Indicators of Diet Quality, Nutrition, and Health for Americans by Program Participation Status, 2011–2016: WIC Report

Final Report

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Indicators of Diet Quality, Nutrition, and Health for Americans by Program Participation Status, 2011–2016: WIC Report

Final Report

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Abbreviations and Acronyms

AI	adequate intake level
AMDR	acceptable macronutrient distribution range
CDC	Centers for Disease Control and Prevention
CDRR	chronic disease risk reduction
DGA	Dietary Guidelines for Americans
DGAC	Dietary Guidelines Advisory Committee
DRI	Dietary Reference Intake
EAR	estimated average requirement
EBT	electronic benefit transfer
FNDDS	Food and Nutrient Database for Dietary Studies
FNS	Food and Nutrition Service
FPED	Food Patterns Equivalents Database
FY	fiscal year
HEI	Healthy Eating Index
HHS	U.S. Department of Health and Human Services
IOM	Institute of Medicine
MEC	Mobile Examination Center
MUFA	monounsaturated fatty acid
NCHS	National Center for Health Statistics
NFS	not further specified
NHANES	National Health and Nutrition Examination Survey
NIH	National Institutes of Health
ODS	Office of Dietary Supplements
PUFA	polyunsaturated fatty acid
SFA	saturated fatty acid
SNAP	Supplemental Nutrition Assistance Program
USDA	U.S. Department of Agriculture
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

Executive Summary

The Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA) administers 15 nutrition assistance programs with the overarching goal of increasing food security and reducing hunger through access to affordable, healthy food and nutrition education. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the focus of this report, is the third largest, in terms of program participation, domestic nutrition assistance program administered by FNS (USDA Economic Research Service, 2020). WIC provides Federal grants to States for supplemental foods, healthcare referrals, and nutrition education, including breastfeeding promotion and support for low-income pregnant, breastfeeding, and postpartum women and infants and children up to age 5.

This study uses 2011–2016 National Health and Nutrition Examination Survey (NHANES) data to examine the bivariate relationship between reported program participation, diet quality, indicators of nutrition and health, food consumption patterns, and nutrient intakes among young children (Centers for Disease Control and Prevention, National Center for Health Statistics, 2020a; see table ES.1). Results presented in this report are descriptive only and not intended to infer causality. They contribute to the evidence base needed to inform future research and, subsequently, WIC policy and practice.

Table ES.1. Indicators of Diet Quality, Nutrition, and Health Examined in the Study Among Children Aged 1–4 Years Old

Outcome	Measures
Chapter 2. Overall Diet Quality	
Diet quality	▪ Healthy Eating Index (HEI)-2015 total score and component scores among children aged 2–4 years old
Chapter 3. Indicators of Nutrition and Health	
Weight status	▪ Percentage of children aged 2–4 years old with a body mass index (BMI)-for-age classified as underweight, normal weight, overweight, or obese
Hemoglobin	▪ Percentage of children with normal or low hemoglobin concentrations
Serum vitamin D	▪ Percentage of children with serum vitamin D concentrations categorized as adequate, insufficient, or associated with deficiency
Chapter 4. Food Consumption Patterns	
Consumption of food classified into supermarket aisle food groups	▪ Percentage of children who consumed WIC-eligible foods on a given day ▪ Percentage of children who consumed foods from supermarket aisle food groups and subgroups on a given day ▪ Mean amounts (in USDA Food Pattern equivalents and in grams) of foods from supermarket aisle food groups and subgroups consumed in a day among the total population and among only consumers
Chapter 5. Usual Energy and Macronutrient Intakes	
Usual energy intakes	▪ Mean usual intakes (in calories) ▪ Distributions of usual intakes
Usual macronutrient intakes[a]	▪ Mean usual intakes ▪ Distributions of usual intakes ▪ Percentages of children with usual intakes below, within, or above the acceptable macronutrient distribution ranges
Consumption of calories from saturated fats and added sugars	▪ Mean percentage of total calories consumed from saturated fat and added sugars

Outcome	Measures
Chapter 6. Usual Micronutrient Intakes	
Usual micronutrient intakes	▪ Mean usual intakes ▪ Distributions of usual intakes ▪ Percentages of children with usual intakes that met or exceeded the estimated average requirement[b] ▪ Percentages of children with usual intakes that met the adequate intake level[c] ▪ Percentages of children with usual intakes that exceeded the chronic disease risk reduction level[d]

[a] Total fat, protein, carbohydrates, linoleic and linolenic fatty acids, and fiber
[b] For vitamins A, B6, B12, C, D, and E; copper; selenium; folate; niacin; riboflavin; thiamin; calcium; iron; magnesium; phosphorus; and zinc
[c] For potassium, sodium, and chloride
[d] For sodium

A. Introduction

1. WIC Overview

In fiscal year (FY) 2019, WIC provided benefits to nearly 6.4 million participants per month on average at an annual cost of $5.2 billion (USDA FNS, 2020); food benefits composed the majority (60 percent) of these costs. Pregnant, postpartum, and breastfeeding women; infants; and children up to age 5 are eligible to receive WIC benefits. Participants must also have income at or below an income level or standard set by the State agency or be determined automatically income-eligible based on participation in certain programs (e.g., Supplemental Nutrition Assistance Program, Temporary Assistance for Needy Families, Medicaid), meet a State residency requirement, and be individually determined to be at "nutritional risk" by a competent professional authority. In FY 2018, most WIC participants (77 percent) were infants or children. More than half of WIC participants were younger than 3 years old (Kline et al., 2020).

State agencies use Federal grant money to provide WIC participants paper vouchers, checks, or electronic benefit transfer (EBT) cards that can be used to purchase specific food items from authorized food vendors.[1] WIC food packages are designed to supplement participants' diets with specific nutrients and food groups. Food packages are tailored to the needs of participants in each life stage. There are three food packages for infants, one for children, and three for women; an additional food package is reserved for issuance to those who have a documented qualifying condition that requires the use of a WIC formula (infant formula, exempt infant formula or WIC-eligible nutritional) because the use of conventional foods is precluded, restricted, or inadequate to address their special nutritional needs.[2] In 2009, the WIC food packages were revised to better align with the current Dietary Guidelines for Americans (DGA) (U.S. Department of Health and Human Services [HHS] & USDA, 2005) and meet the nutritional needs of the populations WIC serves. In FY 2019, the average monthly food cost was $40.90 per participant (USDA FNS, 2020).

The regulatory and legislative requirements to provide nutrition education and breastfeeding support to WIC participants set WIC apart from other FNS nutrition assistance programs (USDA, 2006). WIC

[1] The Healthy, Hunger-Free Kids Act of 2010 (Pub. L. 111–296) requires all WIC State agencies to implement EBT by October 2020. As of August 2020, 21 State agencies were in the process of implementing EBT, and 8 were in the planning process. These State agencies issued benefits through paper vouchers or checks.
[2] For more information on WIC food packages, see https://www.fns.usda.gov/wic/wic-food-packages-maximum-monthly-allowances.

nutrition education is intended to (1) emphasize the relationship between nutrition, physical activity, and health, with special focus on the nutritional needs of pregnant, postpartum, and breastfeeding women, infants, and children younger than 5 years old, and raise awareness about the dangers of using drugs and other harmful substances during pregnancy and while breastfeeding, and (2) help individuals at nutritional risk achieve positive changes in dietary and physical activity habits, resulting in improved nutritional status and the prevention of nutrition-related problems through optimal use of WIC supplemental foods and other nutritious foods (USDA FNS, 2013a).

2. Approach

The primary sources of data for this study were three cycles of NHANES data (2011–2012, 2013–2014, and 2015–2016; CDC NCHS, 2020a). NHANES is designed to assess the health and nutritional status of adults and children in the United States; the survey examines a nationally representative sample of about 5,000 individuals each year. The NHANES includes interviews, physical examination components, and laboratory tests (CDC NCHS, 2017). Several additional data resources, which included the Food Patterns Equivalents Database (FPED), were used to complete the analyses (USDA, Agricultural Research Service [ARS], 2019). Results published in *Diet Quality of American Young Children by WIC Participation Status* (Condon et al., 2015a) were used to support the comparison of key dietary, nutrition, and health indicators from before and after the WIC food package changes were implemented in 2009. Results from the prior study covered the period immediately before implementation, whereas results from this study covered the period immediately following implementation.

Using these data, the study team conducted descriptive analyses on measures of diet quality, nutrition, and health among WIC participants[3] compared with two groups of nonparticipants: individuals who were income-eligible for WIC but reported they did not participate in the program recently (income-eligible nonparticipants), and individuals with higher incomes who were not eligible for WIC (higher income nonparticipants). Primary analyses focused only on age-eligible children (1–4 years old) because the number of infants and women included in the three cycles of NHANES data was not sufficient for reliable estimates of most outcomes. Tabulations are presented by participant group for all young children 1–4 years old and separately by year of age and gender.[4] Because of the descriptive nature of the analyses, the results presented in this report cannot be used to assess the impact of WIC or infer causality. The results from the study can instead contribute to the evidence base needed to inform WIC policy and practice and, in turn, improve the diet quality, nutrition, and health outcomes of WIC participants.

B. Findings

This section presents key findings with a focus on the significant differences between WIC participants and both groups of nonparticipants for each chapter. Not all significant differences are discussed in this section. As noted previously, this research was not designed to measure the impact of WIC participation

[3] WIC program participation was determined by the NHANES survey question, "Is {SP} now receiving benefits from the WIC program?"
[4] Several of the outcome measures used in this study did not apply to children younger than 2 years old, such as the HEI, body mass index, and percentage of calories from saturated fat and added sugars; these outcomes were examined for children 2–4 years old.

on diet quality. Therefore, significant differences that appear between WIC participants and nonparticipants cannot be attributed to participation in WIC. Similarly, the absence of a significant difference cannot be interpreted as evidence participation in WIC has no effect. The accurate assessment of WIC impacts would require specially designed studies or, at minimum, complex analytical models needing a variety of measures, some of which are not available in NHANES data.

When interpreting findings, it is also important to consider the supplemental nature of WIC. The program is not intended to provide all of the participant's daily food requirements. There are many factors associated with dietary intake and health outcomes, and WIC program participation is only one of these factors.

HEI-2015 Components and Maximum Points for Each Component

- **Adequacy components:** Total fruits (5), whole fruits (5), total vegetables (5), greens and beans (5), whole grains (10), dairy (10), total protein foods (5), seafood and plant proteins (5), and fatty acids (10)
- **Moderation components:** Refined grains (10), sodium (10), added sugars (10), and saturated fats (10)

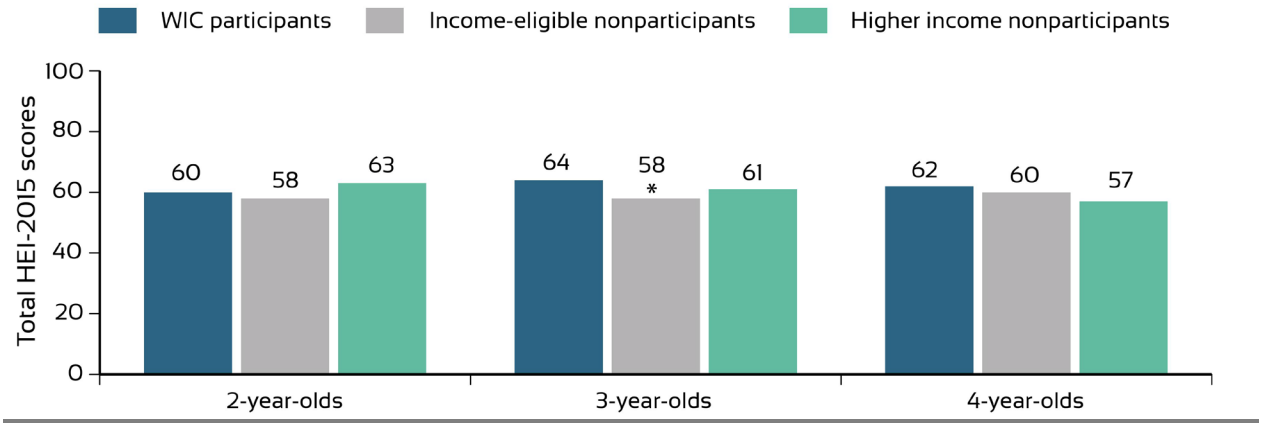
Chapter 2. Overall Diet Quality

Overall diet quality was examined using the Healthy Eating Index (HEI)-2015, which assesses adherence to the 2015 –2020 DGA recommendations.

The HEI-2015 has 13 components: 9 adequacy components representing dietary elements that are encouraged and 4 moderation components representing dietary elements for which limited consumption is recommended. The maximum score for each component ranges from 5 to 10 points (see text box). Scores for each of the 13 components are summed to create a total HEI-2015 score with a range from 0 to 100. A higher HEI score—for each component and in total—indicates a diet that aligns more closely with the DGA. Key findings related to overall diet quality follow:

- Overall, WIC participants had higher mean total HEI scores than income-eligible nonparticipants (62 versus 59 points) on a given day. By age group, 3-year-old WIC participants had higher total HEI scores than income-eligible nonparticipants (see figure ES.1).
- Compared with income-eligible nonparticipants, WIC participants scored higher for the greens and beans, fatty acids, and added sugars components on a given day. Compared with higher income nonparticipants, WIC participants scored better on the fatty acids and saturated fats components but worse for the whole grains component.

Figure ES.1. Mean Total HEI-2015 Scores Among Children 2–4 Years Old on a Given Day by Age and Program Participation



Notes: Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
HEI = Healthy Eating Index
WIC participants n = 627, income-eligible nonparticipants n = 586, higher income nonparticipants n = 504
Sources: National Health and Nutrition Examination Survey (NHANES 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 2–4 years old with complete day 1 dietary recall data.

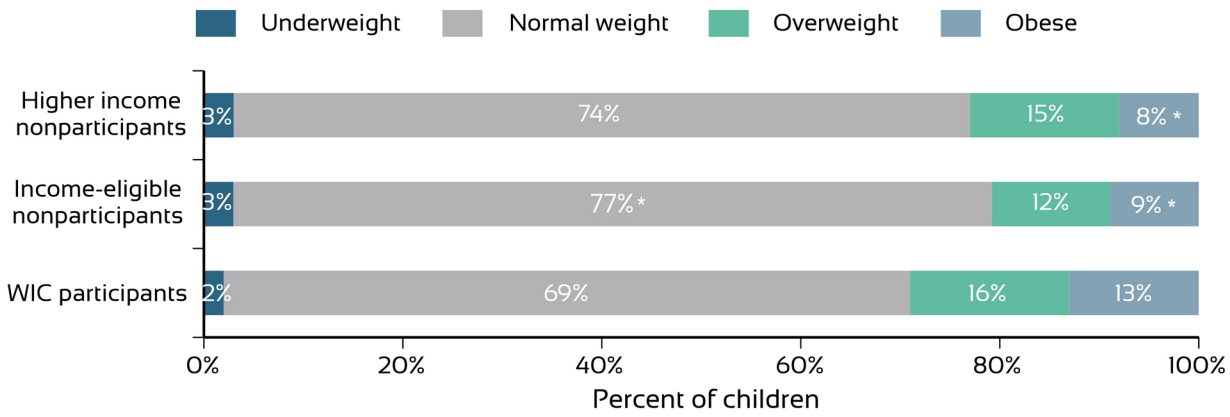
Chapter 3. Indicators of Nutrition and Health

NHANES anthropometric and biochemical data were used to examine body mass index for age (BMI-for-age), hemoglobin, and serum vitamin D.

BMI-for-age

Using CDC growth charts, BMI-for-age percentiles were used to assess weight status of children 2–4 years old. WIC participants were more likely to be obese than either group of nonparticipants (13 versus 9 and 8 percent, respectively; see figure ES.2).

Figure ES.2. Percentage of Children 2–4 Years Old Who Were Underweight, Normal Weight, Overweight, or Obese by Program Participation



Notes: Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 627, income-eligible nonparticipants n = 586, higher income nonparticipants n = 504
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 body measures data. Sample includes NHANES children 2–4 years old with complete day 1 dietary recall, weight, and height data.

Hemoglobin

The study team examined hemoglobin status among children 1–4 years old. Low hemoglobin indicates anemia as a result of iron deficiency or another nutritional or non-nutritional cause. Low hemoglobin is a criterion WIC uses to establish nutrition risk among WIC participants. Most children (96 percent) had normal hemoglobin concentrations, and results were similar for participants and both nonparticipant groups.

Serum vitamin D

Vitamin D plays an important role in bone health; deficiency can cause rickets in children (National Institutes of Health [NIH], Office of Dietary Supplements, 2019). The study team assessed serum concentrations of vitamin D (25-hydroxyvitamin D) for children 1–4 years old. Most children (93 percent) had adequate serum vitamin D concentrations, and results were similar for participants and both nonparticipant groups.

Chapter 4. Food Consumption Patterns

The study team examined the food consumption patterns of WIC participants and nonparticipants by estimating (1) the proportion of individuals consuming any foods from supermarket aisle food groups and subgroups on a given day and (2) the average amounts consumed. The supermarket aisle approach categorizes foods into 1 of 10 food groups and then into subgroups (see text box; Cole & Fox, 2008a). All

the supermarket aisle food groups and subgroups reflect foods consumed as *discrete* items except foods reported as mixed dishes.[5] Key findings related to food consumption patterns follow:

Supermarket Aisle Food Groups

- Grains
- Vegetables
- Fruits and 100 percent fruit juice
- Milk and milk products
- Meat and meat alternatives
- Mixed dishes
- Other beverages
- Sweets and desserts
- Salty snacks
- Added fats and oils

- At the food group level, WIC participants and income-eligible nonparticipants had similar consumption patterns on a given day. Compared with higher income nonparticipants, however, a lower percentage of WIC participants consumed items from the other beverages, grains, fruits and 100 percent fruit juice, and added fats and oils food groups and a higher percentage consumed items from the salty snacks food group on a given day.
- At the subgroup level, a lower percentage of WIC participants than higher income nonparticipants to consume refined grains, yogurt, and water and a higher percentage consume cooked potatoes, noncarbonated sweetened beverages, regular soda, and tea on a given day. A higher percentage of WIC participants consumed fruit juice and unflavored 1 percent milk than either group of nonparticipants on a given day.

Chapter 5. Usual Energy and Macronutrient Intakes

Dietary recall data were used to assess the macronutrients and total energy intakes of children aged 1–4 relative to the Dietary Reference Intakes (DRIs); the percentage of calories consumed from saturated fats and added sugars was assessed for children aged 2–4 relative to the 2015–2020 DGA.[6] The DRIs provide guidelines on appropriate nutrient intakes for healthy individuals based on age, gender, and life stage (Institute of Medicine [IOM], 1997; 1998; 2000; 2001; 2005; 2006; 2011; National Academies of Sciences, Engineering, and Medicine, 2019) and are the most up-to-date scientific standards for determining if dietary patterns are nutritionally adequate. Table ES.2 summarizes the applicable DRIs. The DGA provides evidence-based recommendations for food and beverage intakes and is published every 5 years.

Table ES.2. DRIs Used to Assess Usual Macronutrient Intakes

Nutrient(s)	DRI	Description of DRI
Total fat, protein, and carbohydrate; linoleic and linolenic fatty acids	Acceptable macronutrient distribution range	Reflects a range of usual intakes that are associated with a reduced risk of chronic disease and that also provide adequate intakes of essential nutrients; defined as the percentage of total energy intake from macronutrients and essential fatty acids (linoleic acid and linolenic acid)
Fiber	Adequate intake (AI)	Defined when insufficient data are available to establish an estimated average requirement; groups with mean usual intakes at or above AI levels are assumed to have nutrient adequacy, but no firm conclusions can be drawn when mean usual intakes fall below the AI

DRI = Dietary Reference Intake

[5] All the supermarket aisle food groups and subgroups reflect foods consumed as discrete items. This means combination items—such as sandwiches, Mexican entrees, green salads, and soups—reported in the dietary recall as individual components are counted as one item (e.g., a sandwich reported as a beef patty, cheese, and a roll is counted as one item and included in the "cheeseburger/hamburger" subgroup).
[6] Two nonsequential dietary recalls were used to assess usual intakes. One dietary recall was used to assess the mean percent of calories from saturated fats, added sugars, and alcohol.

Energy intakes

The study team also estimated usual daily intakes of total energy for children aged 1–4 and compared the percentage of energy from saturated fat and added sugars on a given day for children 2–4 with the 2015–2020 DGA recommendations.[7] Key findings related to energy intakes follow:

- Among 1-year-olds, WIC participants consumed fewer calories than income-eligible nonparticipants (1,182 versus 1,300). Importantly, differences in energy intakes may be attributed to variation between the groups in the average level of physical activity, weight and height distributions, and age (in months) at the time of data collection; these factors affect an individual's total energy needs and are not accounted for in these analyses.
- WIC participants obtained a smaller share of their total energy intakes from added sugars than income-eligible nonparticipants (11 versus 13 percent of calories).

Usual macronutrient intakes

The study team compared the usual intakes of fat, protein, carbohydrates, linoleic and linolenic acid with the acceptable macronutrient distribution ranges (AMDRs). Key findings related to macronutrient intakes follow:

- A higher percentage of WIC participants had usual intakes of protein within the AMDR than higher income nonparticipants (100 versus 97 percent).
- The percentage of young children with intakes within the AMDRs for fat, carbohydrates, and linoleic and linolenic acid was similar across participant groups.

Chapter 6. Usual Micronutrient Intakes

The National Cancer Institute (NCI) method was used to estimate mean usual intakes of vitamins and minerals, intake distributions, and the percentage of individuals with usual intakes consistent with DRI standards (NIH NCI, n.d.a).[8] Table ES.3 summarizes the nutrients assessed and their applicable DRIs.

