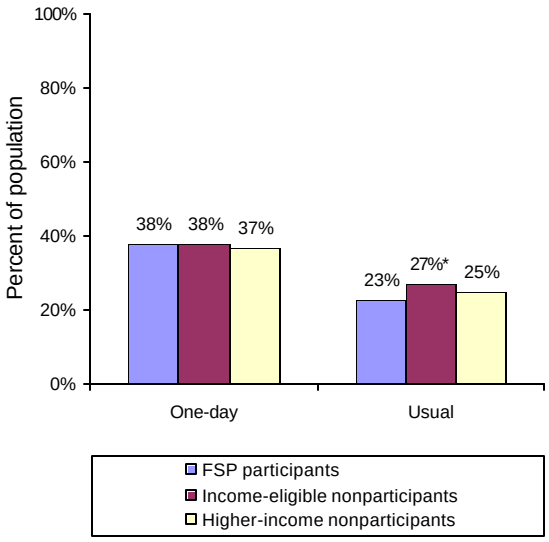
On average, usual intake of saturated fat exceeded the *Dietary Guidelines* recommendation of less than 10 percent of energy. In all three participant/nonparticipant groups, saturated fat contributed roughly 11 percent of usual energy intake (table D-63).[4] There were no significant

[4]The full distribution of usual saturated fat intakes (as a percent of usual energy intake) is presented in table D-65.

between-group differences, overall or by gender, in the mean usual intake of saturated fat.

According to the HEI data, roughly 38 percent of FSP participants and each group of nonparticipants satisfied the *Dietary Guidelines* recommendation for saturated fat (figure 24 and table D-54). The more reliable estimates of usual intake indicate that, for all groups, the percentage of persons who satisfied the *Dietary Guidelines* recommendation for saturated fat was substantially lower, ranging from 23 to 27 percent (figure 24 and table D-64). Moreover, estimates of usual saturated fat intake reveal that FSP participants were significantly less likely than income-eligible nonparticipants to meet the *Dietary Guidelines* recommendation for saturated fat (23% vs. 27%). This difference was largely attributable to a difference among females (table D-64). In fact, among females, FSP participants were less likely than either group of nonparticipants to meet the recommendation for saturated fat intake (24% vs. 29% and 28%).

Figure 24—Percent of persons meeting *Dietary Guidelines* recommendation for saturated fat: One-day (HEI) estimates vs. usual intake estimates



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

Cholesterol

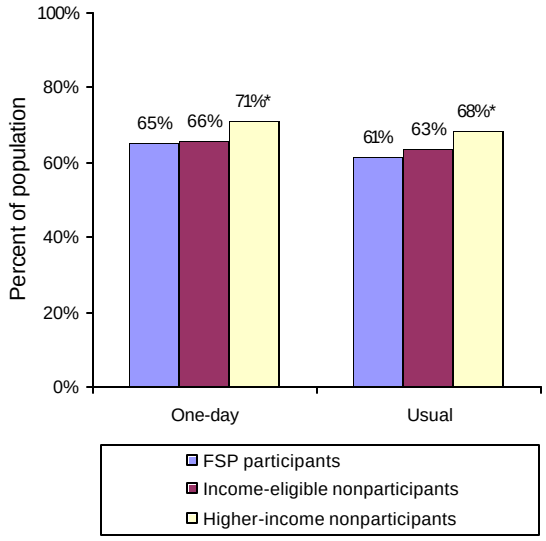
The *Dietary Guidelines* recommend a maximum of 300 mg. of cholesterol per day. On average, usual cholesterol intake (271 mg.) was consistent with this recommendation (table D-66).[5] This was true for all three participant/nonparticipant groups, overall, as well as for females analyzed separately. However, mean usual cholesterol intakes were consistently greater for males than for females (327 mg. vs. 221 mg., overall), and mean usual intakes of males in all three groups exceeded the 300 mg. maximum.

The mean usual cholesterol intake of FSP participants did not differ significantly from the mean usual cholesterol intake of income-eligible nonparticipants. However, the mean usual intake of FSP participants was significantly greater than the mean usual intake of higher-income nonparticipants (291 mg. vs. 267 mg.). Usual mean intakes of both groups were consistent with the *Dietary Guidelines* recommendation. This general pattern of between-group differences was observed for both males and females.

