Chapter Two

Usual Intake of Food Energy and Nutrients Among Children Ages 1 to 4

This chapter describes usual intakes of food energy and four key nutrients and, to the extent possible, the prevalence of adequate intakes among WIC participants and nonparticipants. Nutrients included in the analysis are vitamin C, iron, zinc, and calcium. Usual intakes of fat, saturated fat, cholesterol, sodium, and fiber were also examined. These data are presented in Chapter Three.

The analysis is limited to children who were age-eligible for WIC (1 through 4 years of age). Women were excluded because of small sample sizes and infants were excluded because of differences in the nutrient standards defined for children and infants.[1]

To provide some context for these discussions, the chapter begins with information on several factors that may influence the relative adequacy of children's dietary intakes. These include participation in the Food Stamp Program (FSP), household food sufficiency status, and meal and snacking patterns.

Participation in the Food Stamp Program

NHANES-III provides information on household participation in the FSP. The survey question used to define FSP participation for this analysis measured current participation: "(Are you/Is any member of this family) receiving food stamps at the present time?"

In reviewing data on FSP participation, it is important to bear two facts in mind. First, household survey data tend to yield lower estimates of program participation than estimates derived from program administrative data. For example, data from the Survey of Income and Program Participation (SIPP), which is generally recognized as the optimal source of survey data on program participation, underestimates participation in most programs by 10 to 15 percentage points (Trippe, 2000). Second, data reflect participation rates at the time the NHANES-III data were collected (1988-94) and therefore are not expected to be representative of *current* program participation rates.

The FSP uses a more stringent cutoff for income eligibility than the WIC program: 130 percent of the Federal poverty guideline rather than 185 percent. Therefore, to obtain the most useful information on FSP participation among WIC children and nonparticipant children, the analysis was limited to children who were income-eligible for the FSP.

Overall, 63 percent of 1-4-year-old children who were income-eligible for the FSP resided in households that participated in the FSP (table D-1). Given the expected underreporting in survey data, this estimate is consistent with historical data on child participation in the FSP during the

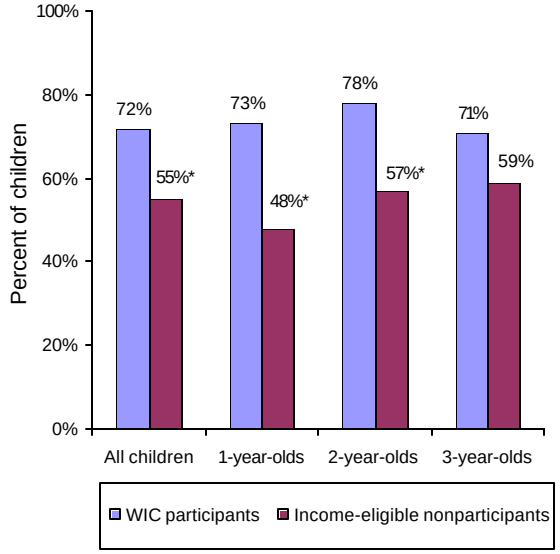
[1]The NHANES-III sample of women categorically eligible for WIC includes 294 pregnant women, 86 breastfeeding women, and 287 nonbreastfeeding postpartum women. These subgroups had to be examined separately because of differing nutritional requirements and had to be further divided into WIC participants and two groups of nonparticipants. Seven of nine cells in the stratified sample had fewer than 100 women. The reference standard used in estimating the prevalence of inadequate intakes of vitamin C, iron, and zinc—the Estimated Average Requirement (EAR)—has either not been defined for infants (vitamin C), or has been defined only for infants 7-11 months of age (iron and zinc).

relevant time period (1988-94) (Cody and Trippe, 1997).[2]

Among 1-4-year-old children who were income-eligible for the FSP, WIC participants were significantly more likely to participate in the FSP than nonparticipants. Overall, 72 percent of FSP-eligible WIC children resided in households that participated in the FSP, compared with 55 percent of FSP-eligible nonparticipant children (figure 1 and table D-1). This difference was concentrated among the youngest children (1-year-olds and 2-year-olds). A potential explanation for the increased rate of FSP participation among WIC children is the referral component of the WIC program, which is designed to ensure that participating families receive needed health and social services.