Table ES.3. DRIs Used to Assess Usual Micronutrient Intakes

Nutrient(s)	DRI	Description of DRI
Vitamins A, B6, B12, C, D, and E; copper; selenium; folate; niacin; riboflavin; thiamin; calcium; iron; magnesium; phosphorus; and zinc	Estimated average requirement (EAR)	Average daily nutrient intake level estimated to meet the requirements for half of the healthy individuals in a life stage or gender group; the proportion of a group with usual intakes equal to or greater than the EAR is an estimate of the prevalence of adequate usual intakes in that group
Potassium, sodium, and choline	Adequate intake (AI)	Defined when insufficient data are available to establish an EAR; groups with mean usual intakes at or above AI levels are assumed to have nutrient adequacy, but no firm conclusions can be drawn when mean usual intakes fall below the AI
Sodium	Chronic disease risk reduction	The intake above which intake reduction is expected to reduce chronic disease risk within an apparently healthy population

DRI = Dietary Reference Intake

[7] The 2015–2020 DGA recommends consuming less than 10 percent of calories from saturated fats or added sugars and applies to children aged 2 and older.
[8] See appendix A for a detailed description of the NCI method.

Usual intakes of vitamins and minerals with defined EARs

Mean usual intakes of 10 vitamins and 7 minerals were assessed relative to the estimated average requirements (EARs; table ES.3). For all selected vitamins and minerals except calcium, the prevalence of adequate usual intake was similar for WIC participants and nonparticipant children: 43 percent for vitamin E, 14 percent for vitamin D, and 99 to 100 percent for all others. WIC participants had a lower prevalence of adequate usual intakes of calcium compared with higher income nonparticipants (86 versus 92 percent).

Usual intakes of nutrients assessed using AI and CDRR levels

Mean usual intakes of choline, potassium, and sodium were compared with the adequate intake levels. Mean usual sodium intake was also compared with the chronic disease risk reduction level. There were no differences in mean usual intakes of potassium or sodium between WIC participants and either group of nonparticipant children. However, among children from all participant categories, over 90 percent exceeded the CDRR for sodium.

Outcomes Compared for Food Package IV Before and After Revisions

Overall diet quality
- Total HEI-2010 scores
- Component HEI-2010 scores for total vegetables, greens and beans, whole grains, sodium, and empty calories

Indicators of nutrition and health
- BMI-for-age

Food consumption patterns
- Whole grains, total vegetables, cooked potatoes, 100 percent fruit juice, total milk, whole milk, fat-reduced milk

Energy and Macronutrient intakes
- Total calories
- Percentage of calories from fat
- Fiber

Micronutrient intakes
- Vitamins A and E, iron, potassium, sodium, and zinc

Chapter 7. Comparisons With 2005–2008 NHANES Before Revisions to the WIC Food Packages

The WIC food packages were revised in 2009 for the first time since 1980 to better align them with the DGA, improve dietary quality and food security of the populations served by WIC, and promote healthy body weight. As a result, the revised food packages are more nutrient-dense and allow a wider variety of options compared with the previous food packages; they emphasize the consumption of fruits, vegetables, whole grains, and fat-reduced milk products (IOM, 2006b). This chapter focuses specifically on changes to Food Package IV, which is the most common food package assigned to young children 1–4 years old.

Findings on key outcomes (see text box) from both studies are presented, but results are strictly observational; differences cannot be attributed to the food package changes, and observed differences were not tested for statistical significance. Key findings follow:

- Among WIC participants aged 2–4, the mean total HEI-2010[9] score was 57 in 2005–2008 and 61 in 2011–2016. For the empty calories[10] component, WIC participants scored 11.0 points in 2005–2008 and 15.1 points in 2011–2016.

[9] HEI-2010 scores were used because HEI-2010 was the standard in place at the time of the previous study.
[10] The HEI-2010 empty calories component comprised solid fats, added sugars, and alcohol.

- Among WIC participants aged 2–4, the prevalence of obesity was 11.1 percent in 2005–2008 and 12.9 percent in 2011–2016.
- Among WIC participants, one-third (33.2 percent) consumed whole grains on a given day in 2005–2008, while almost half (47.5 percent) consumed whole grains in 2011–2016. Over half (56 percent) of WIC participants consumed whole milk on a given day in 2005–2008, and about one-third (35 percent) consumed whole milk in 2011–2016.

C. Conclusions

Although the descriptive analyses presented in this report were not designed to assess the impact of WIC on indicators of diet quality and health or infer causality between WIC participation and these indicators, the results contribute to the evidence base needed to inform future research and, subsequently, WIC policy and practice. In particular, this study highlights areas where children participating in WIC appear to be doing as well as or better than their age-matched counterparts. This study also reveals areas where additional attention may be needed to improve diet quality and weight status of children participating in WIC. Taken together, the findings provide important insights that may have implications for WIC nutrition assessment, education, and promotion.

Chapter 1. Introduction

The Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA) administers 15 nutrition assistance programs with the overarching goal of increasing food security and reducing hunger through access to affordable, healthy food and nutrition education. These programs include the Supplemental Nutrition Assistance Program (SNAP); Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); and National School Lunch Program. WIC, the focus of this report, is the third largest of the domestic nutrition assistance programs administered by FNS. WIC is administered by 50 States, 5 U.S. territories, and 33 Indian tribal organizations and provides Federal grants to States for supplemental foods, healthcare referrals, and nutrition education for low-income pregnant, breastfeeding, and postpartum women, and infants and children up to age 5. This study is the fourth in a series that leverages National Health and Nutrition Examination Survey (NHANES) data to examine the relationship between participation in these programs and diet quality and health outcomes. This series of reports was initially funded by USDA's Economic Research Service (Fox & Cole, 2004a, 2004b; Cole & Fox, 2004a, 2004b) and has been continued by USDA FNS (Cole & Fox, 2008a, 2008b, 2008c; Condon et al., 2015; Condon et al., 2015a; Condon et al., 2015b).

The objectives of this study were as follows:

- For all Americans, assess overall diet quality and compare selected measures of nutrition and health with recommended values.
- Compare the overall diet quality, nutrition, and health of WIC participants with those of income-eligible and higher income nonparticipants (these two groups are described later in this section).
- Compare selected measures of overall diet quality, nutrition, and health between WIC participants and matched income-eligible nonparticipants.

To address the study objectives, the study team measured overall diet quality using the Healthy Eating Index (HEI)-2010 and HEI-2015 and assessed the adequacy of usual nutrient intakes relative to current Dietary Reference Intake (DRI) (Institute of Medicine [IOM], 1997, 1998, 2000, 2001, 2005, 2006a, 2011; National Academies of Sciences, Engineering, and Medicine [NASEM], 2019) and Dietary Guidelines for Americans (DGA) (USDA & U.S. Department of Health and Human Services [HHS], 2015). The study team assessed nutrition and health using various indicators, including anthropometry (e.g., body mass index for age [BMI-for-age]) and blood biomarkers (e.g., hemoglobin). This report also presents data on usual energy intakes, percentage of calories from saturated fats and added sugars, and food consumption patterns as both the proportion of individuals who consumed foods from each food group and the average amounts consumed.

The results of the analyses are presented for WIC participants and two groups of nonparticipants: individuals who were income-eligible for WIC but reported they did not participate in the program recently (income-eligible nonparticipants) and individuals with higher incomes who were not eligible for WIC (higher income nonparticipants). These analyses also include outcomes by age (all young 1-, 2-, 3-, and 4-year-olds) and gender.

Given the descriptive nature of core study analyses, it was not possible to evaluate the causal effects of program participation on outcomes of interest; this research was not designed to assess the impact of WIC or attribute differences observed between WIC participants and nonparticipants to an effect of the program. However, this study does provide data on common shortcomings of diet-related indicators

among WIC participants compared with nonparticipant groups. This information contributes to the evidence base needed to inform future research and, subsequently, WIC policy and practice and, in particular, the nutrition assessment process. This process is used to provide quality nutrition services, including nutrition education, and determine program eligibility. When interpreting findings, it is also important to consider the supplemental nature of WIC. The program is not intended to provide all of the participant's daily food requirements. There are many factors associated with dietary intake and health outcomes, and WIC program participation is only one of these factors.

The remainder of this chapter provides an overview of WIC and more detail on the data and methods used in the study. Findings from the descriptive analyses are presented in chapters 2–6. Observational findings related to WIC food package revisions are discussed in chapter 7. Key findings and conclusions are discussed in chapter 8. The study team provides supporting information for the data and documentation of the analytic methods in appendix A. Appendices B through F present detailed data tables.

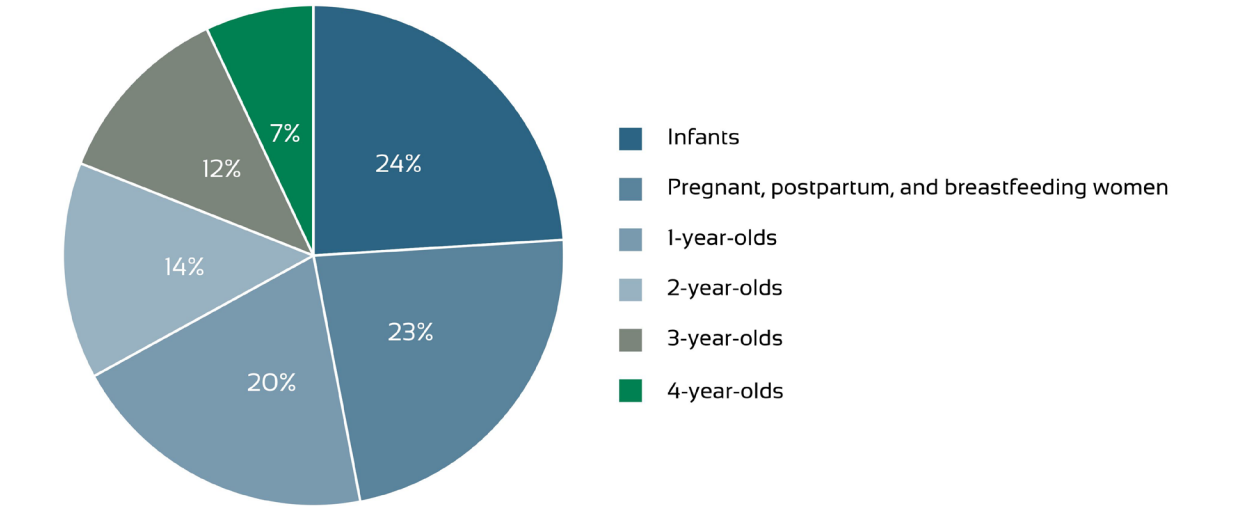
A. WIC Overview

In fiscal year (FY) 2018, WIC provided benefits to nearly 6.9 million women, infants, and children per month on average at an annual cost of $5.4 billion (USDA FNS, 2020). WIC food benefits composed the majority (63 percent) of program costs at $3.4 billion. Because food benefits are provided to participants through electronic benefits or paper vouchers that are only redeemable at authorized food stores, the cash value of monthly benefits varies by State and region. The national average monthly food cost per participant in FY 2018 was $40.95 (USDA FNS, 2020).

In FY 2018, the most recent year for which participant characteristics data are available, most WIC participants (77 percent) were infants or children. More than half of WIC participants were younger than 3 years old (see figure 1.1; Kline et al., 2020). Almost all (91 percent) WIC participants reported an income equal to or less than 185 percent of the relevant Federal Poverty Guidelines, the threshold for income eligibility. [11]

[11] Income data were missing for an additional 6.4 percent of participants. Income eligibility is also conferred by Medicaid participation. In some States with Medicaid expansions, households with income greater than 185 percent of the relevant Federal Poverty Guidelines may be eligible to participate.

Figure 1.1. Distribution of WIC Participants by Eligibility Category



Source: Kline et al., 2020

1. WIC Eligibility and Benefits

Pregnant, postpartum, and breastfeeding women; infants; and children up to age 5 are eligible to receive WIC benefits. Participants must also have income at or below an income level or standard set by the State agency or be determined automatically income-eligible based on participation in certain programs (e.g., Supplemental Nutrition Assistance Program, Temporary Assistance for Needy Families, Medicaid), meet a State residency requirement, and be individually determined to be at "nutritional risk" by a competent professional authority (CPA). Table 1.1 summarizes the four eligibility requirements.

Nutritional risk[12] is based on medical and dietary conditions such as anemia, underweight status or high weight-for-height status, maternal age, history of pregnancy complications, poor pregnancy outcomes, inappropriate dietary patterns, and inadequate diet. All WIC applicants must be seen by a health professional and have their height and weight measured and blood tested for anemia. The health professional can be the applicant's personal healthcare provider or a CPA from the WIC clinic. The USDA maintains an Index of Allowable Nutrition Risk Criteria that State agencies must use when certifying WIC applicants. Some of the criteria on this list are based on recommendations from the National Academy of Sciences, Medicine, and Engineering (formerly the Institute of Medicine, or IOM), but all are approved by USDA. State agencies have some flexibility when implementing these criteria but may not add criteria without approval from USDA. However, very few income-eligible people fail to meet nutrition risk criteria (Oliveira & Blaylock, 2003). In calendar year 2016, an estimated 13.9 million people were eligible to receive WIC benefits, and more than half (55 percent) of eligible people participated in WIC.[13]

[12] Nutritional risk means (a) detrimental or abnormal nutritional conditions detectable by biochemical or anthropometric measurements; (b) other documented nutritionally related medical conditions; (c) dietary deficiencies that impair or endanger health; (d) conditions that directly affect the nutritional health of a person, including alcoholism or drug abuse; or (e) conditions that predispose persons to inadequate nutritional patterns or nutritionally related medical conditions, including homelessness and migrancy.

[13] For more information on WIC eligibility and program reach, see https://www.fns.usda.gov/wic/national-and-state-level-estimates-wic-eligibility-and-wic-program-reach-2016

Table 1.1. Eligibility Requirements for WIC Applicants

Eligibility Requirement	Specifications
Categorical	The following individuals are categorically eligible for WIC: 1. Pregnant women 2. Breastfeeding women (up to 1 year postpartum) 3. Postpartum women (up to 6 months postpartum) 4. Infants (up to 1 year) 5. Children (up to 5 years)
Residential	Applicants must live in the State (i.e., State, DC, or Territory) in which they apply; Indian tribal organizations that serve as WIC State agencies may also establish geographic residency requirements
Income	The following income standards determine WIC eligibility: 1. Income at/below an income level set by the State agency (the State agency's income standard must be between 100 percent of the Federal Poverty Guidelines but cannot be more than 185 percent of the Federal Poverty Guidelines) 2. Automatic income eligibility based on participation in certain programs (e.g., SNAP or Medicaid)
Nutritional risk	Applicants must be determined to be at nutritional risk by a CPA such as a physician, nutritionist, or nurse.

Note: For more information, see https://www.fns.usda.gov/wic/wic-eligibility-requirements
CPA = competent professional authority; SNAP = Supplemental Nutrition Assistance Program

Supplemental food benefits

State agencies use Federal grant money to provide WIC participants paper vouchers, checks, or electronic benefit transfer (EBT) cards that can be used to purchase specific food items from authorized food vendors.[14] WIC food packages are designed to supplement participants' diets with specific nutrients and food groups. Food packages are tailored to the needs of participants in each life stage; there are three food packages for infants, one for children, and three for women; an additional food package provides special formulas or nutritionals for participants with certain qualifying conditions.[15] WIC State agencies designate specific brands and sizes of approved food products within categories determined by FNS according to the nutritional content of each item and cost containment goals of each State agency. In 2009, through an Interim Rule, the WIC food packages were revised to better align with the DGA (HHS & USDA, 2005) and meet the nutritional needs of the populations WIC serves. Chapter 7—which focuses specifically on changes to Food Package IV, which is the food package assigned to children 1–4 years old—provides more information on the WIC food package changes and observational pre/post data comparing the previous report's findings for 2005–2008 with this report's findings for 2011–2016.

The version of Food Package IV that was in place when the NHANES 2011–2016 data were collected included foods in seven categories: juice, milk,[16] breakfast cereal, eggs, fruits and vegetables, whole wheat and whole grain bread options, and legumes[17] (dried beans or peanut butter). No major changes in the content of the WIC food packages have been implemented since the data used in this study were

[14] The Healthy, Hunger-Free Kids Act of 2010 (Pub. L. 111–296) requires all WIC State agencies to implement electronic benefit transfer by October 2020. As of August 2020, 21 State agencies were in the process of implementing electronic benefit transfer, and 8 were in the planning process. These State agencies issued benefits through paper vouchers or checks.
[15] For more information on WIC food packages, see https://www.fns.usda.gov/wic/wic-food-packages-maximum-monthly-allowances
[16] As of the time of data collection, participants could substitute cheese, soy-based beverage, and tofu for some or all of the milk prescription.
[17] Canned legumes may be substituted for dry legumes at the rate of 64 oz. (e.g., four 16-oz cans) of canned beans for 1 pound of dry beans.

collected. However, the packages underwent additional moderate revisions with the implementation of the Final Rule in 2014;[18] these revisions included the authorization of yogurt as a partial substitute for milk and whole wheat pasta as an alternative to whole wheat bread and changes to the types of fat-reduced milk that were authorized for some participant categories.

Nutrition education

The regulatory and legislative requirements to provide nutrition education to WIC participants set WIC apart from other FNS nutrition assistance programs (USDA, 2006). WIC nutrition education must be—

- Available at no cost to participants
- Easily understood by participants
- Practical considering the participant's nutritional needs, household situation, and cultural preferences
- Designed to achieve the regulatory nutrition education goals

FNS regulations require local WIC service agencies to offer participants (or their caregivers) at least two nutrition education sessions during each certification period (Johnson et al., 2013). Participants may be counseled in one-on-one settings, attend group classes, or complete lessons online.[19] Effective nutrition education should elicit a behavior change that will help the participant achieve and maintain a positive change in dietary and physical activity habits, resulting in improved nutritional status and the prevention of nutrition-related problems regardless of the delivery medium. As part of nutrition education and counseling, breastfeeding is promoted as the optimal source of infant nutrition.

WIC nutrition education has two main goals:

1. Emphasize the relationship between nutrition, physical activity, and health, with special focus on the nutritional needs of pregnant, postpartum, and breastfeeding women, infants, and children younger than 5 years old.
2. Help individuals at nutritional risk achieve positive changes in dietary and physical activity habits, resulting in improved nutritional status and the prevention of nutrition-related problems through optimal use of WIC supplemental foods and other nutritious foods (USDA, 2013a).

Referrals

As another core program benefit, WIC provides program applicants, participants, and designated proxies with appropriate referrals[20] to health and public assistance programs that offer services such as income support, child support, childcare services, and substance abuse counseling (USDA, 2013b). In doing so, WIC serves as a link between participants and healthcare providers or systems. Coordination between

[18] See 79 Fed. Reg. 12273 (Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): Revisions in the WIC Food Packages; Final Rule, 2014)

[19] Delivery of nutrition education varies by State. For more information, see https://fns-prod.azureedge.net/sites/default/files/ops/WICNutEd-PhaseI.pdf

[20] Per CFR § 246.7 (b), State and local agencies shall provide WIC program applicants and participants or their designated proxies with information on other health-related and public assistance programs and, when appropriate, shall refer applicants and participants to such programs.

such programs and WIC increased after 1989 with the passage of the Child Nutrition and WIC Reauthorization Act (Pub. L. 101–147).

B. Methods Summary

This section provides a high-level overview of the data sources, sample, and analytic approaches employed for this study. Additional details on the study methods are provided in appendix A.

1. Data Sources

The study team used 6 years of survey data from the NHANES 2011–2016 as the main data source for this study (Centers for Disease Control and Prevention [CDC], National Center for Health Statistics [NCHS], 2020a), but other data sources such as the Food Patterns Equivalents Database (FPED; USDA, Agricultural Research Service [ARS], 2019) were also incorporated.

NHANES

The NHANES is conducted by CDC NCHS and is designed to assess the health and nutritional status of adults and children in the United States; the survey examines a nationally representative sample of about 5,000 individuals each year.[21] The NHANES includes interviews and physical examinations. The interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements and laboratory tests (CDC NCHS, 2017).

This study team relied primarily on data from the dietary interview but also utilized data collected through the household interview, survey questionnaires, and physical examination for the analysis.

- **Dietary interview.** This NHANES component consisted of up to two 24-hour dietary recall interviews that quantified foods and beverages consumed during the preceding 24 hours for 2 separate days (day 1 and day 2 dietary recalls). The dietary recalls were conducted using the USDA automated multiple-pass method instrument. Respondents were provided with measurement aids to help them estimate the portion sizes of foods they consumed. The first dietary interview was conducted in person in the NHANES Mobile Examination Center (MEC), and the second dietary interview was conducted by telephone 3 to 10 days after the day 1 dietary recall. The day 2 dietary recall was used to control for within-person variance in nutrient intakes when estimating usual nutrient intakes. For children younger than 6 years old, the dietary recall interviews were conducted with a proxy, generally the person most knowledgeable about the child's dietary intake. For children 6 to 11 years old, the interviews were conducted jointly with the child and the proxy. For the 2011–2016 NHANES, 86 percent of respondents with complete day 1 dietary recall also had complete day 2 dietary recall. The dietary interview component of the NHANES, referred to as What We Eat in America, was conducted as a partnership between USDA and HHS.
- **Household interview, survey questionnaires, and examination data.** These NHANES components gathered information on respondents' characteristics (e.g., WIC program participation, age, sex); anthropometry (e.g., height, weight); and laboratory values (e.g., hemoglobin).

[21] For more information on the NHANES, see https://www.cdc.gov/nchs/nhanes/about_nhanes.htm

Other data sources

In addition to NHANES, the study team used other data sources and programs to support the analysis. For example, to analyze food consumption patterns, the team used 6 years (2011–2012, 2013–2014, and 2015–2016) of FPED data (USDA ARS, 2019). FPED converts the foods and beverages in USDA's Food and Nutrient Database for Dietary Studies (FNDDS), which is updated for every 2-year release of What We Eat in America (USDA, Agricultural Research Service [ARS], 2020), to the 37 USDA Food Patterns components in both Food Patterns units (e.g., cup equivalents of fruit, ounce equivalents of protein foods) and per 100 grams. The team linked each unique food reported in the NHANES 2011–2016 food-level files to the appropriate FPED source and computed the average amounts of each food pattern component consumed based on the amount of food reported in individuals' day 1 dietary recalls. The team also used SAS program and support files from the HEI-2010 and HEI-2015, CDC growth charts, National Cancer Institute (NCI) Usual Dietary Intakes SAS code, and U.S. Census population counts from 2010.

2. Analytic Sample

This section describes the methods the study team used to identify and categorize the analytic sample and provides characteristics for the sample.