The HEI data and the usual intake data lead to comparable conclusions about the percentage of persons whose usual diets were consistent with the *Dietary Guidelines* recommendation for cholesterol. Both data sets indicate that more than 60 percent of persons in the FSP participant group and in each of the nonparticipant groups met the recommendation (figure 25 and tables D-56 and D-67). In addition, both analyses led to comparable conclusions about the statistical significance of differences between FSP participants and the two groups of nonparticipants in the percentage of persons who consumed no more than 300 mg. of cholesterol. There was no significant difference between FSP participants and income-eligible nonparticipants in this regard. However, FSP participants were signifi-

[5]The full distribution of usual cholesterol intakes is presented in table D-68.

Figure 25—Percent of persons meeting *Dietary Guidelines* recommendation for cholesterol: One-day (HEI) estimates vs. usual intake estimates



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

cantly less likely than higher-income nonparticipants to have usual cholesterol intakes that were consistent with the *Dietary Guidelines* recommendation.

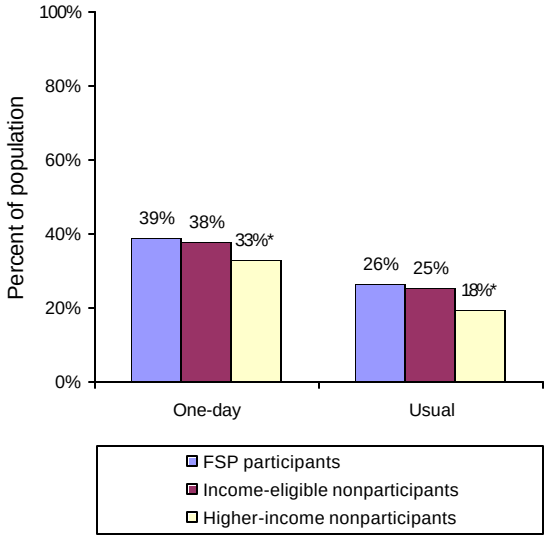
Sodium

The *Dietary Guidelines* recommend that daily intake of sodium not exceed 2,400 mg. On average, usual sodium intake (3,463 mg.) exceeded this recommendation (table D-69).[6] Males had consistently greater usual sodium intakes than females (4,076 mg. vs. 2,897 mg.). However, mean usual intakes of both males and females in all three participant/nonparticipant groups exceeded the *Dietary Guidelines* recommendation.

Overall, there was no significant difference between the mean usual sodium intakes of FSP participants and income-eligible nonparticipants. In comparison with higher-income nonparticipants, however, the mean usual sodium intake of FSP participants was significantly lower. The general patterns observed in the aggregate analysis were also observed for males; however, the difference between FSP participants and higher-income nonparticipants was not statistically significant. Among females, mean usual intakes of both groups of nonparticipants were lower than the mean usual intake of FSP participants, but only the difference between FSP participants and income-eligible nonparticipants was statistically significant.

According to the HEI data, between 33 and 39 percent of FSP participants and nonparticipants satisfied the recommendation for sodium intake (figure 26 and table D-58). These data also indicate that FSP participants were significantly more likely than higher-income nonparticipants to satisfy the sodium recommendation (39% vs. 33%). This difference was observed for males but not for females (table D-58).

Figure 26—Percent of persons meeting *Dietary Guidelines* recommendation for sodium: One-day (HEI) estimates vs. usual intake estimates



*Statistically significant difference from FSP participants at the .05 level or better.
Note: *Dietary Guidelines* recommendation has been replaced by UL (see text and appendix B).
Source: NHANES-III, 1988-94.

[6]The full distribution of usual sodium intakes is presented in table D-71.

The more reliable data on usual sodium intakes indicate that the percentage of persons who satisfied the *Dietary Guidelines* recommendation for sodium intake was actually lower than estimated in the HEI, ranging from 18 percent to 26 percent (figure 26 and table D-70). FSP participants were significantly more likely than higher-income nonparticipants to meet the recommendation (26% vs. 18%). This between-group difference was observed for both males and females (table D-70).