[2]Studies of FSP participation over time indicate that participation rates for income-eligible preschoolers were lower in the earliest years of NHANES-III (1988-91) than in later years (1992-94) (Cody and Trippe, 1997 and Stavrianos, 1997). The biennial WIC Participant and Program Characteristics Studies (for example, Bartlett et al., 2003) do not report FSP participation by WIC participant category, and the FSP participation rates that are reported apply to all WIC participants rather than to those who are income-eligible for the FSP.

Figure 1 - Percent of income-elgible 1-4-year-old children participating in the Food Stamp Program



*Statistically significant difference from WIC participants at the .05 level or better.

Note: "All children" includes 1-4-year- old children; 4-year-olds are not shown separately because the point estimate for 4-year-old WIC participants is statistically unreliable.

Source: NHANES-III, 1988-94.

Household Food Sufficiency

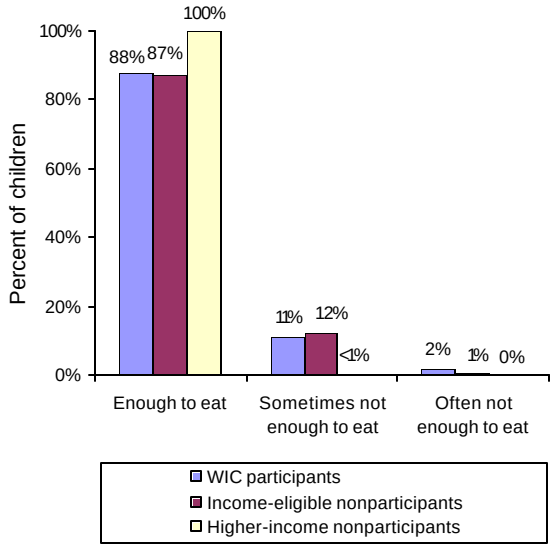
NHANES-III data were collected before dissemination of the 18-item Federal food security module, the currently accepted standard for measuring household and individual food security (Price et al., 1997 and Bickel et al., 2000). NHANES-III included a question that asked whether the household had enough to eat, sometimes did not have enough to eat, or often did not have enough to eat. Respondents who indicated that their household sometimes or often did not have enough to eat were asked how many days this occurred during the past month and why it occurred.[3] This measure has been used in NHANES-III as well as in other studies to identify households with food insufficiency (defined as households that report that there is "sometimes" or "often" not enough food to eat) (Alaimo et al., 1998).

The data indicate that the majority (87% or more) of 1-4-year-old children in all three groups resided in households that were food sufficient (households that always had enough to eat) (figure 2 and table D-2). Eleven percent of WIC children and 12 percent of income-eligible nonparticipant children lived in households that sometimes did not have enough food to eat. This problem was reported for less than 1 percent (0.5%) of higher-income nonparticipant children, but the difference between WIC participants and higher-income nonparticipants was not statistically significant.

Approximately two percent of WIC children lived in households that often did not have

[3]Versions of the questionnaires used in the last two rounds of data collection included additional followup questions about whether children or adults in the household had decreased the size of their meals because there was not enough food. These questions were not tabulated for this report because of the restricted nature of the sample.

Figure 2 - Distribution of 1-4-year-old children by household food sufficiency status



No statistically significant differences between WIC participants and either group of nonparticipants.
Source: NHANES-III, 1988-94.

enough food to eat. The same was true for one percent of income-eligible nonparticipant children and zero higher-income nonparticipant children. Neither of the differences between WIC participants and nonparticipants was statistically significant.