Sample definitions

This report contains tabulations of dietary measures for WIC participants and nonparticipants. The study team identified WIC participants through their affirmative responses to the NHANES survey question, "Is {SP} now receiving benefits from the WIC program?" (CDC NCHS, 2020b). The team categorized those who did not report currently receiving WIC benefits as nonparticipants. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines or individuals who were identified as adjunctively eligible (e.g., qualify for Medicaid or SNAP), and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines.

All the analyses described in this report were restricted to NHANES respondents 1–4 years old with complete day 1 dietary recall data; some analyses had additional sample restrictions. To compute most dietary measures, the study team used only day 1 dietary recall data. For the usual nutrient intake analysis, both day 1 and day 2 dietary recall data were used to control for within-person day-to-day variance in nutrient intakes.[22] The team excluded pregnant, breastfeeding, and postpartum women from the analytic sample because of small sample sizes.[23] Infants were excluded from primary analyses because of difficulty determining volume and nutrient content of breast milk. Selected results for infants and pregnant, breastfeeding, and postpartum women appear in appendix H.

This report provides tabulations of WIC participants, income-eligible nonparticipants, and higher income nonparticipants for all young children 1–4 years old and separately by year of age and gender. Most of

[22] The analysis did not include nutrient intakes from supplements. See appendix G for results on supplement use.
[23] The sample of 20- to 44-year-old women was too small for analysis; pregnant and breastfeeding women outside this age range could not be identified in the data.

the tabulations included in the appendices provide separate estimates by these age groups and by gender. Table 1.2 shows the sample sizes and weighted population counts for WIC participants and both groups of nonparticipants. Only the unweighted sample sizes are presented in remaining report tables. Sampling weights are discussed in appendix A.

Table 1.2. Sample Sizes of 2011–2016 NHANES Respondents With Complete Day 1 Dietary Recalls by Age and Program Participation

Subgroup	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample Sizes				
All young children 1–4 years old	2,314	902	729	671
1-year-olds	590	275	143	167
2-year-olds	701	282	222	193
3-year-olds	522	186	171	162
4-year-olds	501	159	193	149
Weighted Population Counts				
All young children 1–4 years old	15,561,831	4,580,167	4,608,733	6,293,639
1-year-olds	3,360,663	1,245,185	769,663	1,306,163
2-year-olds	4,275,782	1,388,140	1,317,223	1,552,595
3-year-olds	4,129,448	1,036,702	1,195,272	1,875,657
4-year-olds	3,795,938	910,140	1,326,575	1,559,224

Notes: "All young children" includes children with missing WIC participation or income. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Weighted population counts were based on NHANES day 1 dietary sample weights to adjust for nonresponse in the day 1 dietary recall and the differential allocation by day of the week for the dietary intake data collection.
NHANES = National Health and Nutrition Examination Survey
Source: NHANES 2011–2016 dietary recalls and demographic data. Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

Characteristics of WIC participants and nonparticipants

Table 1.2 presents demographic data for WIC participants, income-eligible nonparticipants, and higher income nonparticipants. Compared with either group of nonparticipants, WIC participants were more likely to be Mexican American or other Hispanic but less likely to be non-Hispanic White (see table 1.3). Compared with higher income nonparticipants, WIC participants were more likely to be non-Hispanic Black and less likely to be another race or multiracial.

Table 1.3. Race and Ethnicity of WIC Participants and Nonparticipants 1–4 Years Old

Subgroup	All Young Children		WIC Participants		Income-Eligible Nonparticipants		Higher Income Nonparticipants	
	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
Sample size	2,314	–	902	–	729	–	671	–
Mexican American	15.8	(2.10)	28.5	(3.95)	15.3 **	(2.52)	7.2 ***	(1.39)
Other Hispanic	9.1	(1.08)	15.8	(2.27)	7.8 **	(1.29)	5.3 ***	(1.08)
Non-Hispanic White	50.7	(3.28)	27.5	(4.02)	46.0 **	(4.25)	70.7 ***	(3.07)
Non-Hispanic Black	14.4	(1.79)	20.7	(2.95)	21.3	(2.73)	4.7 ***	(0.80)
Other race, multiracial	10.0	(1.06)	7.5	(1.21)	9.6	(1.29)	12.2 *	(1.98)

Notes: "All young children" includes children with missing WIC participation or income. Percentages may not sum to 100 percent because of rounding. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls and demographic data. Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

In comparing estimates for WIC participants and nonparticipants, it is important to consider the age composition of these groups may be different. WIC participants were younger than nonparticipants on average; 30 percent of WIC participant children were 1 year old compared with 20 percent of income-eligible nonparticipants and 25 percent of higher income nonparticipants. Therefore, age-adjusted estimates are presented to eliminate between-group differences that resulted solely from differences in the age distributions of the groups.

3. Analysis

This report describes differences in overall diet quality, nutrient intakes, food consumption patterns, and other indicators of nutrition and health between WIC participants and two types of nonparticipants: those who are income-eligible and those whose income is higher than WIC eligibility guidelines. This report does not test for differences between the two groups of nonparticipants. Table 1.4 summarizes the outcomes and measures examined in this study and the relevant ages for each outcome or measure.

Table 1.4. Summary of Outcomes and Measures

Outcome	Measures	Ages (years)
Chapter 2. Overall Diet Quality		
Overall diet quality	▪ Healthy Eating Index (HEI)-2015 total score[a] ▪ HEI-2015 component scores	2–4
Chapter 3. Indicators of Nutrition and Health		
Weight status	▪ Percentages of children who were underweight, normal weight, overweight, or obese	2–4
Hemoglobin	▪ Percentages of children with normal or low hemoglobin concentrations	1–4
Serum vitamin D	▪ Percentages of children with serum vitamin D concentrations categorized as adequate, insufficient, or associated with deficiency	1–4
Chapter 4. Food Consumption Patterns		
Consumption of specific food groups and discrete food items	▪ Percentage of children who consumed foods from supermarket aisle food groups and subgroups on a given day ▪ Mean amounts (in USDA Food Pattern equivalents and in grams) of foods from supermarket aisle food groups and subgroups consumed on a given day among the total population and among only consumers	1–4
Consumption of WIC foods	▪ Percentage of children consuming WIC-eligible foods	1–4
Chapter 5. Usual Energy and Macronutrient Intakes		
Usual energy intakes	▪ Mean usual intakes (in calories)[a] ▪ Distributions of usual intakes	1–4
Usual macronutrient intakes	▪ Mean usual intake ▪ Distributions of usual intake ▪ Usual intakes compared with DRIs and percentages of children meeting DRIs	1–4
Consumption of saturated fats and added sugars	▪ Mean percentage of calories contributed from saturated fats and added sugars	2–4
Chapter 6. Usual Micronutrient Intakes		
Usual micronutrient intakes	▪ Mean usual intakes ▪ Distributions of usual intakes ▪ Usual intakes compared with DRIs and percentages of children meeting DRIs	1–4
Chapter 7. Comparisons With 2005–2008 NHANES Before Revisions to the WIC Food Packages		
Overall diet quality	▪ Total HEI-2010 score ▪ Selected HEI-2010 component scores	2–4
Weight status	▪ Percentages of children who were underweight, normal weight, overweight, or obese	2–4
Food consumption patterns	▪ Proportion of children consuming foods from selected supermarket aisle food groups in a day ▪ Proportion of children consuming foods from selected supermarket aisle subgroups among children consuming foods from the relevant major food group	1–4
Usual macronutrient intakes	▪ Percentage of children meeting DRIs for fat and fiber	1–4
Usual energy intakes	▪ Mean usual intakes (in calories)[a]	1–4
Usual micronutrient intakes	▪ Percentage of children meeting DRIs for vitamin A, vitamin E, iron, zinc, potassium, and sodium	1–4

DRI = Dietary Reference Intake

[a] Energy is measured in units of kilocalories; however, for brevity throughout the report, the more common term—calories—is used.

The study team tested the statistical significance of differences between WIC participants and both groups of nonparticipants overall and by year of age and gender using *t*-tests. Detailed tables showing all results are provided in appendices B through G. Statistically significant differences are noted throughout the report with asterisks. Because of the large number of *t*-tests conducted, caution should be used in interpreting results; a proportion of these tests are expected to be significant by chance. Throughout the report, the discussion focuses on the differences between WIC participants and one or both groups of nonparticipants and also references differences between age groups or genders (e.g., girls compared with boys) when the differences are noteworthy. However, the team did not test the statistical significance of these secondary comparisons; these comparisons are not the focus of this report.

Additional information about the analytic approach, including the use of NHANES sampling weights, calculation of standard errors, and age standardization is provided in appendix A. The study team also identified individual point estimates that did not meet the standards of reliability or precision because of large coefficients of variation. In keeping with NHANES reporting guidelines, such estimates are reported in detailed tables but are clearly flagged with a "**u**" for unreliable. In some cases, between-group differences may be statistically significant even when one point estimate is unreliable. Unreliable differences are not discussed in this report.

As noted previously, this research was not designed to measure the impact of WIC participation on diet quality. Therefore, significant differences that appear between WIC participants and nonparticipants cannot be attributed to participation in WIC. Similarly, the absence of a significant difference cannot be interpreted as evidence participation in WIC has no effect. The accurate assessment of WIC impacts would require specially designed studies or, at minimum, complex analytical models needing a variety of measures, some of which are not available in NHANES data.

Chapter 2. Overall Diet Quality

Key Takeaways

Total HEI-2015 scores serve as a measure of overall diet quality. Among children aged 2–4, mean total HEI-2015 scores sit well below the maximum possible score of 100, suggesting on a given day, children fall short of meeting the 2015–2020 DGA recommendations. The study also found—

- WIC children had **higher** mean **total HEI scores** on a given day than income-eligible nonparticipant children.
- For component scores, **WIC children scored better** than income-eligible nonparticipants in the greens and beans, fatty acids, and added sugars components. WIC children also **scored better** than higher income nonparticipant children in the saturated fats and fatty acids components.
- Among all children, the **maximum score** was achieved for the total fruits and whole fruits components and nearly achieved for the dairy component.

This chapter examines the diet quality of WIC participants and nonparticipants using the HEI. The HEI is a measure of diet quality that assesses adherence to key DGA nutrition recommendations (USDA & HHS, 2015).

Section A provides background information on the HEI. Section B presents results on total HEI-2015 scores, and section C presents HEI-2015 component scores. This chapter discusses only statistically significant differences between WIC participants and nonparticipants; detailed results of the HEI-2015 analysis are presented in appendix B. Findings based on the HEI-2010 are also presented in appendix B to facilitate comparisons with the 2007–2010 Diet Quality study (Condon et al., 2015).

A. Healthy Eating Index Background

The HEI has been adopted by USDA as a tool to monitor the nutritional quality of foods consumed by the U.S. population and monitor progress toward healthier eating habits among nutrition assistance program participants (Guenther et al., 2008). The HEI was first created in 1995 by the USDA Center for Nutrition Policy and Promotion and is updated with each iteration of the DGA. It was revised in 2006 to reflect the 2005 DGA (HEI-2005), updated in 2012 to reflect the 2010 DGA (HEI-2010), and updated again in 2018 to reflect the 2015–2020 DGA (HEI-2015; Krebs-Smith et al., 2018). Although the NHANES 2011–2016 data spanned both the HEI-2010 and HEI-2015, this chapter presents HEI-2015 findings because they provide a measure of diet quality relative to the current DGA recommendations (see

appendix B for HEI-2010 results).[24] HEI scores are estimated at the population level using the population ratio method with the day 1 dietary recall.[25]

Table 2.1 outlines the 13 HEI-2015 components, maximum points that can be earned for each, and standards for achieving the minimum and maximum number of points for each component. The standards used to assign HEI-2015 component scores are expressed on a density basis (i.e., amounts per 1,000 calories or as a percentage of calories) rather than absolute amounts of foods consumed; this reflects the recommendation individuals should strive to meet nutritional guidelines while maintaining energy balance.

Each component of the HEI-2015 reflects a key aspect of diet quality. Adequacy components are dietary elements that are encouraged; higher scores for adequacy components reflect greater consumption. The nine adequacy components are total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids. By contrast, moderation components are dietary elements recommended for limited consumption; higher scores for moderation components reflect lower consumption. The four moderation components are refined grains, sodium, added sugars, and saturated fats. Scores for intakes between the minimum and maximum standards are scored proportionately; the minimum score for each component is zero. Scores for each of the 13 components are summed to create a total HEI-2015 score with a range from 0 to 100. A higher HEI-2015 score indicates a diet that better aligns with the corresponding 2015–2020 DGA. When interpreting HEI scores, a difference of 5 to 6 points between groups may be meaningful (Kirkpatrick et al., 2018).

Table 2.1. HEI-2015 Component Scores and Standards for Scoring

Component	Maximum Score	Standard for Maximum Score	Standard for Minimum Score
Adequacy Components			
Total fruits	5	≥ 0.8 cup equiv. per 1,000 calories	No fruit
Whole fruits	5	≥ 0.4 cup equiv. per 1,000 calories	No whole fruit
Total vegetables	5	≥ 1.1 cup equiv. per 1,000 calories	No vegetables
Greens and beans	5	≥ 0.2 cup equiv. per 1,000 calories	No dark green vegetables or legumes
Whole grains	10	≥ 1.5 ounce equiv. per 1,000 calories	No whole grains
Dairy	10	≥ 1.3 cup equiv. per 1,000 calories	No dairy
Total protein foods	5	≥ 2.5 ounce equiv. per 1,000 calories	No protein foods
Seafood and plant proteins	5	≥ 0.8 ounce equiv. per 1,000 calories	No seafood or plant proteins
Fatty acids	10	(PUFAs + MUFAs)/SFAs ≥ 2.5	(PUFAs + MUFAs)/SFAs ≤ 1.2

[24] The main difference between the HEI-2010 and HEI-2015 is in the empty calories construct. In the HEI-2015, the empty calories component (i.e., calories from solid fats, alcohol, and added sugars) was replaced with two discrete components for saturated fats and added sugars. With this change, saturated fats replaced solid fats, and alcohol was removed as an item contributing to a specific component. For a full comparison of the HEI-2005, HEI-2010, and HEI-2015, see https://epi.grants.cancer.gov/hei/comparing.html

[25] This method involves calculating mean intakes of relevant food groups, nutrients, and calories for the population, then calculating the ratios of the means with calories in the denominator and comparing with HEI standards for scoring.

Component	Maximum Score	Standard for Maximum Score	Standard for Minimum Score
Moderation Components			
Refined grains	10	≤ 1.8 ounce equiv. per 1,000 calories	≥ 4.3 ounce equiv. per 1,000 calories
Sodium	10	≤ 1.1 grams per 1,000 calories	≥ 2.0 grams per 1,000 calories
Added sugars	10	≤ 6.5 percent of calories	≥ 26 percent of calories
Saturated fats	10	≤ 8 percent of calories	≥ 16 percent of calories
Total HEI score	**100**		

Notes: Intakes between the minimum and maximum standards are scored proportionately. Total fruits include 100 percent fruit juice; whole fruits include all forms except juice. Total vegetables include greens and beans; total protein foods include legumes (beans and peas). Dairy includes all cow's milk products, such as fluid milk, yogurt, and cheese, and fortified soy-based beverages. Seafood and plant proteins include seafood, nuts, seeds, soy products (other than beverages), and legumes. Fatty acids are measured by the ratio of PUFAs and MUFAs to SFAs.
calories = kilocalories; equiv. = equivalent; HEI = Healthy Eating Index; MUFA = monounsaturated fatty acid; ounce = ounce; PUFA = polyunsaturated fatty acid; SFA = saturated fatty acid

Table 2.2 provides a synopsis of the data sources, sample, and measures examined in this chapter. Children younger than 2 years old were excluded from all HEI analyses because the 2015–2020 DGA did not apply to them.

Table 2.2. Data, Sample, and Measures Used to Assess HEI-2015 Scores

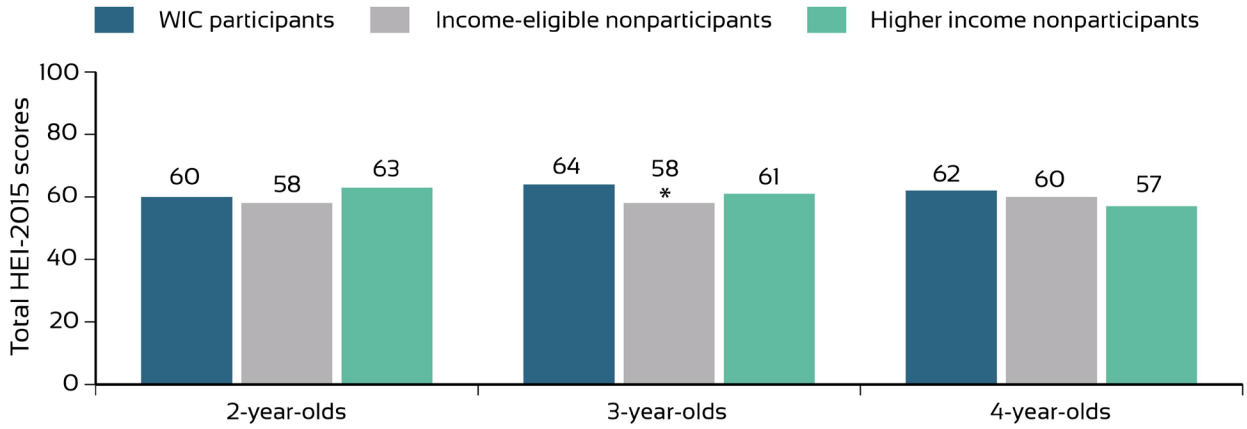
Data	Sample	Measures
NHANES 2011–2016 *Single 24-hour dietary recall per person* FPED 2011–2012, 2013–2014, 2015–2016	Children 2–4 years old	HEI-2015 total score HEI-2015 component scores

FPED = Food Patterns Equivalents Database; HEI = Healthy Eating Index; NHANES = National Health and Nutrition Examination Survey

B. HEI-2015 Total Scores

The total HEI-2015 score for all children 2–4 years old was 61 out of 100 possible points on a given day (see appendix B table B.1). WIC participants had a higher mean HEI score than income-eligible nonparticipants (62 versus 59 points). By age group, HEI scores were generally similar, but 3-year-old WIC participants had a higher mean HEI score than income-eligible nonparticipants (see figure 2.1). Total HEI-2015 scores across all groups suggest, on a given day, children fall short of meeting the DGA recommendations.

Figure 2.1. Total HEI-2015 Scores Among Children 2–4 Years Old on a Given Day by Age and Program Participation



Notes: Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 627, income-eligible nonparticipants n = 586, higher income nonparticipants n = 504
HEI = Healthy Eating Index
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 2–4 years old with complete day 1 dietary recall data.

C. HEI-2015 Component Scores

This section discusses significant findings related to HEI-2015 component scores on a given day. Several WIC foods directly correspond to adequacy components for the HEI (see text box). See table 4.2 in chapter 4 for more details on Food Package IV, the WIC food package assigned to children 1–4 years old.

WIC Food Package IV, for children 1–4 years old, includes the following:

- 100 percent fruit juice
- Milk
- Breakfast cereal
- Eggs
- Fruits and vegetables
- Whole wheat bread
- Legumes or peanut butter

Among all children 2–4 years old, the maximum score was achieved for the total fruits (5 out of 5 points) and whole fruits (5 out of 5 points) components (see table 2.3) on a given day. The maximum score was nearly achieved for the dairy component (9.9 out of 10 points). Scores were below 50 percent of the maximum score for the total vegetables (2.1 out of 5 points), greens and beans (1.6 out of 5 points), whole grains (3.2 out of 10 points), and fatty acids (2.5 out of 10 points) components. The components with low scores highlighted areas in which children's diets diverged from the 2015–2020 DGA recommendations on a given day.

Compared with income-eligible nonparticipants, WIC participants scored higher for the greens and beans, fatty acids, and added sugars components (see table 2.3) on a given day. Compared with higher income nonparticipants, WIC participants also scored higher for the fatty acids and saturated fats components but scored lower for the whole grains component (see table 2.3).

Table 2.3. HEI-2015 Mean Component Scores for Children 2–4 Years Old on a Given Day by Program Participation

Components	Maximum Score	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	–	1,724	627	586	504
Adequacy Components					
Total fruits	5	5.0	5.0	4.9	4.8
Whole fruits	5	5.0	4.9	4.8	5.0
Total vegetables	5	2.1	2.3	2.1	2.0
Greens and beans	5	1.6	2.1	1.4 *	1.6
Whole grains	10	3.2	3.0	2.8	3.8 *
Dairy	10	9.9	9.6	9.6	9.9
Total protein foods	5	4.1	4.2	4.1	3.9
Seafood and plant proteins	5	2.9	2.9	2.5	3.3
Fatty acids	10	2.5	3.1	2.3 *	2.3 *
Moderation Components					
Refined grains	10	5.9	5.9	6.2	5.5
Sodium	10	5.9	5.7	6.1	5.9
Added sugars	10	7.3	7.7	6.8 **	7.7
Saturated fats	10	5.1	5.7	5.1	4.8 *
Total HEI-2015 score	**100**	**60.5**	**61.9**	**58.7 ***	**60.5**

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Mean component scores may not sum to total score because of rounding. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.

HEI = Healthy Eating Index

Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 2–4 years old with complete day 1 dietary recall data.

Chapter 3. Indicators of Nutrition and Health

Key Takeaways

Indicators such as BMI-for-age, hemoglobin, and serum vitamin D provide insight into the nutrition and health status of children. The study found—

- A majority of children aged 1–4 had **normal** hemoglobin and serum vitamin D concentrations; **results were similar** by participant group.
- The prevalence of obesity was **higher** among **WIC children** aged 2–4 than either group of nonparticipant children.

This chapter examines selected measures of diet quality and health appropriate for comparisons between WIC participants and nonparticipants 1–4 years old and available through the NHANES MEC examination and laboratory analysis. The MEC examination includes anthropometric measurements, blood pressure, and other measures. The laboratory analysis collects biological specimens (e.g., blood, urine) that provide information about participants' health and nutritional status. Eligibility for specific laboratory tests is based on a survey participant's gender and age at the time of screening.

In this chapter, data from the MEC and laboratory analysis are used to examine BMI-for-age, hemoglobin, and serum vitamin D. The study team discusses only statistically significant differences between WIC participants and nonparticipants. Detailed results are presented in appendix C. Table 3.1 provides a synopsis of the data sources, sample, and measures examined in this chapter.