As noted previously, new reference standards have been established for sodium intake since the time HEI scores were computed by NCHS staff and the tabulations presented in this report were prepared. Standards have been defined for both Adequate Intake (AI) and Tolerable Upper Intake Levels (UL) (IOM, 2004). Given that the major concern about sodium is the potential for excess consumption, the standard of greatest interest for this analysis is the UL.[7] The UL is the highest intake likely to pose no adverse health effects; chronic consumption above the UL may increase risk of adverse effects. In the case of sodium, the primary potential adverse effect is the development of high blood pressure (IOM, 2004). ULs for sodium are lower than the *Dietary Guidelines* recommendation, especially for the youngest age groups. The ULs are 1,500 mg. for 2-3-year-olds, 1,900 mg. for 4-8-yearolds, 2,200 mg. for 9-13-year-olds, and 2,300 mg. for all those 14 years and older.

Mean usual sodium intakes of all age groups exceeded defined ULs (table D-69). This was true for FSP participants and both groups of nonparticipants in the aggregate analysis as well as in the gender-specific analyses. Only two subgroups had mean usual intakes that did not exceed their defined UL. These were female income eligible nonparticipants 51-70 years and 71 years and older (mean usual sodium intakes of 2,292 mg. and 2,247 mg., respectively, compared with a UL of 2,300 mg.). Female FSP participants 71 and older had a mean usual sodium intake that came close to the UL (2,313 mg.).

Distributions of usual sodium intake provide some information about the percentage of persons whose usual sodium intakes were consistent with the UL. The data indicate that, for persons 2 to 30 years of age, fewer than 10 percent had usual sodium intakes that did not exceed the UL. In these age groups, usual intakes at the 10th percentile were greater than the UL (table D-71). The percentage of persons with usual sodium intakes that were consistent with the UL increased with age. For 31-50-year-olds, usual intake exceeded the UL at the 15th percentile. For 51-70-year-olds and 71 years and older, the threshold was crossed at the 25th and 50th percentiles, respectively.

There were few significant differences between FSP participants and income-eligible nonparticipants in the distribution of usual sodium intake. In contrast, there were many more significant differences in the distributions of usual sodium intakes of FSP participants and higher-income nonparticipants. These differences indicate that, among 2-3-year-olds, 4-8-year-olds, and 14-18-year-olds, FSP participants were significantly less likely than higher-income nonparticipants to have usual sodium intakes consistent with the UL. In all of these age groups, usual intakes at the 10th and/or 5th percentiles were significantly higher for FSP participants than for higher-income nonparticipants. In addition, FSP participant intakes exceeded the UL, while higher-income participant intakes did not.

The trend was reversed for older age groups. For all subgroups of adults 19 and older, FSP

[7]AIs for sodium range from a minimum of 1,000 mg. (1.0 gm.) for 1-3-year-olds to a maximum of 1,500 mg. (1.5 gm.) for persons 9 to 50 years of age. Given the mean usual intakes of sodium described in the text and shown in table D-69, sodium intakes of all age groups of FSP participants and nonparticipants can be assumed to be "adequate."

participants were significantly more likely than higher-income nonparticipants to have usual sodium intakes that were consistent with the UL. In these subgroups, usual intakes at the 5th percentile were significantly lower for FSP participants than for higher-income nonparticipants and FSP participant intakes were consistent with the UL. As age increased, the extent of the between-group difference increased. Among adults 71 years and older, significant differences that affect conclusions about the UL were noted at the 25th percentile of the distributions.

It is important to note that NHANES-III estimates of sodium intake include only sodium found in foods and beverages reported by respondents. Sodium from table salt is not included in nutrient calculations because its use cannot be measured (estimated) reliably. To get some insight into additional sources of sodium, the NHANES-III dietary intake interview included a question about use of table salt.