Because so few children in the various subgroups examined in this report resided in households that sometimes or often did not have enough to eat, the followup questions on how often and why households experienced these problems were not analyzed. Sample sizes were too small to produce reliable subgroup estimates.

Meals and Snacks Consumed

This analysis examined the number of meals and snacks consumed by 1-to-4-year-old children in the preceding 24 hours. Data from the 24-hour dietary recall were used to compute, for each child, the total number of meals and snacks consumed. (As dietary intakes were reported, respondents were asked to identify eating occasions as meals (breakfast, brunch, lunch, or dinner/supper) or snacks.) Responses to a separate survey question about daily breakfast consumption were also tabulated.

Number of Meals Consumed

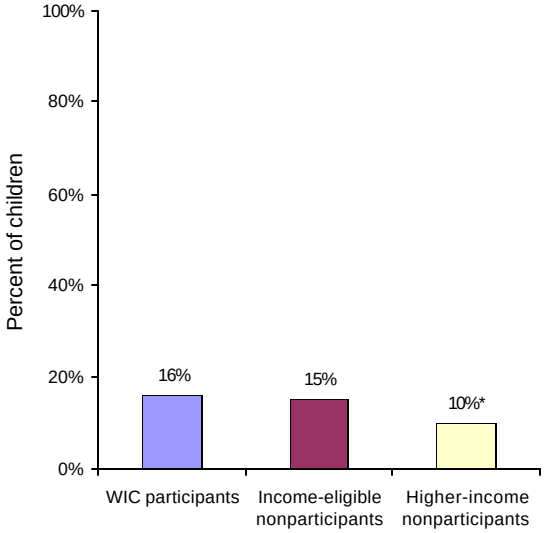
Overall, 13 percent of 1-4-year-old children consumed fewer than three meals per day (table D-3).[4] The percentage of WIC children who consumed fewer than three meals per day was comparable to that of income-eligible nonparticipants (15-16%) (figure 3). In comparison with higher-income nonparticipants, however, WIC children were more likely to consume fewer than three meals per day (16% vs. 10%). This difference was largely attributable to a difference among 2-year-olds (table D-3). In this age group, the proportion consuming fewer than three meals per day was twice as high for WIC participants than for higher-income nonparticipants (12% vs. 6%).

Consumption of Breakfast

NHANES-III included a separate question about usual breakfast consumption habits: "How often

[4]Data on the mean number of meals consumed is presented in table D-4.

Figure 3 - Percent of 1-4-year-old children consuming fewer than three meals per day



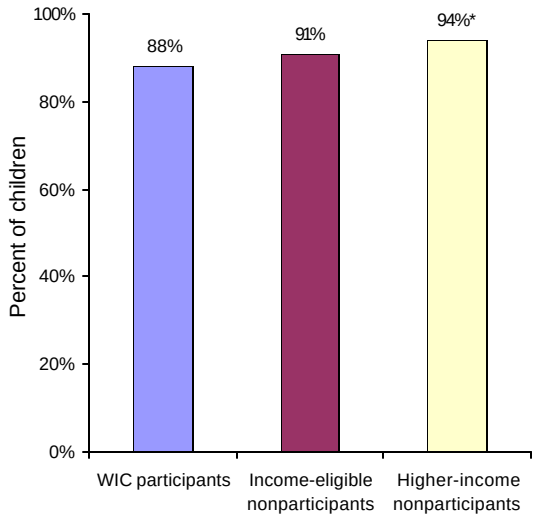
*Statistically significant difference from WIC participants at the .05 level or better.
Source: NHANES-III, 1988-94.

does [child] eat breakfast?" Response options were every day, on some days, rarely, never, and on weekends only. Overall, the percentage of 1-4-year-old children who consumed breakfast every day was high—92 percent (table D-5). Among WIC children, 88 percent consumed breakfast every day. This compares with 91 percent of income-eligible nonparticipants and 94 percent of higher-income nonparticipants (figure 4). The difference between WIC participants and higher-income nonparticipants was statistically significant and may account for at least part of the difference in the percentage of WIC children and higher-income-nonparticipant children who consumed fewer than three meals per day.