Table 3.1. Data, Sample, and Measures Used to Assess Indicators of Nutrition and Health

Data	Sample	Measures
NHANES 2011–2016 *MEC examination and laboratory data*	Children 1–4 years old *(hemoglobin and vitamin D blood serum concentrations)* Children 2–4 years old *(BMI-for-age)*	Percentages of children within various reference levels for each outcome

MEC = mobile examination center; NHANES = National Health and Nutrition Examination Survey

A. BMI-for-Age

Using CDC growth charts, BMI-for-age percentiles[26] were used to assess weight status of children 2–4 years old. Childhood BMI is of concern because being overweight or obese in childhood has been shown to persist into adulthood (Freedman et al., 2005; Must & Strauss, 1999). Being overweight or obese significantly increases the chances of developing many diseases, including type 2 diabetes, high blood

[26] BMI-for-age percentiles were evaluated relative to Centers for Disease Control and Prevention (CDC) growth charts (CDC,2018).

pressure, coronary heart disease, stroke, gallbladder disease, respiratory problems, osteoarthritis, sleep apnea, and some types of cancer (HHS, Office of Disease Prevention and Health Promotion, n.d.).

This section examines the percentage of children who fell into each BMI category. Because children grow at different rates at different ages, children's weight status was determined by using BMI-for-age percentiles that considered a child's age and gender (see table 3.2).

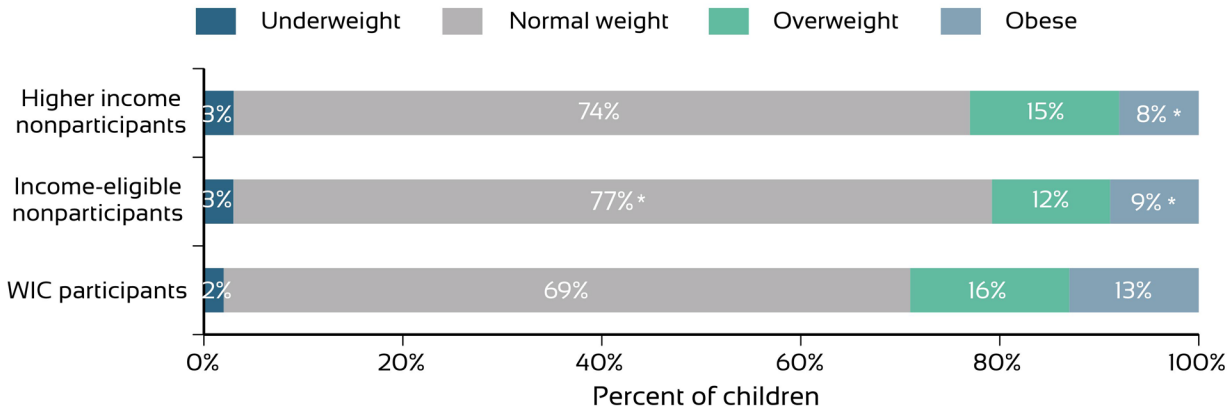
Table 3.2. Reference Values for BMI-for-Age Categories

BMI Category	Cutoff
Underweight	Below the 5th percentile
Normal weight	5th percentile to below the 85th percentile
Overweight	85th percentile to below the 95th percentile
Obese	Above or at the 95th percentile

Source: CDC, 2018

Among all children 2–4 years old included in the NHANES 2011–2016 surveys, 3 percent were underweight, about three-quarters (74 percent) were normal weight, 14 percent were overweight, and 9 percent were obese (see appendix table C.1). WIC participants had a higher prevalence of obesity than either income-eligible or higher income nonparticipants (13 versus 9 and 8 percent; see figure 3.1). Among boys, a lower percentage of WIC participants were normal weight compared with higher income nonparticipants (65 versus 77 percent; see appendix table C.1). There were no differences in BMI-for-age among girls by participant group.

Figure 3.1. Percentage of Children 2–4 Years Old in Each BMI-for-Age Category by Program Participation



Notes: Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 627, income-eligible nonparticipants n = 586, higher income nonparticipants n = 504
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 body measures data. Sample includes NHANES children 2–4 years old with complete day 1 dietary recall, weight, and height data.

B. Hemoglobin

This section examines hemoglobin status among children 1–4 years old. A low hemoglobin concentration (less than 110 grams per liter; World Health Organization [WHO], 2011) indicates anemia as a result of iron deficiency or other nutritional or non-nutritional causes.[27] Low hemoglobin is a criterion WIC uses to establish nutritional risk among WIC participants and as a proxy for iron deficiency. Among children, iron deficiency anemia can have serious cognitive and psychomotor effects that can lead to learning difficulties (NIH ODS, 2019).

Among all children 1–4 years old, 96 percent had normal hemoglobin concentrations, and results were similar across participant groups (see appendix table C.2). Among girls, a lower percentage of WIC participants had normal hemoglobin than higher income nonparticipants (95 versus 98 percent). These findings are consistent with the intake-based findings in chapter 6 that the prevalence of adequate usual iron intakes among children was 100 percent.

C. Serum Vitamin D

Vitamin D plays an important role in bone health, and deficiency can cause rickets in children (NIH ODS, 2019). This section assesses serum concentrations of vitamin D (25-hydroxyvitamin D) against normal ranges among WIC participants and nonparticipants.[28] Reference values for serum vitamin D for children younger than 5 years old are provided in table 3.3. Intakes of vitamin D are presented in chapter 6 and briefly noted in this chapter to provide additional context.

Table 3.3. Reference Values for Serum Vitamin D Concentrations in Children 1–4 Years Old

Serum Vitamin D Concentration	Cutoff
Adequate	Greater than or equal to 50 and less than 125 nmol/L
Insufficient	Greater than or equal to 30 and less than 50 nmol/L
Associated with deficiency	Less than 30 nmol/L

nmol/L = nanomoles per liter
Source: IOM, 2011

Among all children 1–4 years old, most (93 percent) had serum vitamin D concentrations considered adequate for bone health, and results were similar across participant groups (see appendix table C.3). Among boys, a lower percentage of WIC participants had adequate serum vitamin D concentrations compared with higher income nonparticipants (91 versus 99 percent). As expected, these findings differ from the intake-based findings in chapter 6 that the prevalence of adequate usual vitamin D intakes among children was 14 percent. This is because very few foods contain vitamin D unless they are fortified (e.g., milk). Vitamin D is also synthesized by the skin through sun exposure (IOM, 2011).

[27] These reference levels are used for the nonsmoking population residing at sea level. Adjustments are made for smokers and those residing at 1000 or more meters above sea level based on WHO (2011) recommendations. Hemoglobin concentrations were not adjusted for measures of inflammation.
[28] This indicator of health was identified from CDC's report on its study to assess the U.S. population's nutritional status as of 2012 (CDC, n.d.).

Chapter 4. Food Consumption Patterns

Key Takeaways

Food consumption patterns reflect food groups and subgroups consumed on a given day. Overall, percentages of children consuming each food group were similar for WIC children and income-eligible nonparticipant children. The study also found—

- A **lower** percentage of **WIC children** consumed whole milk on a given day compared with income-eligible nonparticipant children.
- A **higher** percentage of **WIC children** consumed 100 percent fruit juice and 1 percent milk on a given day than either group of nonparticipant children.
- A **lower** percentage of **WIC children** consumed cooked vegetables and canned or frozen fruit on a given day compared with income-eligible nonparticipant children.

This chapter examines the food consumption patterns of WIC participants and nonparticipants by estimating the following:

- **Proportions of children consuming foods provided in WIC Food Package IV.** The percentages reported for Food Package IV, which is assigned to young children 1–4 years old, reflect the proportion of children who consumed various WIC-eligible foods (see table 4.2) on the day covered in the dietary recall.
- **Proportions of children consuming foods from supermarket aisle food groups and subgroups.** The percentages reported for supermarket aisle food groups reflect the proportion of children consuming one or more foods from a given food group, in any amount, on the day covered in the dietary recall.
- **Consumption of specific supermarket aisle food subgroups.** The percentages reported for supermarket aisle food subgroups reflect the proportion of children who consumed one or more foods in a given food subgroup, among those consuming any food from a given food group, on the day covered in the dietary recall. This approach allowed the study team to compare food choices of WIC participants and nonparticipants while controlling for overall levels of consumption at the food group level.
- **Average amounts of food consumed from supermarket aisle food groups and subgroups.** The amounts reported reflect the average amounts consumed among those consuming any food from a given food group or subgroup, on the day covered in the dietary recall. Average amounts are reported in FPED units of cup or ounce equivalents and/or in grams, depending on which unit is appropriate for the food group.

The food groups and subgroups used in the analysis are defined using the "supermarket aisle" approach (Cole & Fox, 2008a). This approach categorizes foods into 1 of 10 food groups and then into subgroups. For example, whole milk, 2 percent milk, cheese, and yogurt are subgroups in the milk and milk products group. Table 4.1 presents the complete list of food groups and subgroups used for the supermarket aisle approach. All the supermarket aisle food groups and subgroups reflect foods consumed as discrete items. This means combination items—such as sandwiches, Mexican entrees, green salads, and soups—reported in the dietary recall as individual components are counted as one item (e.g., a sandwich reported as a beef patty, cheese, and a roll is counted as one item and included in the "cheeseburger/hamburger" subgroup).

Table 4.1. Supermarket Aisle Food Groups and Subgroups Used to Classify Types of Foods Consumed

Food Group	Subgroups		
Grains	▪ Bread ▪ Rolls ▪ English muffin ▪ Bagels ▪ Biscuits, scones, croissants ▪ Muffins	▪ Cornbread ▪ Corn tortillas ▪ Flour tortillas ▪ Taco shells ▪ Crackers ▪ Breakfast/granola bar	▪ Pancakes, waffles, French toast ▪ Cold cereal ▪ Hot cereal ▪ Rice ▪ Pasta
Vegetables	▪ Raw lettuce/greens ▪ Raw carrots ▪ Raw tomatoes ▪ Raw cabbage/coleslaw ▪ Other raw ▪ Salad (w/ greens) ▪ Cooked green beans	▪ Cooked corn ▪ Cooked peas ▪ Cooked carrots ▪ Cooked broccoli ▪ Cooked tomatoes ▪ Cooked mixed ▪ Cooked starchy	▪ Other cooked deep yellow ▪ Other cooked dark green ▪ Other cooked ▪ Other fried ▪ Cooked potatoes, not fried ▪ Cooked potatoes, fried ▪ Vegetable juice
Fruits and 100 percent fruit juice	▪ Fresh orange ▪ Fresh other citrus ▪ Fresh apple ▪ Fresh banana ▪ Fresh melon ▪ Fresh watermelon ▪ Fresh grapes	▪ Fresh peach/nectarine ▪ Fresh pear ▪ Fresh berries ▪ Other fresh fruits ▪ Avocado/guacamole ▪ Lemon/lime—any form ▪ Canned/frozen peaches	▪ Applesauce, canned/frozen apples ▪ Canned/frozen pineapple ▪ Other canned/frozen ▪ Noncitrus juice ▪ Citrus juice ▪ Dried fruit
Milk and milk products	▪ Unflavored whole milk ▪ Unflavored 2 percent milk ▪ Unflavored 1 percent milk ▪ Unflavored skim milk ▪ Unflavored milk—percent fat NFS	▪ Flavored whole milk ▪ Flavored 2 percent milk ▪ Flavored 1 percent milk ▪ Flavored skim milk ▪ Flavored milk—percent fat NFS	▪ Dry or evaporated milk ▪ Yogurt ▪ Cheese
Meat and meat alternatives	▪ Beef ▪ Ground beef ▪ Pork ▪ Ham ▪ Lamb and misc. meats ▪ Chicken ▪ Organ meats	▪ Turkey ▪ Cold cuts ▪ Fish ▪ Shellfish ▪ Bacon/sausage ▪ Eggs ▪ Beans	▪ Baked/refried beans ▪ Soy products ▪ Protein/meal enhancement ▪ Nuts ▪ Peanut/almond butter ▪ Seeds

Food Group	Subgroups		
Mixed dishes	▪ Tomato sauce and meat (no pasta) ▪ Chili con carne ▪ Meat mixtures with red meat ▪ Meat mixtures with chicken/turkey ▪ Meat mixtures with fish ▪ Hamburgers/cheeseburgers ▪ Hot dogs	▪ Luncheon meat sandwich ▪ Beef/pork/ham sandwich ▪ Chicken/turkey sandwich ▪ Cheese (no meat) sandwich ▪ Fish sandwich ▪ Peanut butter sandwich ▪ Breakfast sandwich ▪ Mexican entrees	▪ Pizza (no meat) ▪ Pizza with meat ▪ Macaroni and cheese ▪ Pasta dishes ▪ Rice dishes ▪ Other grain mixtures ▪ Soups/stews ▪ Vegetable mixtures ▪ Entrée salads
Other beverages[a]	▪ Coffee ▪ Tea ▪ Beer ▪ Wine ▪ Liquor	▪ Energy drinks ▪ Water (plain) ▪ Regular soda ▪ Sugar-free soda ▪ Plant-based beverages	▪ Noncarbonated sweetened drink ▪ Noncarbonated low-calorie/sugar-free drinks
Sweets and desserts	▪ Sugar and sugar substitutes ▪ Syrups/sweet toppings ▪ Jelly ▪ Gelatin dessert ▪ Ice cream	▪ Pudding ▪ Flavored ice ▪ Sweet rolls ▪ Cake/cupcakes ▪ Cookies	▪ Pie/cobblers ▪ Pastries ▪ Doughnuts ▪ Candy
Salty snacks	▪ Corn-based salty snacks ▪ Pretzels/party mix	▪ Popcorn	▪ Potato chips
Added fats and oils	▪ Butter ▪ Margarine ▪ Other added oils	▪ Salad dressing ▪ Mayonnaise ▪ Gravy	▪ Cream cheese ▪ Cream/sour cream

Notes: "Other raw" and "Other cooked" vegetables include all vegetables not categorized separately.
NFS = not further specified
[a] The "Other beverages" food group excludes milk and 100 percent fruit juice but includes water.

Federal WIC regulations specify the types and quantities of each type of food allowed to be provided in the food package.[29] Regulatory and policy changes announced in the Interim Rule (implemented in 2009) substantially altered the contents of WIC food packages.[30] The version of Food Package IV—the food package assigned to children 1–4 years old, as explained earlier in this chapter—that was in place when the NHANES 2011–2016 data were collected, after implementation of the Interim Rule, included the following types of foods: juice, milk, breakfast cereal, eggs, fruits and vegetables, whole wheat or whole grain bread, and legumes or peanut butter (see table 4.2; USDA FNS, 2013c). WIC food packages underwent additional moderate revisions with the implementation of the Final Rule in 2014, at the midpoint of the NHANES data collection period used for this study.[31] These revisions included the authorization of yogurt as a partial milk substitute, whole wheat pasta as a whole grain option, and the authorization only of 1 percent and skim milk (i.e., no 2 percent milk) for women and children 2–4 years old. WIC-eligible foods were identified in the NHANES data based on food descriptions (hereafter referred to as WIC foods).

[29] WIC State agencies can further restrict the foods authorized to WIC participants.
[30] See 73 Fed. Reg. 14153 (Special Supplemental Nutrition Program for Women, Infants and Children (WIC): Revisions in the WIC Food Packages; Delay of Implementation Date, 2009)
[31] See 79 Fed. Reg. 12273 (Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): Revisions in the WIC Food Packages; Final Rule, 2014)

Table 4.2. Foods Provided to Children 1–4 Years Old Through Food Package IV

Food Group	Quantity per Month	Parameters[a]
Juice	128 fluid ounces	▪ 100 percent unsweetened pasteurized juice ▪ Any fruit and/or vegetable juice or juice blends ▪ Fresh, single-strength, from concentrate, frozen, canned, shelf stable
Milk	16 quarts	▪ 1-year-olds: whole fat cow's milk ▪ 2- to 4-year-olds: low-fat (1 percent), or nonfat (skim) cow's milk ▪ Cultured, evaporated, dry, calcium-fortified, lactose-reduced, lactose-free, acidified, shelf stable, flavored, or unflavored ▪ Allowable options are yogurt, cheese, soy-based beverage, and tofu
Breakfast cereal	36 ounces	▪ Ready-to-eat ▪ Instant and regular hot cereals
Eggs	1 dozen	▪ Fresh-shell domestic hen's eggs, dried egg mix, pasteurized liquid whole eggs
Fruits and vegetables	$8.00 in cash value vouchers[b]	▪ Any variety of fresh whole, fresh cut, canned, frozen, or dried without added sugars, fats, oils, or salt ▪ Includes fresh, canned, or frozen beans, peas, or lentils
Whole wheat or whole grain bread	2 pounds	▪ Allowable options are whole grain bread, brown rice, bulgur, oatmeal, whole grain barley, whole wheat macaroni products, or soft corn or whole wheat tortillas
Legumes or peanut butter	1 pound (64 ounces canned) or 18 ounces	▪ Any type of mature dry beans, peas, or lentils in dry-packaged or canned forms ▪ Legumes may not contain added sugars, fats, oils or meat, fruits, or vegetables as purchased ▪ Peanut butter may be creamy or chunky, regular or reduced fat, or salted or unsalted

[a] Parameters reflect options authorized under the Final Rule implemented in 2014. For complete regulatory requirements, see https://www.fns.usda.gov/wic/wic-food-packages-regulatory-requirements-wic-eligible-foods
[b] Also known as the cash value benefit in State agencies using EBT systems

This chapter discusses only statistically significant and reliable differences between WIC participants and nonparticipants.[32] Section A compares overall consumption for each food group. Section B discusses consumption of WIC-eligible foods. Sections C through L provide more details on consumption patterns for each supermarket aisle food group, separately. Appendix D presents data for every food group and subgroup defined in the supermarket aisle approach. Average amounts of food consumed are not discussed in this chapter but appear in appendix tables D.3 through D.6.

Table 4.3 provides a synopsis of the data sources, sample, and measures examined in this chapter. In this chapter, findings are used to compare reported intakes between WIC participants and nonparticipants; findings presented in this chapter should not be construed as representing total intakes of FPED food groups or compared with recommendations for these food groups. Importantly, these analyses are based on 1 day of dietary recall data (specifically, the day 1 dietary recall). These findings represent intakes on a given day and should not be interpreted as usual intakes of food groups or subgroups.

[32] In some cases, between-group differences may be statistically significant even when one point estimate is unreliable. This report does not discuss results determined to be unreliable or comparisons for which either estimate in the comparison was determined to be unreliable.

Table 4.3. Data, Sample, and Measures Used to Assess Food Consumption Patterns

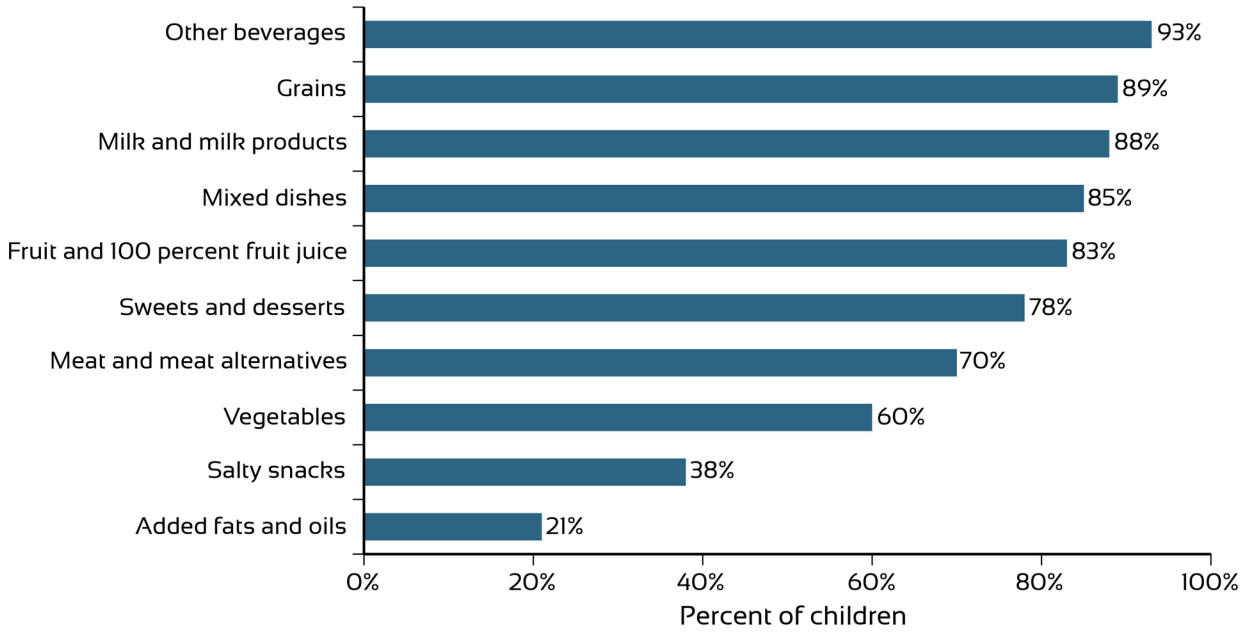
Data	Sample	Measures
NHANES 2011–2016 *Single 24-hour dietary recall per person* FPED 2011–2012, 2013–2014, 2015–2016	Children 1–4 years old	Proportion of children who consumed foods provided in the WIC food **package** Proportion of children who consumed food from each supermarket aisle food **group** Proportion of children who consumed food from each supermarket aisle food subgroup, among those consuming the food group Mean amounts (in FPED units and grams) of food consumed from supermarket aisle food groups and subgroups, among those consuming the food group

FPED = Food Patterns Equivalents Database; NHANES = National Health and Nutrition Examination Survey

A. Consumption of Each Food Group

Overall, most children (80 percent or more) consumed discrete food items from the other beverages, grains, milk and milk products, mixed dishes, and fruits and 100 percent fruit juice supermarket aisle food groups on the day covered in the dietary recall (see figure 4.1).