Fifty-one percent of persons reported using table salt (table D-72). Use of table salt was more common among males than females (54% vs. 49%) and use decreased with age after 14-18 years (males) or 19-30 years (females). Overall, there were no significant differences between FSP participants and either group of nonparticipants in the use of table salt. Among males, however, FSP participants were more likely than higher-income nonparticipants to repot use of table salt (61% vs. 53%). This suggests that the actual size of the difference between FSP participant males and higher-income nonparticipant males, in terms of both mean usual sodium intake and the percentage of persons consuming less than 2,400 mg. of sodium per day, may be smaller than observed in this analysis.

Usual Intake of Dietary Fiber

On average, usual daily intake of dietary fiber was 15.9 gm. (table D-73).[8] Mean usual intake of dietary fiber was greater for males than females (18.2 gm. vs. 13.8 gm.) (statistical significance of gender-based difference not tested).

FSP participants usually consumed significantly less dietary fiber, on average, than either income-eligible nonparticipants or higher-income nonparticipants (14.4 gm. vs. 15.4 gm. and 16.1 gm.). These differences were largely attributable to differences among females (12.6 gm. vs. 13.5 gm. and 13.9 gm.)

At the time the analyses presented in this report were completed, there was no established standard for intake of dietary fiber. To assess the adequacy of fiber intakes, the analysis used a standard referred to as the "age-plus-five rule." This standard, originally developed by Williams et al. (1995), was adapted by the American Heart Association (AHA) (Van Horn, 1997) and has been used in previous research (Gleason and Suitor, 2001). Recommended intake of dietary fiber (in gm.) is equivalent to age in years plus five, up to a maximum of 25 gm. Overall, less than a quarter (22%) of all persons had usual intakes of dietary fiber that were consistent with this standard (table D-74).

The difference between males and females on this measure was striking. Thirty-one percent of males had usual intakes of dietary fiber that were consistent with the standard, compared with 14 percent of females (statistical significance of gender-based difference not tested).

Overall, FSP participants were no more or less likely than either group of nonparticipants to

[8]The full distribution of usual fiber intakes is presented in table D-75.

meet the "age-plus-five" standard for dietary fiber (21% vs. 23% and 22%). Among females, however, FSP participants were more likely to meet this standard than higher-income nonparticipants (15% vs. 13%).

Since this analysis was completed, AIs have been defined for fiber (IOM, 2002b). The AIs have been defined for *total* fiber, which includes dietary fiber as well fructo-oligosaccharides, compounds which are destroyed in the current analytic methods used to quantitate fiber in foods (IOM, 2002b). Although fructo-oligosaccharides are assumed to make up a relatively small percentage of total fiber, it is estimated that, on average, American adults consumed approximately 5.1 gm. more fiber per day than estimated in the most recent Continuing Survey of Food Intakes by Individuals (CSFII) because CSFII data, like the data used in this analysis, include only dietary fiber (IOM, 2002b).

The AIs for total fiber are shown in appendix B. In comparison with the standard used in this analysis, the AIs are higher for all males, regardless of age, and for all females younger than 20. For females 20 to 50 years, the AI is equivalent to the standard used in this analysis (25 gm.). For females 51 to 70 years, the AI is slightly lower (21 gm.).

As noted in Chapter Two, AIs cannot be used to assess the prevalence of adequate intakes, so assessment of usual intakes must focus on comparison of mean intakes to gender-and-age appropriate AIs. Mean usual intakes of all age-specific subgroups (overall and by gender) fall short of the new AIs (table D-73). Some of this disparity is due to the difference in fiber data (dietary fiber vs. total fiber). However, even if one were to assume that mean usual intakes of dietary fiber were actually 5 gm. higher (the average increment estimated for American adults, overall, to account for fructo-oligosaccharides, as described above), mean usual intakes of all age-specific subgroups would still fall short of the AI.

The differences observed between FSP participants and nonparticipants in mean usual intakes of dietary fiber are real, regardless of which reference standard is used. However, the advent of the AIs for fiber means that results of the analysis that compared usual intakes of dietary fiber to the "age-plus-five" reference standard must be interpreted with caution. These estimates cannot be interpreted as valid estimates of the percentage of persons consuming adequate amounts of dietary fiber.