Number of Snacks Consumed

Ninety-five percent of all 1-4-year-old children consumed at least one snack per day (table D-6). On average, children in all three groups consumed about three snacks per day (table D-7). WIC children consumed significantly more snacks per day, on average, than income-eligible nonparticipating children, but the difference was small (2.8 vs. 2.6).

Figure 4 - Percent of 1-4-year-old children consuming breakfast every day



*Statistically significant difference from WIC participants at the .05 level or better.

Source: NHANES-III, 1988-94.

Usual Intake of Food Energy and Key Nutrients

This section describes usual intakes of food energy, vitamin C, iron, zinc, and calcium among 1-4-year-old WIC participants and nonparticipants. Tabulations are based on the single 24-hour recall collected in NHANES-III. The data have been adjusted, however, to account for within-person variation using variance estimates from the Continuing Survey of Food Intake of Individuals (CSFII). (The procedures used in making these adjustments are described in appendix C.) As such, the data presented are indicative of children's *usual* dietary intakes, exclusive of vitamin and mineral supplements, and can be used to assess the prevalence of adequate intakes.[5]

Standards Used To Assess Adequacy of Usual Intake

Children's usual nutrient intakes were assessed relative to Estimated Average Requirements (EARs) and Adequate Intakes (AIs). EARs and AIs are part of a newly established set of dietary standards—the Dietary Reference Intakes (DRIs) (Institute of Medicine (IOM), 1999, 2000a, 2000b, 2002a, 2002b, 2004). The DRIs replace the *Recommended Dietary Allowances* (RDAs) used in most previous research (National Research Council (NRC), 1989a).[6] When adequate scientific evidence is available, an EAR is established. The EAR is

[5]Data on usual nutrient intakes do not include contributions from vitamin and mineral supplements. At the time this report was being prepared, other investigators were working on methods for incorporating supplement data into estimates of usual nutrient intake. In the NHANES-III data, the issue is not straightforward because of a lack of congruence in recall period—the preceding 24 hours for food and beverage intake vs. the preceding month for supplements.

[6]In addition to EARs and AIs, the DRIs define two other reference standards: Recommended Dietary Allowances (RDAs) and Tolerable Upper Intake Levels (ULs) (see appendix B).

the level of intake that is estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group. When the available data are insufficient to estimate requirements, an AI is established rather than an EAR. The AI is the level of intake that is assumed to be adequate, based on observed or experimentally determined estimates of intake.

EARs have been defined for three of the four nutrients examined in this chapter (vitamin C, iron, and zinc). For the fourth nutrient (calcium), AIs have been defined. For nutrients that have EARs and a symmetrical requirement distribution, the IOM recommends that usual nutrient intakes be assessed using the "EAR-cutpoint method" (IOM, 2001). This approach compares the distribution of usual intakes in a population with a population-specific EAR. The proportion of the population with usual intakes below the EAR is an estimate of the proportion of the population with inadequate intakes—intakes that do not meet nutrient requirements.

For nutrients with AIs, methods for assessing usual intakes are more limited. AIs cannot be used to determine the proportion of a population with inadequate intakes. Instead, assessment focuses on comparison of mean usual intakes to the AI. Populations with a mean usual intake equivalent to or greater than the population-specific AI can be assumed to have adequate intakes.

At the time the analyses presented in this report were completed, DRIs had not been established for food energy.[7] Therefore, assessment of usual energy intakes also focuses on comparison of mean intakes, expressed as a percentage of the 1989 Recommended Energy Allowance (REA) (NRC, 1989a).