Figure 4.1. Percentage of Children 1–4 Years Old Consuming Any Discrete Food Items From 10 Supermarket Aisle Food Groups on a Given Day



Notes: The "Other Beverages" food group excludes milk and 100 percent fruit juice but includes water.
Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population.
All young children n = 2,314
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

A higher percentage of WIC participants than higher income nonparticipants consumed discrete items from the grains, fruits and 100 percent fruit juice, other beverages, and added fats and oils food groups on a given day. A higher percentage of WIC participants than higher income nonparticipants consumed discrete items from the salty snacks food group (see table 4.4). Percentages of children consuming each food group were similar for WIC participants and income-eligible nonparticipants.

Table 4.4. Percentage of Children Consuming Any Discrete Food Items From 10 Supermarket Aisle Food Groups by Program Participation on a Given Day

Food Group	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Grains	89.1	86.1	87.0	92.7 **
Vegetables	60.0	56.3	59.7	62.4
Fruits and 100 percent fruit juice	83.4	80.5	77.7	88.7 ***
Milk and milk products	88.4	88.5	86.9	90.0
Meat and meat alternatives	70.0	70.4	68.9	69.9
Mixed dishes	84.5	83.9	84.6	85.1
Other beverages[a]	93.1	90.5	93.5	94.6 *
Sweets and desserts	78.2	75.4	80.1	78.7
Salty snacks	38.0	40.3	40.5	34.1 *
Added fats and oils	21.3	16.4	18.7	26.8 ***

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
[a] The "Other Beverages" food group excludes milk and 100 percent fruit juice but includes water.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

B. Consumption of WIC Foods

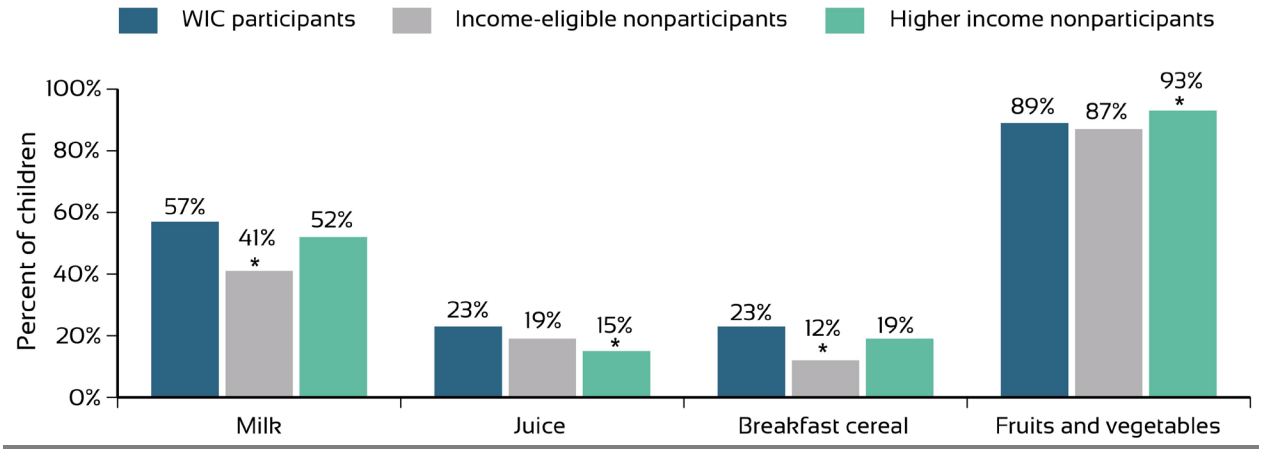
This section discusses significant findings related to the percentages of children consuming WIC-eligible foods as either discrete food items or as part of a mixed dish on a given day.

The WIC food package for children 1–4 years old (see table 4.2) allows some flexibility in food choices. Substitutions for fluid milk include yogurt, cheese, soy-based beverage, and tofu. Substitutions for whole wheat bread include whole grain bread, brown rice, bulgur, oatmeal, whole grain barley, whole wheat macaroni products, and soft corn or whole wheat tortillas. Legumes (dry beans and peas) may be provided in dry-packaged or canned forms; legumes or peanut butter is offered. For cereal and juice, participants are given a list of WIC-approved foods that specifies all brands, types, and package sizes of allowable items that can be selected. Each State's list of WIC-approved foods is based on the Federal nutrient requirements for WIC foods as well as cost-containment practices, product availability, and participant preference, which vary by WIC State agency. Because the rate of substitutions is unknown and varies by State, and because some substitutions are not authorized in every State (e.g., yogurt, whole wheat pasta), substitute food items were excluded from the analysis here (i.e., Section B).

Otherwise, an inclusive definition of WIC-eligible foods was used. WIC-eligible foods identified as components of mixed dishes were included in the analysis. The definition of whole grain bread the study team was able to apply using FPED data differs from the WIC eligibility standard that whole grain must be the primary ingredient by weight. Neither NHANES nor FPED contain information about ingredients in food items.

Nearly all children (95 percent) consumed at least one WIC-eligible food on the day covered in the dietary recall (see appendix table D.1). A higher percentage of WIC participants reported consuming WIC-eligible foods overall than income-eligible nonparticipants. Compared with higher income nonparticipants, a higher percentage of WIC participants consumed 100 percent fruit juice (15 versus 23 percent), but a lower percentage consumed fruits and vegetables (89 versus 93 percent; see figure 4.2). Compared with income-eligible nonparticipants, a higher percentage of WIC participants consumed WIC-eligible milk[33] and breakfast cereal[34] (57 versus 41 percent and 23 versus 12 percent, respectively).

Figure 4.2. Percentage of Children 1–4 Years Old Consuming Selected WIC-Eligible Foods by Program Participation on a Given Day



Notes: Estimates are based on the day 1 dietary recall. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

[33] WIC-eligible includes unflavored cow's milk, dry milk, evaporated milk, lactose-free milk, and soy beverages. Allowed fat content of WIC-eligible cow's milk depends on age and year to reflect changes in milk eligibility. The analysis is limited to whole milk for 1-year-olds; 2 percent, 1 percent, and skim milk for 2- to 4-year-olds from 2011–2014; and 1 percent and skim milk for 2- to 4-year-olds from 2015–2016.
[34] WIC-eligible breakfast cereal must contain at least 28 milligrams of iron and less than 21.2 grams of sugar per 100 grams dry cereal.

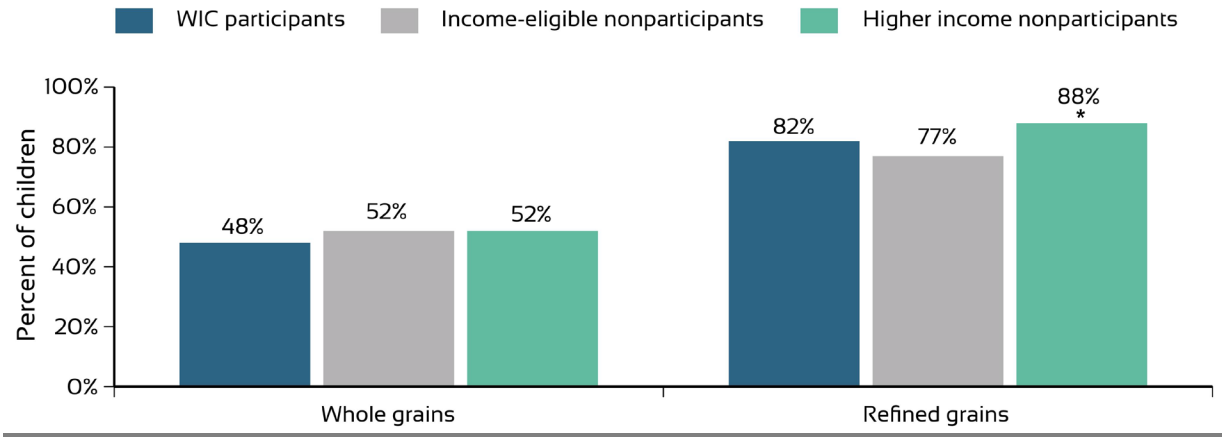
C. Consumption of Grains as Discrete Food Items

This section discusses significant findings related to the percentages of children consuming grains as a discrete food item and the consumption of specific grain items on a given day.

1. Percentage of children consuming grains as discrete food items

Most children (89 percent) consumed a discrete grain or grain-based item on the day covered in the dietary recall (see figure 4.1). This excludes grains and grain-based foods included in mixed dishes like sandwiches. A lower percentage of WIC participants than higher income nonparticipants consumed discrete grains (86 versus 93 percent; see table 4.4). Among children who consumed a discrete grain, more than half (51 percent) consumed whole grains, and 83 percent consumed refined grains. A lower percentage of WIC participants consumed a discrete refined grain than higher income nonparticipants (82 versus 88 percent; see figure 4.3).

Figure 4.3. Among Children Consuming Any Discrete Grains on a Given Day, Percentage of Children 1–4 Years Old Consuming Whole Grains[a] and Refined Grains by Program Participation



Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
[a] Grains are classified as whole grains if more than 50 percent of the total grains are whole grain. The Food Patterns Equivalents Database (FPED) data sources listed below were used to classify grains.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; FPED 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

2. Consumption of specific grains

Among children eating at least one discrete grain item, cold cereal was the most commonly consumed item overall (49 percent of children; see table 4.5). More than one-third (38 percent) of children consumed crackers, and about one-quarter (22 percent) consumed bread. Compared with higher income nonparticipants, a higher percentage of WIC participants consumed cold cereal, but a much lower percentage consumed crackers or pancakes, waffles, and French toast.

Table 4.5. Top Five Most Commonly Consumed Discrete Grains on a Given Day by Program Participation

Discrete Grain	All Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Cold cereal	49.0	53.0	52.1	44.6 *
Crackers	38.0	28.4	31.6	49.0 ***
Bread	22.4	22.3	19.4	24.5
Pancakes, waffles, French toast	15.6	10.5	13.3	20.9 **
Rice	13.9	16.1	13.7	12.5

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

D. Consumption of Vegetables as Discrete Food Items

This section discusses significant findings related to the percentages of children consuming vegetables as a discrete food item and the consumption of specific vegetable items on a given day.

1. Percentage of children consuming vegetables as discrete food items

Sixty percent of children consumed a discrete vegetable on the day covered in the dietary recall (see figure 4.1). Among these children, two-thirds (65 percent) consumed cooked vegetables excluding potatoes (hereafter referred to as cooked vegetables), 43 percent consumed cooked potatoes, and 21 percent consumed raw vegetables (see appendix table D.2). A higher percentage of WIC participants than higher income nonparticipants consumed cooked potatoes (50 versus 33 percent). A lower percentage of WIC participants than either group of nonparticipants consumed cooked vegetables (58 versus 68 and 69 percent).

2. Consumption of specific vegetables

Among children eating at least one discrete vegetable, fried potatoes were the most commonly consumed vegetable overall (31 percent of children; see table 4.6). A higher percentage of WIC participants consumed potatoes in general, either fried or not fried, than higher income nonparticipant children (see table 4.6). Compared with income-eligible nonparticipants, a much higher percentage of WIC participants consumed cooked corn (6 versus 19 percent).

Table 4.6. Top Five Most Commonly Consumed Discrete Vegetables on a Given Day by Program Participation

Discrete Vegetable	All Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Cooked potatoes, fried	31.0	38.0	32.0	25.3 **
Cooked tomatoes	21.5	20.6	21.8	22.9
Cooked green beans	13.3	13.3	9.5	16.0
Cooked potatoes, not fried	13.2	13.6	19.4	8.1 *
Cooked corn	10.5	5.5	18.9 ***	7.8

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls
; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

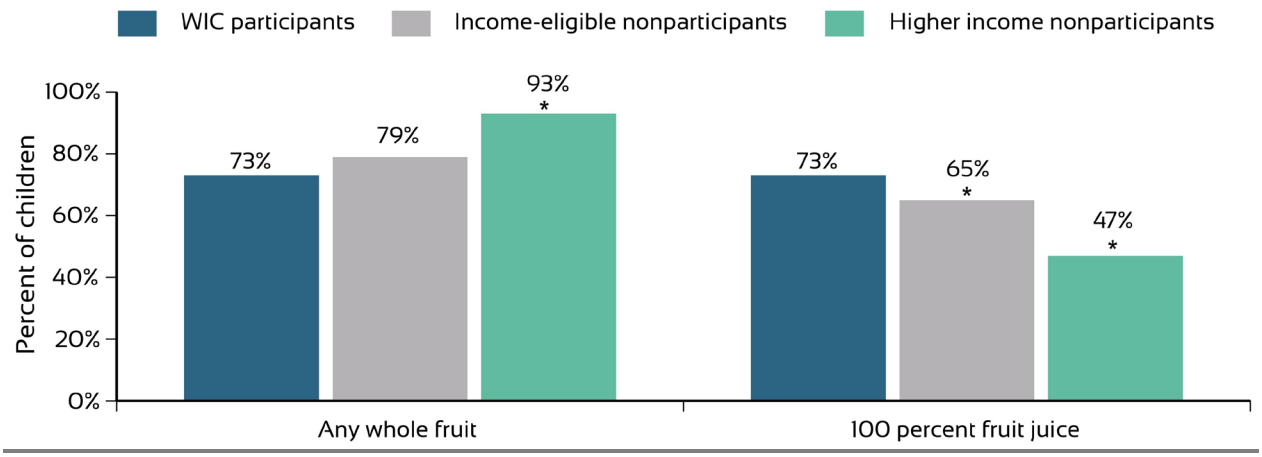
E. Consumption of Fruits and 100 Percent Fruit Juice as Discrete Food Items

This section discusses significant findings related to the percentages of children consuming fruits and 100 percent fruit juice (hereafter referred to as fruit juice) as discrete food items and the consumption of specific fruits and fruit juice items on a given day.

1. Percentage of children consuming fruits and 100 percent fruit juice as discrete food items

Most children (83 percent) consumed a discrete fruit or fruit juice on the day covered in the dietary recall (see figure 4.1). A lower percentage of WIC participants consumed fruits and fruit juice overall compared with higher income nonparticipants (81 versus 89 percent; see table 4.4). Whole fruits were consumed by 83 percent of children, and almost two-thirds (60 percent) consumed fruit juice. A lower percentage of WIC participants consumed whole fruits than higher income nonparticipants (73 versus 93 percent, see figure 4.4). A higher percentage of WIC participants than income-eligible nonparticipants and higher income nonparticipants consumed fruit juice (73 versus 65 and 47 percent, respectively).

Figure 4.4. Percentage of Children 1–4 Years Old Consuming Whole Fruits and 100 Percent Fruit Juice Among Those Consuming Any Fruits and 100 Percent Fruit Juice on a Given Day by Program Participation



Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls
; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

2. Consumption of specific fruits and 100 percent fruit juices

Among children consuming at least one discrete fruit or fruit juice on the day covered in the dietary recall, almost one-quarter (71 percent) consumed fresh fruit (see appendix table D.2). The most commonly consumed fresh fruits were bananas and apples (26 and 22 percent, respectively; see table 4.7). About half (49 percent) of children consumed noncitrus juice.

A lower percentage of WIC participants than either income-eligible or higher income nonparticipants consumed canned or frozen fruits without syrup on a given day (13 versus 21 and 28 percent, respectively). Compared with higher income nonparticipants, a higher percentage of WIC participants consumed noncitrus juice (59 versus 38 percent), and they were more than three times less likely to consume fresh berries (8 versus 27 percent). Compared with income-eligible nonparticipants, a higher percentage of WIC participants consumed fresh banana (29 versus 22 percent).

Table 4.7. Top Five Most Commonly Consumed Discrete Fruits and 100 Percent Fruit Juices on a Given Day by Program Participation

Discrete Fruits or 100 Percent Fruit Juice	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Noncitrus juice	48.5	59.0	53.1	37.5 ***
Fresh banana	26.4	29.1	22.0 *	28.0
Fresh apple	22.3	23.1	21.7	22.1
Canned or frozen fruits, no syrup	21.8	13.3	20.8 **	28.0 ***
Fresh berries	16.7	7.9	10.2	26.5 ***

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

F. Consumption of Milk and Milk Products as Discrete Food Items

This section discusses significant findings related to the percentages of children consuming milk and milk products as discrete food items and the consumption of specific milk and milk product items on a given day.

1. Percentage of children consuming milk and milk products as discrete food items

The majority (88 percent) of children consumed discrete milk or milk products on the day covered in the dietary recall (see figure 4.1). Most children (91 percent) consumed cow's milk, 30 percent consumed cheese, and 23 percent consumed yogurt. There were no differences in overall milk and milk product consumption by participant group (see table 4.4)

2. Consumption of specific milk and milk products

Among children consuming at least one discrete milk or milk product, unflavored whole milk and unflavored 2 percent milk were the most commonly consumed items on the day covered in the dietary recall (40 and 36 percent, respectively; see table 4.8). Cheese and yogurt were the next most commonly consumed milk products.

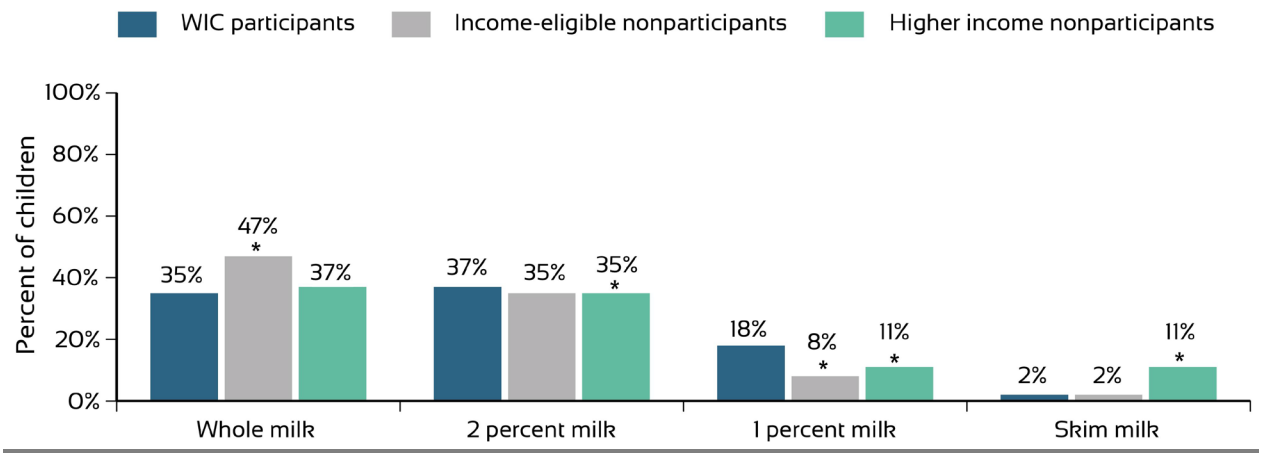
A higher percentage of WIC participants consumed unflavored 1 percent milk than either income-eligible or higher income nonparticipants (18 versus 8 and 11 percent, see figure 4.5). Compared with income-eligible nonparticipants, a lower percentage of WIC participants consumed unflavored whole milk. Compared with higher income nonparticipants, a lower percentage of WIC participants consumed yogurt (18 versus 31 percent).

Table 4.8. Top Five Most Commonly Consumed Discrete Milk and Milk Products on a Given Day by Program Participation

Discrete Milk or Milk Product	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Whole milk, unflavored	39.9	34.9	47.1 **	37.2
2 percent milk, unflavored	35.6	37.3	35.3	34.9
Cheese	29.8	24.9	30.3	32.6
Yogurt	22.6	17.6	17.1	30.6 ***
1 percent milk, unflavored	11.8	17.7	8.0 **	10.6 *

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

Figure 4.5. Percentage of Children 1–4 Years Old Consuming Each Type of Unflavored Milk on a Given Day Among Those Consuming Milk and Milk Products by Program Participation



Notes: Excludes flavored milk. Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

G. Consumption of Meat and Meat Alternatives as Discrete Food Items

This section discusses significant findings related to the percentages of children consuming meat and meat alternatives as discrete food items and the consumption of specific meat and meat alternative items on a given day.

1. Percentage of children consuming meat and meat alternatives as discrete food items

More than two-thirds (70 percent) of children consumed a discrete meat or meat alternative on the day covered in the dietary recall (see figure 4.1). There were no differences in the percentage of children consuming discrete meats or meat alternatives by participant group (see table 4.4).

2. Consumption of specific meat and meat alternatives

Among children eating at least one discrete meat or meat alternative, chicken and eggs were the most commonly consumed items on a given day (43 and 31 percent, respectively; see table 4.9). Consumption of meat and meat alternatives was generally similar across participant groups, but a lower percentage of children participating in WIC consumed hot dogs than higher income nonparticipants (8 versus 16 percent).

Table 4.9. Top Five Most Commonly Consumed Discrete Meats and Meat Alternatives on a Given Day by Program Participation

Discrete Meat or Meat Alternative	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Chicken	42.7	45.2	47.2	37.8
Eggs	31.2	33.4	32.2	29.4
Bacon/sausage	14.9	13.0	17.3	14.8
Beans	10.6	12.8	9.2	10.4
Hot dogs	10.5	7.5	5.8	16.4 **

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.

Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

H. Consumption of Mixed Dishes

This section discusses significant findings related to the percentages of children consuming mixed dishes and the consumption of specific mixed-dish items on a given day.

1. Percentage of children consuming mixed dishes as discrete food items

Most children (85 percent) consumed a discrete mixed dish on the day covered in the dietary recall (see figure 4.1). There were no differences in consumption of mixed dishes overall by program participation status (see table 4.4).

2. Consumption of specific mixed dishes

Among children who reported eating at least one discrete mixed dish, pasta dishes and Mexican entrees were the most commonly consumed items on the day covered in the dietary recall (16 percent for both; see table 4.10). Macaroni and cheese, peanut butter sandwiches, and soups/stews were also commonly consumed. Compared with income-eligible and higher income nonparticipants, a lower percentage of WIC participants consumed peanut butter sandwiches (7 versus 12 and 17 percent, respectively) and a higher percentage consumed soups/stews (22 versus 11 and 10 percent, respectively).