Because the EARs and the calcium AI are relatively new reference standards, appendix B includes a table that shows the 1989 RDAs for vitamin C, iron, zinc, and calcium—the reference standards used in most previous research. The interested reader can compare data on mean usual intakes with the most appropriate RDA to obtain a reasonable approximation of how these data compare with previously published data. In addition, appendix D includes tables that show means and the full distribution of usual intakes (the 5th, 10th, 15th, 25th, 50th, 75th, 85th, 90th, and 95th percentiles) for food energy and each of the four nutrients.

Food Energy

On average, the diets consumed by 1-4-year-old children provided roughly 100 percent of the 1989 REA (table D-9).[8] WIC children consumed a significantly greater percentage of the 1989 REA than either income-eligible nonparticipant children or higher-income nonparticipant children (107% vs. 101% and 99%) (figure 5). Differences were concentrated among 2-year-olds (WIC children vs. income-eligible children) and 3-year-olds (WIC children vs. higher-income children).

Vitamin C, Iron, and Zinc

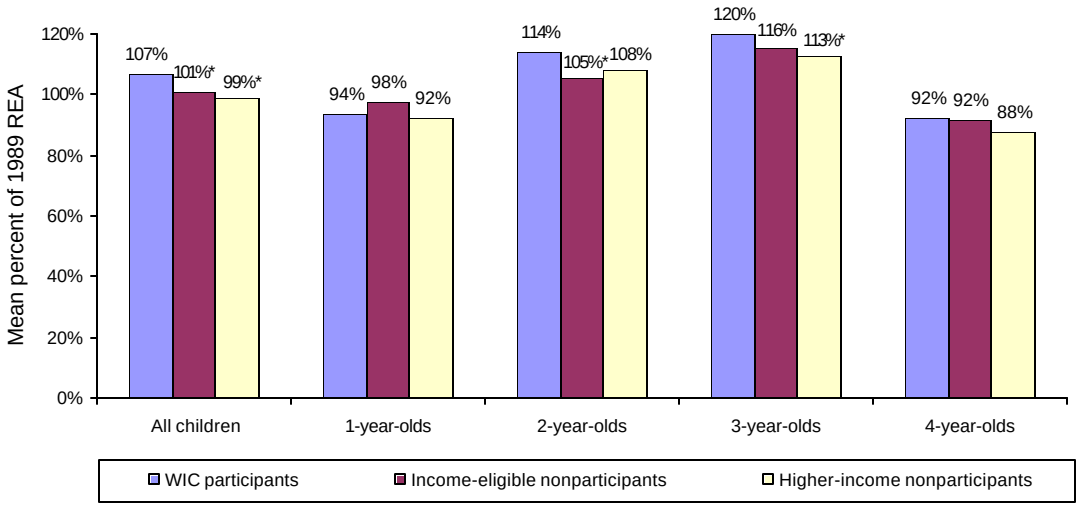
Virtually all 1-4-year-old children consumed adequate amounts of vitamin C, iron, and zinc (tables D-12, D-15, and D-18).[9] For vitamin C and iron, there were statistically significant differences between WIC participants and one or both groups of nonparticipants in the percentage of children with adequate usual intakes; however, the differences were substantively

[7]DRIs for food energy have subsequently been released (IOM, 2002b).

[8]Data on mean usual energy intakes (in kilocalories) are presented in table D-8 and the full distribution of usual energy intakes is presented in table D-10.

[9]Data on mean usual intakes (in mg.) and the full distribution of usual intakes are presented in tables D-11 and D-13 (vitamin C), D-14 and D-16 (iron), and D-17 and D-19 (zinc).

Figure 5 - Mean intake of food energy as a percent of the 1989 Recommended Energy Allowance: 1-4-year-old children



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

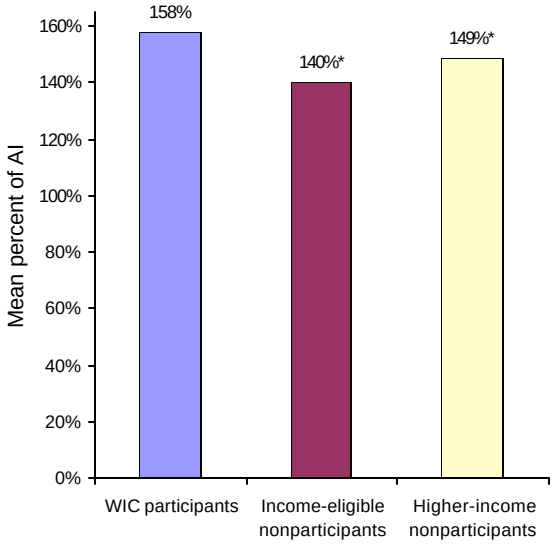
negligible (100% vs. 99.8% and 99.9% (vitamin C) and 99.7% vs. 99.9% (iron)).

Calcium

As noted in the introduction to this section, it is not possible to determine the percentage of children with adequate intakes of calcium because EARs for calcium have not been established. Therefore, in comparing calcium intakes across groups of children, the analysis examined mean intakes, expressed as a percentage of the AI. Populations with mean intakes that meet or exceed the population-specific AI can be assumed to have adequate intakes.

The mean usual calcium intake of 1-4-year-old children exceeded the AI (table D-21).[10] This suggests that, overall, 1-4-year-old children had adequate calcium intakes. On average, the usual calcium intake of WIC children was significantly greater than the usual calcium intakes of both groups of nonparticipant children (figure 6). In all cases, however, mean intakes exceeded the

Figure 6 - Mean intake of calcium as a percent of Adequate Intake: 1-4-year-old children



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

AI by a substantial margin. The difference between WIC participants and income-eligible nonparticipants was concentrated among 2-year-olds (167% of the AI vs. 147%) (table D-21).

[10]Data on mean usual calcium intakes (in mg.) are presented in table D-20 and the full distribution of usual calcium intakes is presented in table D-22.

Consumption of Milk and Soft Drinks

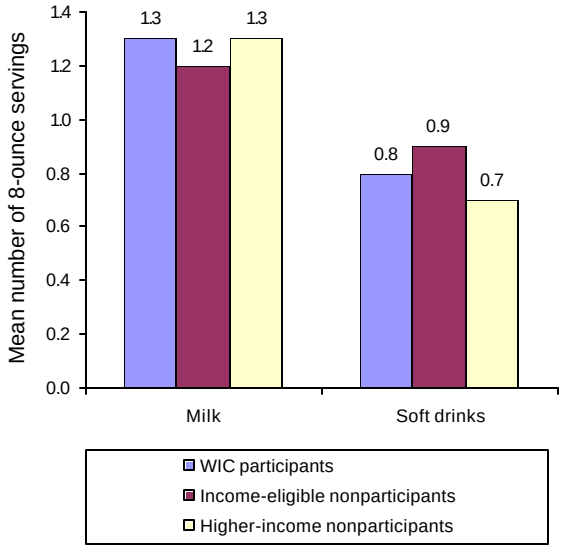
Data on trends in the national food supply indicate that Americans are consuming substantially less milk and substantially more soft drinks than they were 25 years ago (Putnam and Gerrior, 1999). On average, Americans consume more soft drinks per day than milk. Concerns have been raised about the potential impact of this trend on calcium intake, particularly among children (Yen and Lin, 2002).

To determine whether the relative consumption of soft drinks and milk differed for WIC children and nonparticipant children, 24-hour recall data were used to compute the total grams of fluid milk consumed and the total grams of soft drinks consumed in the preceding 24-hour period. Both carbonated and noncarbonated soft drinks were included in the tabulations. Coffee and tea were not included. For ease in interpretation, gram weights were translated into 8-ounce equivalent servings.