Table 4.10. Top Five Most Commonly Consumed Discrete Mixed Dishes on a Given Day by Program Participation

Discrete Mixed Dish	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Pasta dishes	16.1	15.4	18.6	14.5
Mexican entrees	15.9	17.7	16.0	15.2
Macaroni and cheese	15.4	15.5	14.6	15.5
Soups/stews	13.6	22.1	11.0 ***	9.5 ***
Peanut butter	12.6	6.7	12.0 *	17.1 ***

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

I. Consumption of Beverages Other Than Milk and 100 Percent Fruit Juice

This section discusses significant findings related to the percentages of children consuming beverages other than milk and 100 percent fruit juice (hereafter referred to as beverages) as a discrete item and the consumption of specific beverages on a given day.

1. Percentage of children consuming beverages other than milk and 100 percent fruit juice as discrete food items

Almost all (93 percent) children reported consuming a discrete beverage on the day covered in the dietary recall (see figure 4.1). WIC participants were less likely to consume a discrete beverage than higher income nonparticipants (see table 4.4).

2. Consumption of specific beverages other than milk and 100 percent fruit juice

Among children consuming at least one discrete beverage, water was the most commonly consumed beverage (87 percent of children, see table 4.11). Noncarbonated sweetened drinks (e.g., juice drinks that were not 100 percent fruit juice) were the second most commonly consumed type of beverage. A higher percentage of WIC participants consumed noncarbonated sweetened beverages, regular soda, and tea than higher income nonparticipants, and a lower percentage consumed water.

Table 4.11. Top Five Most Commonly Consumed Discrete Beverages on a Given Day by Program Participation

Discrete Beverage	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Water (plain)	86.5	83.8	82.9	91.4 **
Noncarbonated, sweetened drinks	35.5	41.4	41.6	26.4 ***
Soda, regular	14.0	18.7	17.3	8.2 ***
Noncarbonated, low-calorie/sugar-free drinks	9.2	11.0	9.8	7.8
Tea	7.4	8.3	10.1	4.4 *

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

J. Consumption of Sweets and Desserts

This section discusses significant findings related to the percentages of children consuming sweets and desserts as a discrete food item and the consumption of specific sweets and desserts on a given day. Sugar-sweetened beverages are not included in the sweets and desserts but rather in the beverages other than milk and 100 percent fruit juice category, discussed in section I of this chapter.

1. Percentage of children consuming sweets and desserts as discrete food items

Most children (78 percent) consumed a discrete sweet or dessert on the day covered in the dietary recall (see figure 4.1). The percentage of children consuming a sweet or dessert was comparable across participant groups (see table 4.4).

2. Consumption of specific sweets and desserts

Among children consuming at least one discrete sweet or dessert, cookies and candy were the most commonly consumed items on the day covered in the dietary recall (46 and 38 percent, respectively; see table 4.12). A lower percentage of children participating in WIC consumed candy compared with income-eligible nonparticipants (33 versus 42 percent).

Table 4.12. Top Five Most Commonly Consumed Discrete Sweets and Desserts on a Given Day by Program Participation

Discrete Sweets and Desserts	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Cookies	45.9	44.7	41.7	48.4
Candy	37.9	33.1	42.0 *	37.3
Ice cream	19.7	17.3	17.6	22.8
Syrups/sweet toppings	16.2	13.4	16.1	18.1
Flavored ice	9.1	7.1	10.4	9.1

Notes: Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Sources: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

K. Consumption of Salty Snacks

This section discusses significant findings related to the percentages of children consuming salty snacks as a discrete food item and the consumption of specific salty snack items on a given day. Salty snacks were divided into four categories: corn-based salty snacks, pretzels/party mix, popcorn, and potato chips.

1. Percentage of children consuming salty snacks as discrete food items

More than one-third (38 percent) of children consumed a discrete salty snack on the day covered in the dietary recall (see figure 4.1). A lower percentage of WIC participants consumed salty snacks compared with higher income nonparticipants (40 versus 34 percent; see table 4.4).

2. Consumption of specific salty snacks

Among children eating at least one discrete salty snack, corn-based salty snacks were the most commonly consumed item on a given day (42 percent; see appendix table D.1).

L. Consumption of Added Fats and Oils

This section discusses significant findings related to the percentages of children consuming added fats and oils as a discrete food item and the consumption of specific added fats and oils on a given day.

1. Percentage of children consuming added fats and oils as discrete food items

Less than one-quarter (21 percent) of children consumed a discrete fat or oil on the day covered in the dietary recall (see figure 4.1). A lower percentage of WIC participants consumed a discrete fat or oil compared with higher income nonparticipants (16 versus 27 percent; see table 4.4).

Among children consuming at least one discrete fat or oil, butter was the most commonly consumed item overall (40 percent). Consumption of butter was similar across participant groups (see appendix table D.1).

Chapter 5. Usual Energy and Macronutrient Intakes

Key Takeaways

Mean usual intakes of macronutrients and fiber for children aged 1–4 were compared with the acceptable macronutrient distribution ranges (AMDR) and adequate intake level (AI), respectively. Percentage of energy intakes from saturated fats and added sugars on a given day were compared with the 2015–2020 DGA recommendations for children aged 2–4. Generally, macronutrient intakes were within the AMDRs, but percentages of calories consumed from saturated fats and added sugars on a given day exceeded DGA recommendations. The study also found—

- A **higher** percentage of **WIC children** had usual intakes of protein **within the AMDR** compared with higher income nonparticipant children.
- A **similar** percentage of **WIC children** and nonparticipant children had mean usual intakes of fat, carbohydrates, and linoleic and linolenic fatty acids **within the AMDRs**.
- **WIC children** obtained a **smaller** share of their total energy intakes from **added sugars** compared with income-eligible nonparticipant children.

This chapter examines the adequacy of energy and nutrient intakes among WIC participants and nonparticipants by estimating usual energy and macronutrient intakes. Macronutrients are dietary components that contribute to energy intake and include fat, protein, carbohydrates, and alcohol (HHS & USDA, 2015). The chapter also examines usual intakes of essential fatty acids and fiber, which are categorized as fats and carbohydrates, respectively. Essential fatty acids (i.e., linoleic and linolenic acid) are fats the body is unable to synthesize and, therefore, must be consumed in the diet to maintain health (NIH ODS, 2018). Fiber is a nondigestible carbohydrate found in plants that promotes satiety, regulates blood sugar, and supports cardiovascular and gastrointestinal health.

The study team compared the usual intakes of total fat, protein, carbohydrates, linolenic and linoleic fatty acids, and fiber with the DRIs established by NASEM, formerly IOM,[35] Food and Nutrition Board. The DRIs provide guidelines on appropriate intake amounts for healthy individuals based on age, gender, and life stage (IOM, 1997; 1998; 2000; 2001; 2005; 2006a; 2011; NASEM, 2019) and are the most up-to-date scientific standards for determining if dietary patterns are nutritionally adequate. The DRIs consist of acceptable macronutrient distribution range (AMDR), estimated average requirement (EAR), adequate intake level (AI), and chronic disease risk reduction level (CDRR). AMDR and AI are used to assess intakes in this chapter (see table 5.1); EAR, AI, and CDRR are used to assess micronutrient intakes in chapter 6.

[35] Now known as the Health and Medicine Division of the National Academies of Sciences, Engineering, and Medicine

Table 5.1. Standards Used to Assess Energy and Macronutrient Intakes

Nutrient(s)	DRI	Description of DRI
Total fat, protein, and carbohydrate; linoleic and linolenic fatty acids	AMDR	Reflects a range of usual intakes that are associated with a reduced risk of chronic disease and that also provide adequate intakes of essential nutrients. Defined as the percentage of total energy intake from macronutrients and essential fatty acids (linoleic acid and linolenic acid)
Fiber	AI	Defined when insufficient data are available to establish an EAR. Groups with mean usual intakes at or above AI levels are assumed to have nutrient adequacy, but no firm conclusions can be drawn when mean usual intakes fall below the AI

AI = adequate intake; AMDR = acceptable macronutrient distribution range; DRI = Dietary Reference Intake; EAR = estimated average requirement

The team also compared intakes of saturated fats and added sugars to the 2015–2020 DGA. The DGA provides evidence-based recommendations for food and beverage intakes and is published every 5 years. The 2015–2020 DGA describes calories from saturated fats and added sugars, along with refined grains and any other excess calories, as "calories for other uses." Because of challenges with estimating calories in excess of individuals' energy requirements, this study did not examine "calories for other uses" as defined in the 2015–2020 DGA. Instead, the study team estimated the individual contribution of saturated fats and added sugars to total energy intake among WIC participants and nonparticipants and compared these estimates with thresholds recommended in the 2015–2020 DGA (see table 5.2).

Table 5.2. 2015–2020 DGA Recommendations for the Consumption of Saturated Fats and Added Sugars

DGA Recommendation	2015–2020 DGA
Saturated fats[a]	Consume less than 10 percent of calories per day from saturated fats
Added sugars[b]	Consume less than 10 percent of calories per day from added sugars

DGA = Dietary Guidelines for Americans
[a] Fatty acids that have no double bonds; fats high in saturated fatty acids are usually solid at room temperature.
[b] Caloric sweeteners added to foods during processing or preparation or consumed separately

The study team used the method developed by NCI to estimate the usual intake distributions, mean intakes, and percentage of individuals in each group with usual intakes consistent with DRI standards (NIH NCI, n.d.a). These analyses, included in sections A and B, use two dietary recalls and represent mean usual intakes. Detailed descriptions of the NCI method and DRI standards are provided in appendix A. It is important to note that analyses for the percentage of calories from added sugars and saturated fats, included in section C, are calculated using one dietary recall and represent intakes on a given day. These estimates reflect nutrient intakes from foods and beverages; they do not include nutrient contributions from dietary supplements.

Only statistically significant and reliable differences in intakes between WIC participants and nonparticipants are discussed in this chapter.[36] Detailed results appear in appendix E. Table 5.3 provides a synopsis of the data sources, samples, and measures examined in this chapter.

[36] In some cases, between-group differences may be statistically significant even when one point estimate is unreliable. This report does not discuss results determined to be unreliable or comparisons for which either estimate in the comparison was determined to be unreliable.

Table 5.3. Data, Samples, and Measures Used to Assess Intakes of Macronutrients and Calories

Data	Sample	Measures
NHANES 2011–2016 Two 24-hour dietary recalls per child	Children 1–4 years old	Mean usual intakes Distribution of usual intakes Percentages of individuals with usual intakes above, below, or within AMDRs Percentage of AI
NHANES 2011–2016 One 24-hour dietary recall per child	Children 2–4 years old	Percentage of total calories from saturated fats and added sugars Percentages of individuals with saturated fat and added sugar intakes consistent with 2015–2020 DGA

AI = adequate intake; AMDR = acceptable macronutrient distribution range; DGA = Dietary Guidelines for Americans; NHANES = National Health and Nutrition Examination Survey

A. Usual Energy Intakes

This section discusses the significant findings on children's usual energy intakes (in calories) overall and by age. The total number of calories a child needs each day to maintain energy balance varies by age, height, weight, and level of physical activity. Table 5.4 presents the estimated calories needed to maintain energy balance for children 2–4 years old at three levels of physical activity; the DGA does not estimate calorie needs for children younger than 2 years old.

Table 5.4. Estimated Daily Energy Needs by Age and Physical Activity Level

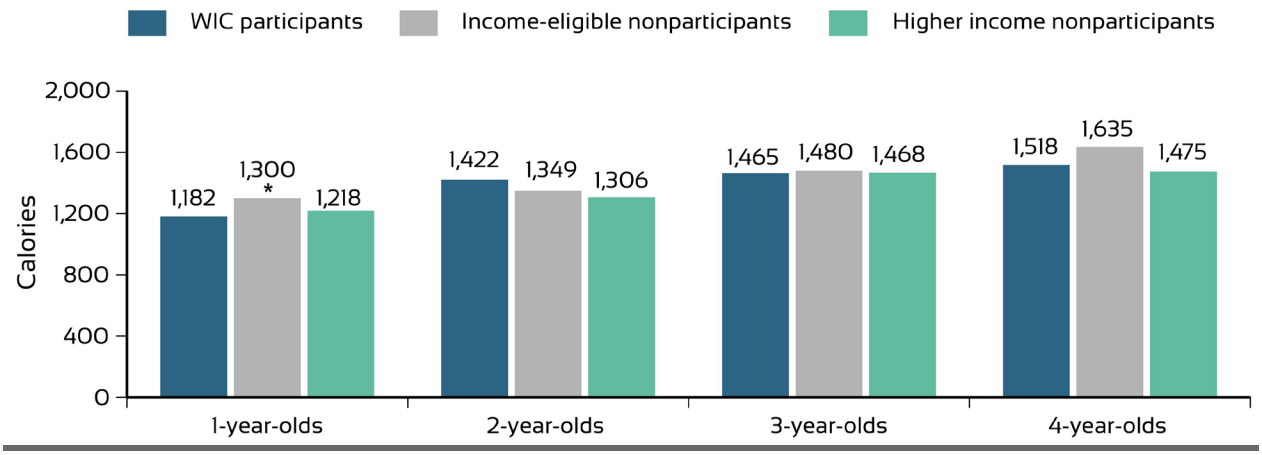
Age	Estimated Daily Energy Needs[a]		
	Sedentary	Moderately Active	Active
2 years old	1,000	1,000	1,000
3 years old	1,000	1,200–1,400	1,400
4 years old	1,200	1,400	1,400–1,600

Notes: Energy is measured in units of kilocalories; however, for brevity throughout the report, the more common term—calories—is used. The lower range of intakes represents girls' needs, and the higher range represents boys' needs.
[a] The average estimates presented in this table may be higher or lower than an individual's calorie needs.
Source: IOM, 2006a

It is difficult to use self-reported dietary intakes to assess whether intake is consistent with calorie needs because dietary intake is often misreported (Moshfegh et al., 2008; Tooze et al., 2004). Because young children cannot be expected to complete a dietary recall, proxy interviews were conducted for NHANES participants younger than 6 years old. The child's proxy was the person most knowledgeable about the child's intake. Unlike those who self-report dietary intake, parents do not modify or exclude foods from their children's reported intake based on perceived healthfulness (Wallace, 2018). However, estimated intakes based on parental reports tend to overestimate energy intake (Fisher, 2008; Wallace, 2018). Findings on usual energy intakes in this chapter should be interpreted with caution.

Children 1–4 years old had mean daily intakes of 1,395 calories. Mean daily energy intakes were lowest for 1-year-olds (1,216 calories per day) and highest for 4-year-olds (1,540 calories per day; see appendix table E.17). Among 1-year-olds, WIC participants consumed fewer calories than income-eligible nonparticipants (see figure 5.1).

Figure 5.1. Mean Daily Energy Intakes for Children 1–4 Years Old by Age and Program Participation



Notes: Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Because long-term imbalances between energy intake and expenditure result in weight change, measuring BMI is recommended for assessing the appropriateness of usual energy intakes (for children aged 2 and older; IOM, 2006a). See chapter 3 for a discussion of the BMI findings.

B. Usual Intakes of Macronutrients

This section discusses the significant findings for children's intakes of total fat, protein, carbohydrate, and essential fatty acids (i.e., linoleic and linolenic acid) relative to the AMDRs (see text box). This section also discusses usual intakes of fiber. The study team assessed mean usual intakes of fiber as both a percentage of the AI and on a gram-per-calorie basis; the standard used to establish the AI for fiber was 14 grams per 1,000 calories (IOM, 2005).[37, 38] The 2015 Dietary Guidelines Advisory Committee (DGAC) classified fiber as a nutrient of public health concern; its underconsumption has been linked to adverse health outcomes in the scientific literature. To increase intake of fiber, the DGA recommends making the nutritional shift to eating more vegetables, fruits, and whole grains. Nutrients of public health concern are further discussed in chapter 6.

AMDR

- AMDRs are defined for macronutrients and essential fatty acids. The AMDR is the intake range associated with reduced risk of chronic disease and provides adequate intakes of essential nutrients.
- This section discusses AMDRs for total fat, protein, carbohydrate, and linoleic and linolenic fatty acids. The mean usual percentage of calories from each macronutrient is compared with the AMDRs and discussed as falling above, within, or below these ranges.
- AMDR ranges are defined in appendix A.

AI

- The AI is used when insufficient evidence is available to establish an EAR. The AI is expected to fall above the unknown EAR value and meet or exceed the nutritional needs of all members of a healthy population.
- This section discusses AI for fiber. Mean usual intake of fiber is expressed as a percentage of the AI.
- Unlike the EAR, the AI level cannot be used to calculate the prevalence of adequate nutrient intakes for a group.

1. Fat

Overall, 75 percent of children 1–4 years old had usual intakes of total fat consistent with the AMDR (see table 5.5). Children with intakes inconsistent with the AMDR were more likely to have intakes below than above the recommended range. There were no differences between WIC participants and either group of nonparticipant children in usual intakes of total fat compared with the AMDR.

Usual intakes of linoleic and linolenic acid were within the AMDRs for 77 and 61 percent, respectively, of children (see appendix tables E.13 and E.15). Among children whose intakes did not fall within the AMDR range for either fatty acid, the majority fell below the recommended range. There were no differences between WIC participants and either group of nonparticipant children in the usual intakes of linoleic or linolenic acid compared with the AMDRs.

[37] Based on the median calorie intakes for each age and gender group as reported in the 1994–1996, 1998 Continuing Survey of Food Intakes by Individuals (USDA, ARS, 2016)

[38] Estimated intakes of fiber include dietary fiber only, but AIs are established for total fiber; estimated intakes of fiber do not account for functional fiber (i.e., isolated fiber added to a food or supplement).

Table 5.5. Percentages of Children 1–4 Years Old With Macronutrient Intakes Below, Within, and Above the AMDR by Program Participation

Standard	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Total Fat				
Below the AMDR	17.7	18.2	16.1	16.5
Within the AMDR	74.7	72.9	78.2	76.1
Above the AMDR	7.6 **u**	8.9	5.7 **u**	7.4 **u**
Protein				
Below the AMDR	0.1 **u**	0.0 **u**	0.5 **u**	0.0 **u**
Within the AMDR	98.3	99.6	97.6	96.9 **
Above the AMDR	1.6 **u**	0.4 **u**	1.9 **u**	3.1 **
Carbohydrate				
Below the AMDR	4.0	3.5 **u**	3.2 **u**	5.7
Within the AMDR	95.1	96.0	96.0	92.5
Above the AMDR	0.9 **u**	0.5 **u**	0.8 **u**	1.8 **u**

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. The data reflect nutrient intakes from foods and beverages but do not include the contribution of vitamin and mineral supplements. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
AMDR = acceptable macronutrient distribution range
u Indicates individual estimates did not meet the standards of reliability or precision because of large coefficient of variation
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

2. Protein

Essentially all (98 percent) children 1–4 years old had usual intakes of protein within the AMDR. WIC participants were more likely to have usual intakes of protein within the AMDR than higher income nonparticipants (100 versus 97 percent; see table 5.5).

3. Carbohydrate

Similarly, almost all children (95 percent) had usual intakes of carbohydrate consistent with the AMDR, and intakes relative to the AMDR were comparable for WIC participants and both groups of nonparticipant children (see table 5.5).

In general, the usual intakes of fiber among children 1–4 years old fell below the AI. Among all young children, mean usual intakes of fiber were 53 percent of the AI (see appendix table E.8). Because these values were less than 100 percent of the AI, no conclusions could be drawn about adequate usual intakes of fiber. On a gram-per-calorie basis, the mean usual intakes of fiber for each group were about 8 grams per 1,000 calories—slightly more than half of the 14-gram standard used in setting the AI (see appendix table E.9).

C. Intakes of Saturated Fats and Added Sugars on a Given Day

This section discusses the significant findings for the percentage of total energy contributed by saturated fats and added sugars on a given day. The analyses included in this section are based on the day 1 dietary recall.

1. Saturated Fats

Among children 2–4 years old, saturated fats accounted for 12 percent of total energy intakes on a given day (see appendix table E.18). Only 15 percent of children met the DGA recommendation of less than 10 percent of calories from saturated fat (see appendix table E.11). No differences were observed between WIC participants or either group of nonparticipants in the percentage of calories consumed from saturated fat (see table 5.6).

Table 5.6. Percentage of Total Energy Contributed by Saturated Fats Among Children 2–4 Years Old on a Given Day by Age and Program Participation

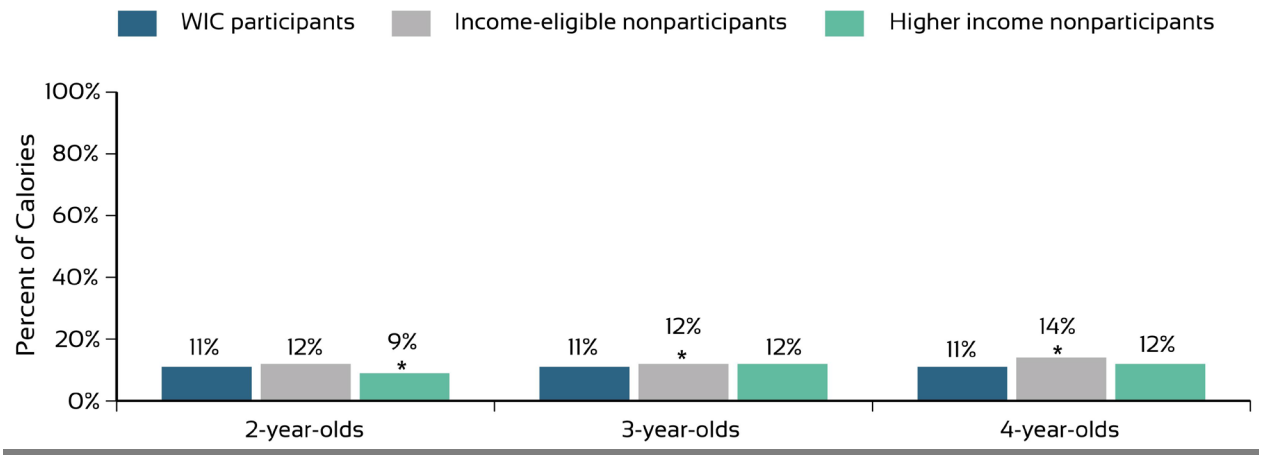
Age	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	1,724	627	477	392
2 years old	12.0	11.5	12.2	11.8
3 years old	11.8	11.4	11.9	11.8
4 years old	11.6	11.2	11.0	11.5

Notes: "All young children" includes children with missing WIC participation or income. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 2–4 years old with complete day 1 dietary recall data.

2. Added Sugars

On a given day, 11 percent of calories consumed by children 2–4 years old came from added sugars, which exceeds the DGA's recommended limit. When pooled across age groups, WIC participants obtained a smaller share of their total energy intakes from added sugars than income-eligible nonparticipants (11 versus 13 percent of calories; see appendix table E.18). This difference was driven largely by 3- and 4-year-olds; for these age groups, total energy intakes from added sugars was 11 percent for WIC participants and 12 and 14 percent, respectively, for 3- and 4-year old income-eligible nonparticipants (see figure 5.2). For 2-year-olds, WIC participants consumed a higher proportion of calories from added sugars compared with higher income nonparticipants (11 versus 9 percent).

Figure 5.2. Percentage of Total Energy Intakes Contributed by Added Sugars on a Given Day by Age and Program Participation



Notes: Estimates are based on the day 1 dietary recall. The data reflect nutrient intakes from foods and beverages but do not include the contribution of vitamin and mineral supplements. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample t-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits.
WIC participants n = 627, income-eligible nonparticipants n = 477, higher income nonparticipants n = 392
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 2–4 years old with complete day 1 dietary recall data.

Chapter 6. Usual Micronutrient Intakes

Key Takeaways

Usual intakes of 10 vitamins and 7 minerals were assessed relative to the estimated average requirement (EAR). Usual intakes of sodium, potassium, and choline were compared with the adequate intake (AI) level; sodium intakes were also compared with the chronic disease risk reduction (CDRR) level. In general, micronutrient intakes were similar across participant groups for children aged 1–4. The study also found—

- For all vitamins and minerals compared with the EAR, the prevalence of **adequate usual intake** was **similar** for **WIC children** and nonparticipant children.
- **WIC children** and income-eligible nonparticipant children had **adequate usual intakes** of choline; choline intakes for higher income nonparticipant children were below the AI.
- Intakes of potassium fell **below the AI** for children in **all participant groups**.
- Intakes of sodium were **high** for children in **all participant groups**; over 90 percent of children **exceeded** the CDRR for sodium.

This chapter examines the prevalence of adequate micronutrient intakes among WIC participants and nonparticipant children by estimating the usual intakes of vitamins and minerals. Consistent with chapter 5, the study team used the NCI method to estimate the usual intake distributions, mean intakes, and percentage of individuals in each group with usual intakes consistent with DRI standards (NIH NCI, n.d.a). The EAR, AI, and CDRR levels are used to assess micronutrient intakes in this chapter (see table 6.1). These estimates reflect micronutrient intakes from foods and beverages; they do not include intakes from dietary supplements. Detailed descriptions of the NCI method and DRI standards are provided in appendix A.

Table 6.1. DRIs Used to Assess Usual Micronutrient Intakes

Nutrient(s)	DRI	Description of DRI
Vitamins A, B6, B12, C, D, and E; copper; selenium; folate; niacin; riboflavin; thiamin; calcium; iron; magnesium; phosphorus; and zinc	EAR	Average daily nutrient intake level estimated to meet the requirements for half of the healthy individuals in a life stage or gender group. The proportion of a group with usual intakes equal to or greater than the EAR is an estimate of the prevalence of adequate usual intakes in that group
Potassium, sodium, and choline	AI	Defined when insufficient data are available to establish an EAR. Groups with mean usual intakes at or above AI levels are assumed to have nutrient adequacy, but no firm conclusions can be drawn when mean usual intakes fall below the AI

Nutrient(s)	DRI	Description of DRI
Sodium	CDRR	The intake level above which a reduction in intake is expected to reduce chronic disease risk within an apparently healthy population

AI = adequate intake; CDRR = chronic disease risk reduction; DRI = Dietary Reference Intake; EAR = estimated average requirement

Only statistically significant and reliable differences in usual micronutrient intakes between WIC participants and nonparticipants are discussed in this chapter.[39] Full tabulations of the results presented in this chapter are provided in appendix F. Table 6.2 provides a synopsis of the data sources, sample, and measures examined in this chapter.

Table 6.2. Data, Sample, and Measures Used to Assess Nutrient Intakes

Data	Sample	Measures
NHANES 2011–2016 *One or two 24-hour dietary recalls per child*	Children 1–4 years old	Mean usual intakes Distribution of usual intakes Percentages of individuals with usual intakes above EARs and CDRR Percentage of AI

AI = adequate intake; CDRR = chronic disease risk reduction; EAR = estimated average requirement; NHANES = National Health and Nutrition Examination Survey

Low mean usual intakes of some micronutrients discussed in this chapter do not necessarily hold public health significance; findings on the prevalence of adequate usual intakes should be interpreted with caution.

The 2015 DGAC identified nutrients of public health concern as follows (DGAC, 2015):

- Underconsumed relative to the EAR or AI
- Evidence of underconsumption based on biochemical indicators of nutritional status
- Evidence of direct relation between nutrient inadequacy and a specific health condition

By these standards, DGAC did not classify vitamins A, C, or E as nutrients of public health concern because their underconsumption has not been linked to adverse health outcomes in the scientific literature. Micronutrients of public health concern included calcium, vitamin D, and potassium. To increase intakes of these nutrients, DGAC recommended making the nutritional shift to eating more vegetables, fruits, whole grains, and dairy. Although DGAC classified vitamin D as a nutrient of public health concern, it can be obtained through one's diet and synthesized endogenously through skin exposure to sunlight—making it unique among nutrients. The findings related to serum vitamin D status based on a biochemical indicator, 25-hydroxyvitamin D, are presented in chapter 3. The DGAC also identified sodium and saturated fat as nutrients that were overconsumed and might pose health risks; findings related to saturated fat intake are presented in chapter 5.

[39] In some cases, between-group differences may be statistically significant even when one point estimate is unreliable. This report does not discuss results determined to be unreliable or comparisons for which either estimate in the comparison was determined to be unreliable.

A. Usual Intakes of Vitamins and Minerals With Defined EARs

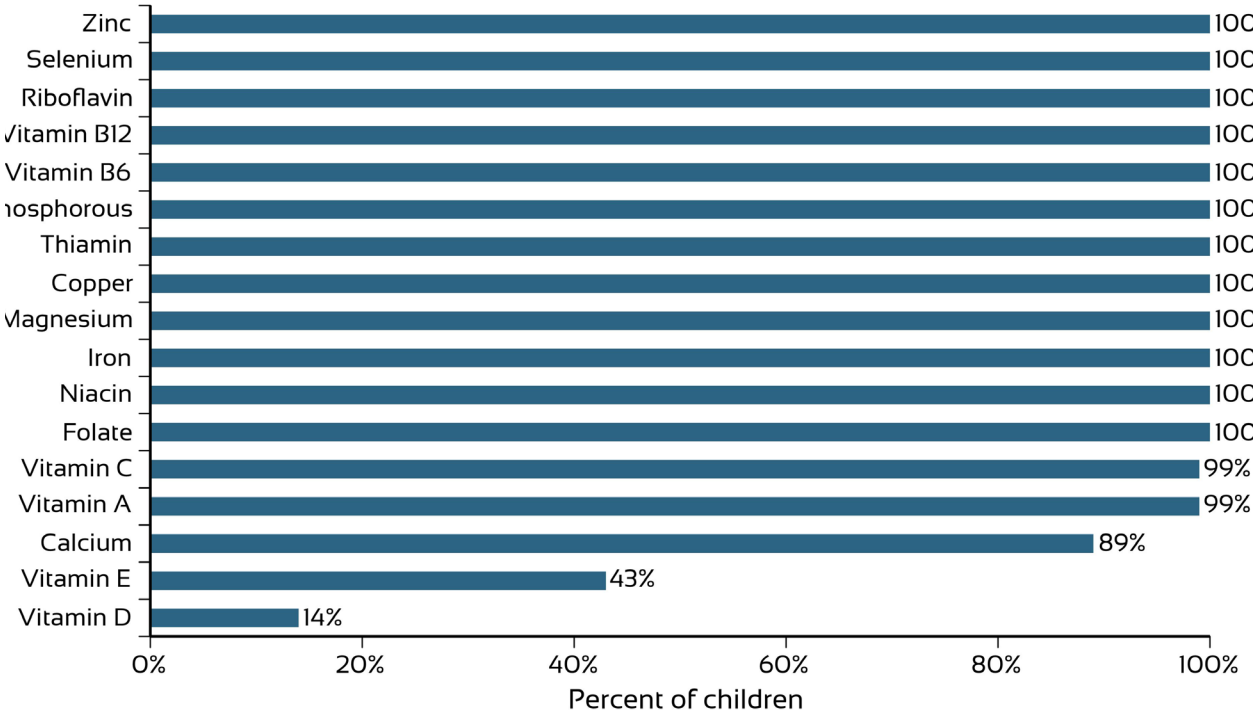
This section discusses significant findings for vitamins and minerals with defined EARs (see text box). The proportion of individuals in a group with usual intakes greater than or equal to the EARs is an estimate of the prevalence of adequate intakes in that population group.

EAR

- The EAR is the average daily nutrient intake level estimated to meet the requirement for half of the healthy individuals in a life stage or gender group.
- This section discusses EARs for vitamins A, B6, B12, C, D, and E; copper; selenium; folate; niacin; riboflavin; thiamin; calcium; iron; magnesium; phosphorus; and zinc. Mean usual intake is expressed as the percentage of individuals with intakes equal to or greater than the EAR.
- The proportion of a group with usual intakes equal to or greater than the EAR is an estimate of the prevalence of adequate usual intakes in that group.

Nearly all children 1–4 years old (99 to 100 percent) had adequate usual intakes of vitamin A, vitamin B6, vitamin B12, vitamin C, copper, folate, iron, magnesium, niacin, phosphorous, riboflavin, selenium, thiamin, and zinc (see figure 6.1 and table 6.3). Eighty-nine percent of children had adequate usual intakes of calcium. The prevalence of adequate usual intakes was considerably lower for vitamin D (14 percent) and vitamin E (43 percent). For all selected vitamins and minerals except calcium, the prevalence of adequate usual intakes was similar for WIC participants and both groups of nonparticipant children (see table 6.3). Compared with higher income nonparticipants, WIC participants were less likely to have adequate calcium intakes (86 versus 92 percent).

Figure 6.1. Prevalence of Adequate Usual Intakes Among All Children 1–4 Years Old



Notes: "All young children" includes children with missing WIC participation or income. Usual intake was estimated using the National Cancer Institute method. Totals are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants.
All young children n = 2,314
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Table 6.3. Prevalence of Adequate Usual Intakes Among Children 1–4 Years Old by Program Participation

Vitamins and Minerals	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
		Vitamins		
Vitamin A	99.0	97.9	99.6	98.5
Vitamin B6	100.0	99.9	100.0	100.0
Vitamin B12	100.0	99.9	100.0	100.0
Vitamin C	99.0	99.6	99.1	98.0
Vitamin D	13.7	13.1	15.1	13.5
Vitamin E	43.1	36.1	45.5	45.8
Folate	99.6	99.0	99.3	99.9
Niacin	99.6	99.1	99.4	99.9
Riboflavin	100.0	100.0	100.0	100.0
Thiamin	99.9	99.8	99.9	100.0

Vitamins and Minerals	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Minerals				
Calcium	88.5	86.2	86.8	91.6 *
Copper	99.8	99.4	99.8	99.9
Iron	99.7	99.2	99.7	99.9
Magnesium	99.7	99.8	99.8	99.6
Phosphorous	99.9	99.9	99.9	100.0
Selenium	100.0	100.0	100.0	100.0
Zinc	100.0	100.0	99.8	100.0

Notes: "All young children" includes children with missing WIC participation or income. Totals are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Standard errors were estimated using balanced repeated replication to account for complex survey design.
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

B. Usual Intakes of Nutrients Assessed Using AI and CDRR Levels

This section discusses the significant findings on intakes of micronutrients that do not have without assigned EARs. Intakes of these nutrients (choline, potassium, and sodium; see text box) are compared with AI levels. This section also includes a discussion of mean usual sodium intakes compared with the CDRR (see text box).

AI

- The AI is used when insufficient evidence is available to establish an EAR. The AI is expected to fall above the unknown EAR value and meet or exceed the nutritional needs of all members of a healthy population.
- This section discusses the AIs for potassium, sodium, and choline. Mean usual intake is expressed as a percentage of the AI.
- Unlike the EAR, the AI level cannot be used to calculate the prevalence of adequate nutrient intakes for a group.

CDRR

- CDRR is the intake level above which a reduction in intake is expected to reduce chronic disease risk within an apparently healthy population.
- This section discusses the CDRR for sodium. Mean usual intake is presented as the percentage of individuals with an intake that exceeded the CDRR.

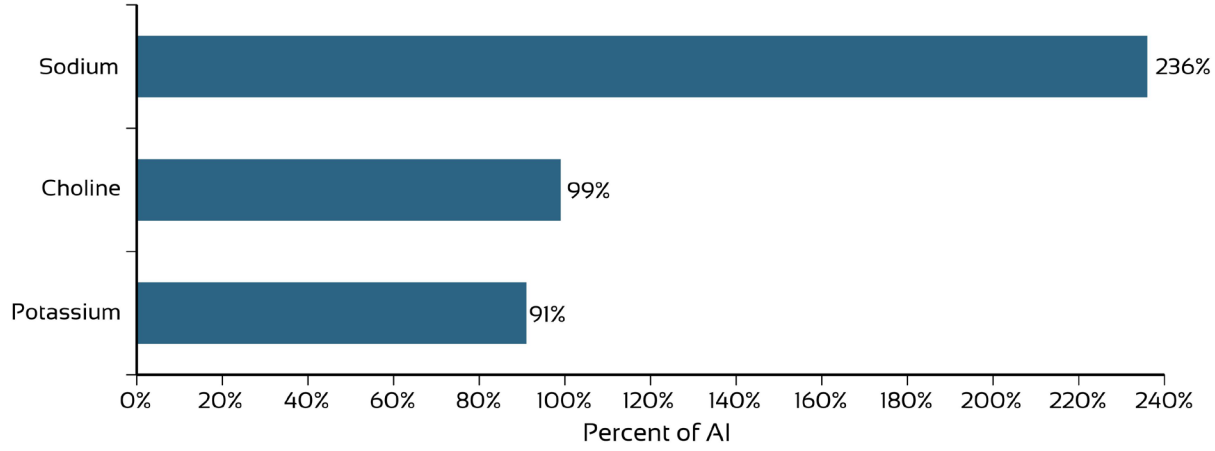
Among children 1–4 years old, the mean usual intakes of potassium were 91 percent of the AI (see figure 6.2 and table 6.4). There was no difference in mean usual intakes of potassium between WIC participants and either group of nonparticipant children. Because this value was less than 100 percent of the AI, no conclusions could be drawn about adequate usual intakes of potassium.

For sodium, the study team assessed usual intakes relative to the AI and the CDRR. Overall, children's mean usual intakes of sodium were more than twice the AI (236 percent; see figure 6.2 and table 6.4). Almost all children (92 percent) had usual sodium intakes that exceeded the CDRR (see table 6.5). There were no differences between WIC participants and nonparticipant children for sodium consumption measured as a percentage of AI or a percentage that exceeded the CDRR.

Almost all children had nutritionally adequate intakes of choline; the mean usual intakes of choline were 99 percent of the AI (see figure 6.2 and table 6.4). WIC participants had higher mean usual intakes of

choline compared with higher income nonparticipant children (102 versus 96 percent of AI). Because the choline intakes for WIC participants and income-eligible nonparticipants exceeded the AI, it can be assumed these populations had high levels of adequate choline intake.

Figure 6.2. Mean Usual Nutrient Intakes Among All Children 1–4 Years Old as a Percentage of AI



Notes: Includes children with missing WIC participation or income. Totals are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population.
AI = adequate intake
All young children n = 2,314
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Table 6.4. Mean Usual Percentage of AI Consumed by Children 1–4 Years Old by Program Participation

Nutrient	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Choline	98.9	102.1	101.3	96.0 *
Potassium	91.1	94.1	91.5	89.5
Sodium	236.4	240.4	243.0	232.3

Notes: "All young children" includes children with missing WIC participation or income. Totals are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Standard errors were estimated using balanced repeated replication to account for complex survey design.
AI = adequate intake
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Table 6.5. Percentage of Children 1–4 Years Old With Intakes That Exceeded the CDRR by Program Participation

Nutrient	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2,314	902	729	671
Sodium	91.8	90.7	92.4	93.4

Notes: "All young children" includes children with missing WIC participation or income. Totals are age adjusted to account for the different age distributions of WIC participants and nonparticipants. Estimates are weighted to account for differential probabilities of selection, nonresponse to survey instruments, and differences between the final sample and the U.S. civilian noninstitutionalized population. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$. Differences were tested using two-sample *t*-tests comparing WIC participants with income-eligible nonparticipants or higher income nonparticipants. WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Standard errors were estimated using balanced repeated replication to account for complex survey design.
CDRR = chronic disease risk reduction
Source: National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Chapter 7. Comparisons With 2005–2008 NHANES Before Revisions to the WIC Food Packages

Key Takeaways

Select outcomes for WIC participants and nonparticipants were compared before (2005–2008) and after (2011–2016) the Food Package IV revisions were implemented. The revised food packages are more nutrient-dense and provide a wider variety of options compared with the previous food packages; they emphasize the consumption of fruits, vegetables, whole grains, and fat-reduced milks. These results are strictly observational, so differences cannot be attributed to the food package changes. Differences were not tested for statistical significance.

Among WIC children aged 2–4, the study observed —

- The mean total **HEI-2010 score** on a given day was 57 in 2005–2008 and 61 in 2011–2016.
- The prevalence of **obesity** was 11.1 percent in 2005–2008 and 12.9 percent in 2011–2016.

Among WIC children aged 1–4, the study observed—

- Less than two-thirds (64 percent) had intakes of fat **within the AMDR** in 2005–2008, and almost three-quarters (73 percent) had intakes within the AMDR in 2011–2016.
- Mean daily **fiber** intakes for WIC participants were 6.7 grams per 1,000 calories in 2005–2008 and 7.9 grams per 1,000 calories in 2011–2016.

- Among WIC participants, one-third (33.2 percent) consumed **whole grains** on a given day in 2005–2008, while almost half (47.5 percent) consumed whole grains in 2011–2016.
- Over half (56.1 percent) of WIC participants consumed **whole milk** on a given day in 2005–2008, and about one-third (34.9 percent) consumed whole milk in 2011–2016.

The WIC food packages were revised in 2007 for the first time since 1980. The purpose of this revision was to better align WIC food packages with the DGA, improve dietary quality and food security of the populations served by WIC, and promote healthy body weight. As a result, the current food packages are more nutrient dense and allow a wider variety of options compared with the previous food packages; they emphasize the consumption of fruits, vegetables, whole grains, and fat-reduced milks (IOM, 2006b). WIC State agencies began implementing the updated food packages in October 2009. Consistent with the rest of the report, this chapter focuses specifically on changes to Food Package IV, which is the most common food package assigned to young children 1–4 years old[40] (see table 7.1). See chapter 4 for more details on the revised Food Package IV.

[40] Food Packages I–III are for infants, Food Package IV is for children, and Food Packages V–VII are for women. For more details on the WIC food packages, see https://www.fns.usda.gov/wic/wic-food-packages

Table 7.1. Comparison of the Previous and Current Food Package IV

Food Group	Previous Food Package	Current Food Package
Fruits and vegetables	▪ 288 fluid ounces of vitamin C-rich juice	▪ 128 fluid ounces of vitamin C-rich juice ▪ $8.00 cash-value voucher for fresh fruits and vegetables[a]
Milk and milk alternatives	▪ 24 quarts of milk with some allowed substitutions	▪ 16 quarts of milk[b] with additional allowed substitutions
Grains	▪ 36 ounces of iron-fortified cereal	▪ 36 ounces of iron-fortified whole grain cereal ▪ 2 pounds of whole grain bread or other whole grain options
Meat and meat alternatives	▪ 2–2.5 dozen eggs ▪ 1 pound of dried beans or peas *or* 18 ounces of peanut butter	▪ 1 dozen eggs ▪ 1 pound of dried beans or peas or the equivalent canned *or* 18 ounces of peanut butter

[a] Processed fruit and vegetable options also available
[b] Whole milk for 1-year-olds and 1 percent or skim milk for 2- to 4-year-olds

This chapter presents selected outcomes for WIC participants and nonparticipants 1–4 years old before (2005–2008) and after (2011–2016) the Food Package IV revisions were implemented. The analysis for the previous WIC report, *Diet Quality of American Young Children by WIC Participation Status* (Condon et al., 2015a), was limited to 2005–2008, the period immediately preceding implementation of the new WIC food package. The current Diet Quality study uses data from 2011–2016, the period immediately following implementation.

Outcomes included diet quality, BMI-for-age, food choices, and macro- and micronutrient intakes related to the changes to Food Package IV (IOM, 2006b). Findings on key outcomes from both studies are presented side by side in this chapter. These results are strictly observational, so differences cannot be attributed to the food package changes. Observed differences were not tested for statistical significance, and there was no standardization for differences in the age, gender, race/ethnic, or income distribution across the two periods of observation.

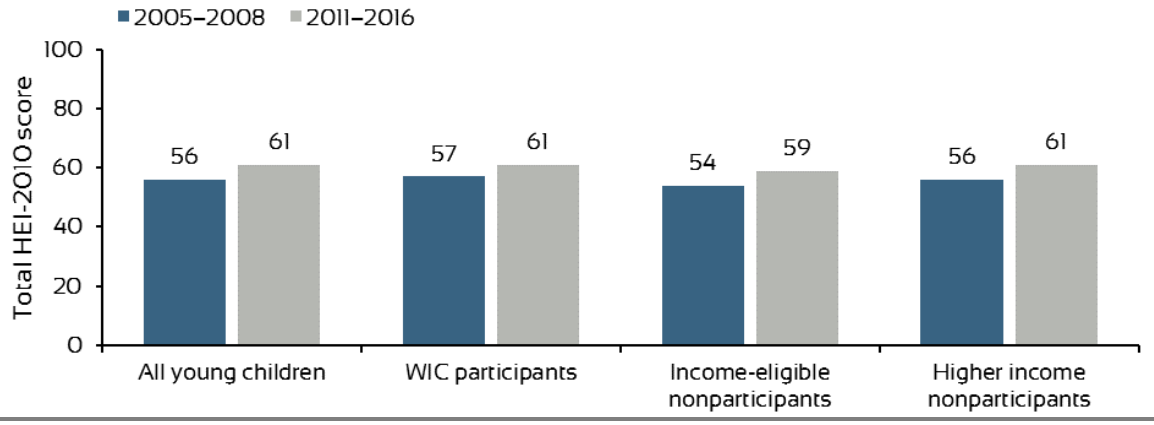
A. HEI-2010 Scores

A higher total HEI-2010[41] score and the scores for each component suggest greater adherence to the DGA. While statistical comparisons were not made between scores from 2005–2008 and 2011–2016, table 7.3 provides the findings from each period. Among WIC participants, the total HEI score was 57 in 2005–2008 and 61 in 2011–2016 (see figure 7.1).