The data, presented in tables D-23 to D-26, reveal that differences in the consumption of milk and soft drinks reported by others (Yen and Lin, 2002) and observed in this series of reports among older children and most other age groups (Fox and Cole, 2004a and Fox and Cole 2004b) do not hold for 1-4-year-olds. On average, 1-4-year-old children consumed more milk per day than soft drinks—1.2 servings of milk per day vs. 0.8 servings of soft drinks.

This pattern was observed for WIC participants and both groups of nonparticipants (figure 7). Overall, there were no significant between-group differences in mean consumption of milk or soft drinks. Among 2-year-olds, however, WIC participants consumed more milk, on average, than income-eligible nonparticipants (1.2 servings vs.1.0 serving) (table D-24). This is consistent with the previously described difference between these two groups of 2-year-olds in mean calcium intake.

Figure 7 - Mean daily servings of milk and soft drinks: 1-4-year-old children



No statistically significant differences between WIC participants and either group of nonparticipants.
Source: NHANES-III, 1988-94.

Use of Dietary Supplements

As noted earlier in this chapter, NHANES-III dietary intake data do not include nutrients provided by dietary supplements. To provide some insight into the potential contribution of dietary supplements, data on reported supplement use were analyzed. The available data do not permit a detailed analysis of this issue by specific nutrient, but provide information on the prevalence of supplement use among 1-4-year-old children and general information on the number and type of supplements taken.

Parents and caregivers were asked whether children received vitamin or mineral supplements during the preceding month. If supplements were used, respondents were asked to show the actual bottles or jars to interviewers so the type of supplement and associated dosage information could be recorded. Respondents were not asked specifically about use of other types of dietary supplements, such as herbs, botanicals, and fish oils; however, many respondents volunteered information about these types of supplements (CDC, 2001).

Overall, 46 percent of children between the ages of 1 and 4 took some type of dietary supplement during the preceding month (table D-27). WIC children were significantly less likely than higher-income children to have taken a dietary supplement (figure 8). Thirty-nine percent of WIC children took a dietary supplement, compared with 55 percent of higher-income children. This pattern was noted for each age-specific cohort (table D-27).

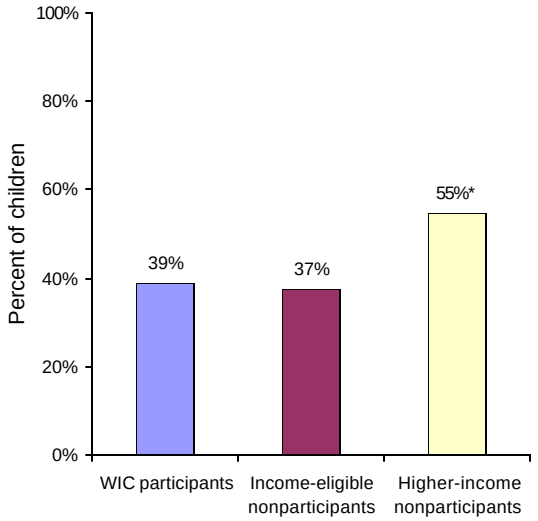
There was no significant difference between WIC participants and income-eligible nonparticipants in the prevalence of supplement use, overall. However, among 2-year-olds, WIC participants were significantly more likely to have taken a supplement than income-eligible nonparticipants (48% vs. 32%) (table D-27).

Among 1-4-year-old children who had used dietary supplements in the past month, the vast majority (91%) used only one supplement (table D-28). There were no significant differences between WIC participants and either group of nonparticipants in the number of dietary supplements used during the past month.

The most common type of supplement used was a multi-vitamin. Fifty-three percent of all 1-4-year-old children who used a supplement during the past month took a multi-vitamin supplement (table D- 29). The next most common type of supplement was a multi-vitamin and mineral combination (40% of all children).

This pattern was observed for all three groups of children. There were a handful of significant differences between WIC children and higher-income children in the prevalence of specific types of dietary supplements; however, the pattern of these differences was consistent with the general pattern described above.

Figure 8 - Percent of 1-4-year-old children taking dietary supplements in past month



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