WIC participants scored below 50 percent of the maximum score for total vegetables, greens and beans, and whole grains in 2005–2008 and 2011–2016 (see table 7.2). WIC participants scored 6.6 points in the sodium component in 2005–2008 and 5.7 points in 2011–2016. For the empty calories component, WIC participants scored 11.0 points in 2005–2008 and 15.1 points in 2011–2016.

[41] Further information on the HEI-2010 components and scoring standards are available from the National Cancer Institute, https://epi.grants.cancer.gov/hei/developing.html#2010

Figure 7.1. Mean Total HEI-2010 Score on a Given Day Among 2–4-Year-Old Children in 2005–2008 Compared With 2011–2016 by Program Participation



Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
HEI = Healthy Eating Index
2005–2008 all young children n = 1,390, WIC participants n = 486, income-eligible nonparticipants n = 400, higher income nonparticipants n = 453; 2011–2016 all young children n = 1,724, WIC participants n = 627, income-eligible nonparticipants n = 586, higher income nonparticipants n = 504
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

Table 7.2. Selected HEI-2010 Mean Component Scores Among 2–4-Year-Old Children in 2005–2008 Compared With 2011–2016 by Program Participation

Component	Maximum Points	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	–	2005–2008	1,390	486	400	453
		2011–2016	1,724	627	586	504
Total vegetables	5	2005–2008	2.3	2.3	2.2	2.3
		2011–2016	1.9	2.0	1.9	1.8
Greens and beans	5	2005–2008	0.7	0.3	0.5	1.0
		2011–2016	0.8	0.9	0.7	0.8
Whole grains	10	2005–2008	2.2	1.8	1.9	2.4
		2011–2016	3.2	2.9	2.8	3.8
Sodium	10	2005–2008	6.0	6.6	5.8	5.8
		2011–2016	5.9	5.7	6.1	5.9
Empty calories	20	2005–2008	10.8	11.0	9.9	11.0
		2011–2016	14.3	15.1	13.5	14.5

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
HEI = Healthy Eating Index
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

B. BMI-for-Age

BMI-for-age is used as a tool to screen for overweight and obesity (CDC, 2018). Statistical comparisons were not made between findings in 2005–2008 and 2011–2016, but table 7.4 provides findings for each period. Based on BMI-for-age, the prevalence of obesity among 2–4-year-old children was 8.8 percent in 2005–2008 and 9.4 percent in 2011–2016.

Among WIC participants, the prevalence of obesity was 11.1 percent in 2005–2008 and 12.9 percent in 2011-2016 (see table 7.3). The prevalence of overweight among WIC participants was 12.4 percent in 2005–2008 and 15.5 percent in 2011–2016.

Table 7.3. Percentage of Children 2–4 Years Old in Each BMI Category in 2005–2008 Compared With 2011–2016 by Program Participation

BMI Category	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2005–2008	1,307	454	383	424
	2011–2016	1,724	627	586	504
Underweight	2005–2008	2.6	2.5	3.4	2.5
	2011–2016	2.8	2.2	2.7	3.1
Normal weight	2005–2008	76.5	74.0	73.8	80.1
	2011–2016	73.5	69.4	76.7	73.7
Overweight	2005–2008	12.0	12.4	13.5	9.5
	2011–2016	14.3	15.5	12.1	14.9
Obese	2005–2008	8.8	11.1	9.4	8.0
	2011–2016	9.4	12.9	8.5	8.2

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Scores are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance. See table 3.2 for reference values.
Source: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from NHANES 2011–2016 body measures data. Sample includes NHANES children 2–4 years old with complete day 1 dietary recall, weight, and height data.

C. Food Consumption Patterns

Food consumption patterns were examined by estimating the proportion of children consuming select food groups and subgroups on a given day. Statistical comparisons were not made between findings in 2005–2008 and 2011–2016, but table 7.4 provides findings for food consumption patterns for each period.

Among WIC participants, one-third (33.2 percent) consumed whole grains on a given day in 2005–2008, while almost half (47.5 percent) consumed whole grains in 2011–2016. Vegetables were consumed by 58.9 percent of WIC participants on a given day in 2005–2008 and 56.3 percent of WIC participants in 2011–2016. Most WIC participants (80.1 percent) consumed 100 percent fruit juice on a given day in 2005–2008, and about three-quarters (72.8 percent) consumed 100 percent fruit juice in 2011–2016. Almost two-thirds (63 percent) of WIC participants consumed cooked potatoes on a given day in 2005–

2008, and half (49.8 percent) of WIC participants consumed cooked potatoes in 2011–2016.[42] Milk consumption was reported by over 90 percent of WIC participants in 2005–2008 and 2011–2016 (95.9 and 90.8 percent, respectively). Over half (56.1 percent) of WIC participants consumed whole milk on a given day in 2005–2008, and about one-third (34.9 percent) consumed whole milk in 2011–2016.

Table 7.4. Percentage of Children 1–4 Years Old Consuming Different Types of Food on a Given Day in 2005–2008 Compared With 2011–2016 by Program Participation

Component	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2005–2008	1,956	791	496	606
	2011–2016	2,314	902	729	671
Whole grains[a]	2005–2008	40.2	33.2	35.4	46.6
	2011–2016	50.8	47.5	51.8	52.1
Total vegetables	2005–2008	64.4	58.9	62.5	68.2
	2011–2016	60.0	56.3	59.7	62.4
Cooked potatoes	2005–2008	53.5	63.4	57.1	47.7
	2011–2016	42.7	49.8	49.1	32.6
100 percent fruit juice	2005–2008	68.3	80.1	61.7	63.7
	2011–2016	59.8	72.8	64.6	46.9
Total milk[b]	2005–2008	92.2	95.9	89.4	90.5
	2011–2016	90.6	90.8	91.7	89.4
Whole milk	2005–2008	44.9	56.1	41.2	40.7
	2011–2016	39.9	34.9	47.1	37.2
Total fat-reduced milk[c]	2005–2008	46.5	39.2	45.8	49.9
	2011–2016	53.1	56.8	46.5	56.0

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on the day 1 dietary recall. Percentages are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
[a] Grains are classified as whole grains if more than 50 percent of the total grains are whole grain. For 2005–2008, the MyPyramid Equivalents Database was used to classify grains. For 2011–2016, The FPED was used to classify grains.
[b] Total milk includes all types of fluid, dry, evaporated, and flavored milk.
[c] Fat-reduced milk is 2 percent, 1 percent, and skim milk.
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls; Food Patterns Equivalents Database 2011–2012, 2013–2014, and 2015–2016 (USDA ARS, 2019). Sample includes NHANES children 1–4 years old with complete day 1 dietary recall data.

D. Usual Energy and Macronutrient Intakes

Mean usual energy and macronutrient intakes were estimated based on 2 days of dietary recall. Statistical comparisons were not made between findings in 2005–2008 and 2011–2016, but table 7.5 and figures 7.2 and 7.3 provide usual intake findings for each period.

[42] White potatoes were initially not eligible for purchase with the WIC cash-value voucher but became eligible for purchase in 2015 (USDA, 2014).

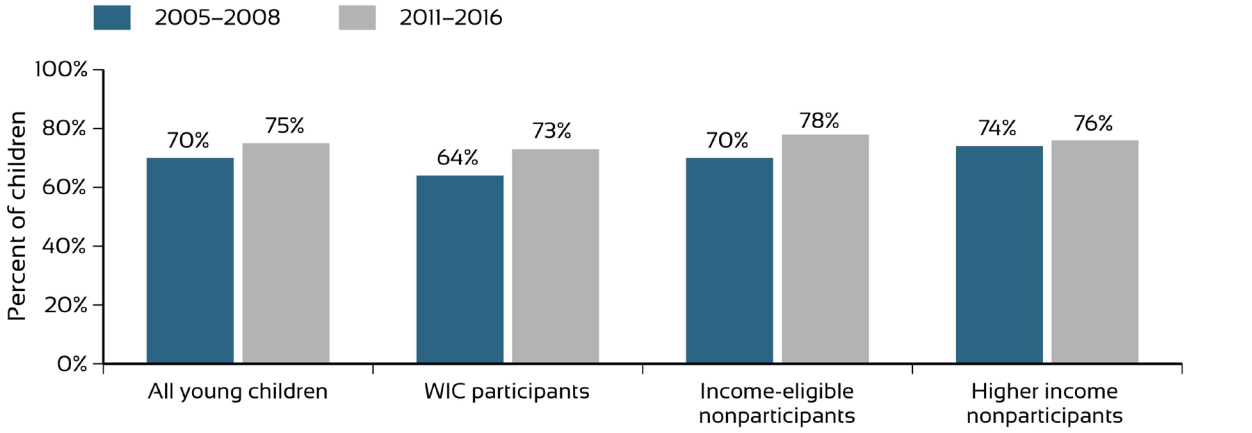
Among WIC participants, mean usual energy intake was 1,482 calories in 2005–2008 and 1,398 calories in 2011–2016 (see table 7.5). The percentage of WIC participants with mean daily fat intakes within the AMDR was less than two-thirds (64 percent) in 2005–2008 and almost three-quarters (73 percent) in 2011–2016 (see figure 7.2). Mean daily fiber intakes for WIC participants were 6.7 grams per 1,000 calories in 2005–2008 and 7.9 grams per 1,000 calories in 2011–2016 (see figure 7.3).

Table 7.5. Mean Daily Energy Intakes Among Children 1–4 Years Old in 2005–2008 Compared With 2011–2016 by Age and Program Participation

Component	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2005–2008	1,956	791	496	606
	2011–2016	2,314	902	729	671
All young children	2005–2008	1,422	1,482	1,465	1,373
	2011–2016	1,395	1,398	1,441	1,368
1-year-olds	2005–2008	1,252	1,290	1,347	1,186
	2011–2016	1,216	1,182	1,300	1,218
2-year-olds	2005–2008	1,447	1,528	1,466	1,399
	2011–2016	1,355	1,422	1,349	1,306
3-year-olds	2005–2008	1,474	1,547	1,517	1,425
	2011–2016	1,463	1,465	1,480	1,468
4-year-olds	2005–2008	1,510	1,556	1,529	1,477
	2011–2016	1,540	1,518	1,635	1,475

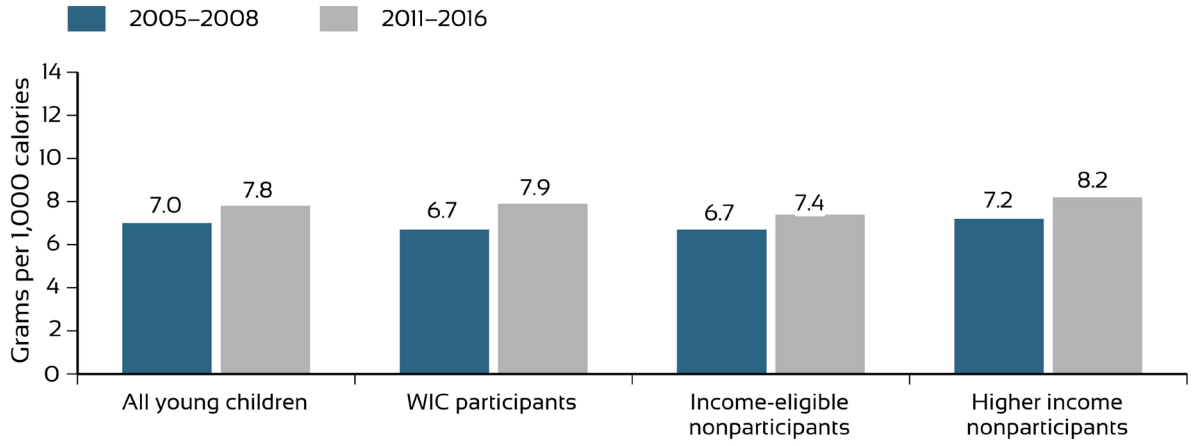
Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Figure 7.2. Percentage of Children 1–4 Years Old With Fat Intakes Within the AMDR in 2005–2008 Compared With 2011–2016 by Program Participation



Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
AMDR = acceptable macronutrient distribution range
2005–2008 all young children n = 1,956, WIC participants n = 791, income-eligible nonparticipants n = 496, higher income nonparticipants n = 606; 2011–2016 all young children n = 2,314, WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Figure 7.3. Mean Daily Fiber Intakes Among Children 1–4 Years Old in 2005–2008 Compared With 2011–2016 by Program Participation



Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
2005–2008 all young children n = 1,956, WIC participants n = 791, income-eligible nonparticipants n = 496, higher income nonparticipants n = 606; 2011–2016 all young children n = 2,314, WIC participants n = 902, income-eligible nonparticipants n = 729, higher income nonparticipants n = 671
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

E. Usual Micronutrient Intakes

Mean usual micronutrient intakes, based on 2 days of dietary recall, were estimated using the NCI method and compared with DRI standards. Statistical comparisons were not made between findings in 2005–2008 and 2011–2016, but tables 7.6 and 7.7 provide usual intake findings for each period.

The prevalence of adequate usual intakes of vitamin A, iron, and zinc among WIC participants exceeded 95 percent for 2005–2008 and 2011–2016. The prevalence of adequate vitamin E intakes was 21.5 percent among WIC participants in 2005–2008 and over one-third (36.1 percent) in 2011–2016. In 2005–2008, three-quarters (75.4 percent) of WIC participants had sodium intakes that exceeded the tolerable upper intake levels; in 2011–2016, a majority (90.7 percent) of WIC participants had sodium intakes that exceed the CDRR.[43]

[43] Sodium intakes in 2005–2008 were compared with the tolerable upper intake level, while sodium intakes 2011–2016 were compared with the chronic disease risk reduction level to reflect the updated DRIs.

Table 7.6. Mean Usual Intakes of Selected Micronutrients Among Children 1–4 Years Old in 2005–2008 Compared With 2011–2016 by Program Participation

Component	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2005–2008	1,956	791	496	606
	2011–2016	2,314	902	729	671
Percent of Children With Usual Intake Greater Than Estimated Average Requirement					
Vitamin A	2005–2008	98.3	98.0	98.2	98.9
	2011–2016	99.0	97.9	99.6	98.5
Vitamin E	2005–2008	17.1	21.5	18.1	10.2
	2011–2016	43.1	36.1	45.5	45.8
Iron	2005–2008	99.9	100.0	100.0	99.8
	2011–2016	99.7	99.2	99.7	99.9
Zinc	2005–2008	99.8	99.8	99.9	99.8
	2011–2016	100.0	100.0	99.8	100.0
Percent of Children With Usual Intake Above Tolerable Upper Intake or Chronic Disease Risk					
Sodium[a]	2005–2008	74.4	75.4	77.0	74.1
	2011–2016	91.8	90.7	92.4	93.4

Notes: "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
DRI = Dietary Reference Intake
[a] Results are based on the 2005 DRIs for 2005–2008; the tolerable upper intake level was 1,500 milligrams for 1- to 3-year-olds and 1,900 milligrams for 4-year-olds. Results are based on the 2019 DRIs for 2011–2016; the CDRR was 1,200 milligrams for 1- to 3-year-olds and 1,500 milligrams for 4-year-olds.
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Table 7.7. Mean Daily Intakes of Potassium as a Percentage of the Adequate Intake Level Among Children 1–4 Years Old in 2005–2008 Compared With 2011–2016 by Program Participation

Component	Years	All Young Children	WIC Participants	Income-Eligible Nonparticipants	Higher Income Nonparticipants
Sample size	2005–2008	1,956	791	496	606
	2011–2016	2,314	902	729	671
Potassium	2005–2008	62.5	66.9	60.3	61.0
	2011–2016	91.1	94.1	91.5	89.5

Notes: Results are based on the 2005 average intake level for 2005–2008 and the 2019 average intake level for 2011–2016. "All young children" includes children with missing WIC participation or income. Estimates are based on two dietary recalls per person. Usual intake was estimated using the National Cancer Institute method. Values are age adjusted to account for the different age distributions of WIC participants and nonparticipants. For 2005–2008, WIC participants consist of children in households who reported receiving WIC benefits in the last 30 days. For 2011–2016, WIC participants consist of children in households that at the time of data collection reported receiving WIC benefits. Observed differences were not tested for statistical significance.
Sources: Data from 2005–2008 are from Condon et al., 2015a. Data from 2011–2016 are from National Health and Nutrition Examination Survey (NHANES) 2011–2016 dietary recalls. Sample includes NHANES children 1–4 years old with complete day 1 and day 2 dietary recall data.

Chapter 8. Conclusions

This study analyzed 2011–2016 NHANES data to assess and compare the diet quality, nutrition, and health of young children 1–4 years old who were either WIC participants or nonparticipants. Nonparticipants consisted of two groups: individuals who were income-eligible for WIC but reported they did not participate in the program recently (income-eligible nonparticipants), and individuals with higher incomes who were not eligible for WIC (higher income nonparticipants). These analyses also included outcomes by age (1-, 2-, 3-, and 4-year-olds) and gender. This chapter summarizes the key study findings and implications.

A. Key Findings

The study team used descriptive analyses to assess the differences in diet quality, nutrition, and health among WIC participants compared with income-eligible nonparticipants and higher income nonparticipants. The team recommends using caution when interpreting these results; this research was not designed to measure the impact of WIC participation on diet quality, and a proportion of these results are expected to be significant by chance.

Chapter 2. Overall Diet Quality

- WIC participants had higher mean total HEI scores than income-eligible nonparticipants on a given day (62 versus 59 points). By age group, only 3-year-old WIC participants had higher total HEI scores than income-eligible nonparticipants.
- Compared with income-eligible nonparticipants, WIC participants scored higher for the greens and beans, fatty acids, and added sugars components on a given day. Compared with higher income nonparticipants, WIC participants scored better in the fatty acids and saturated fats components but worse in the whole grains component.

Chapter 3. Indicators of Nutrition and Health

- Overall, WIC participants had a higher prevalence of obesity than either income-eligible or higher income nonparticipants (13 versus 9 and 8 percent, respectively).
- Most children had normal hemoglobin concentrations (96 percent) and adequate serum 25-hydroxy vitamin D concentrations (93 percent); results were similar across participant groups for both of these indicators.

Chapter 4. Food Consumption Patterns

- At the food group level, WIC participants and income-eligible nonparticipants had similar consumption patterns on a given day. Compared with higher income nonparticipants, however, a lower percentage of WIC participants consumed items from the beverages, grains, fruits and 100 percent fruit juice, and added fats and oils food groups, and a higher percentage consumed items from the salty snacks food group on a given day.

- At the subgroup level, a lower percentage of WIC participants consumed refined grains, yogurt, and water and a higher percentage consumed cooked potatoes, noncarbonated sweetened beverages, regular soda, and tea on a given day. Compared with either nonparticipant group, a higher percentage of WIC participants consumed fruit juice and unflavored 1 percent milk on a given day.

Chapter 5. Usual Energy and Macronutrient Intakes

- A higher percentage of WIC participants had usual intakes of protein within the AMDR compared with higher income nonparticipants (100 versus 97 percent). Intakes relative to the AMDRs for fat, carbohydrates, and linoleic and linolenic acid were similar across all participant groups.
- WIC participants obtained a smaller share of their total energy intakes from added sugars than income-eligible nonparticipants (11 versus 13 percent of calories).

Chapter 6. Usual Micronutrient Intakes

- For all selected vitamins and minerals except calcium, the prevalence of adequate usual intake—based on intakes from foods and beverages—was similar for WIC participants and both groups of nonparticipants: 43 percent for vitamin E, 14 percent for vitamin D, and 99 to 100 percent for all others. A lower percentage of WIC participants had adequate usual intakes of calcium compared with higher income nonparticipants (86 versus 92 percent).
- There were no differences in mean usual intakes of potassium or sodium between WIC participants and either group of nonparticipants. However, over 90 percent of children from all participant categories exceeded the CDRR for sodium.

Chapter 7. Comparisons With 2005–2008 NHANES Before Revisions to the WIC Food Packages

Statistical comparisons were not made between scores from 2005–2008 and 2011–2016. Because these results are strictly observational, differences cannot be attributed to the food package changes.

- Among WIC participants aged 2–4 years old, the mean total HEI-2010 score was 57 in 2005–2008 and 61 in 2011–2016. For the empty calories component, WIC participants scored 11.0 points in 2005–2008 and 15.1 points in 2011–2016.
- Among WIC participants aged 2–4 years old, the prevalence of obesity was 11.1 percent in 2005–2008 and 12.9 percent in 2011–2016. Observed differences were not tested for statistical significance.
- Among WIC participants, one-third (33.2 percent) consumed whole grains on a given day in 2005–2008, while almost half (47.5 percent) consumed whole grains in 2011–2016. Over half (56 percent) of WIC participants consumed whole milk on a given day in 2005–2008, and about one-third (35 percent) consumed whole milk in 2011–2016.

B. Potential Implications of Findings

Although the descriptive analyses presented in this report were not designed to assess the impact of WIC on indicators of diet quality and health or infer causality between WIC participation and these indicators, the results contribute to the evidence base needed to inform future research and, subsequently, WIC policy and practice. In particular, this study highlights areas where children participating in WIC appear to be doing as well as or better than their age-matched counterparts. When interpreting findings, it is also important to consider the supplemental nature of WIC. The program is not intended to provide all of the participant's daily food requirements. There are many factors associated with dietary intake and health outcomes, and WIC program participation is only one of these factors.

This study reveals areas where additional attention may be needed to improve diet quality and weight status of children participating in WIC. Taken together, the findings provide important insights that may have implications for WIC nutrition assessment, education, and promotion. Future research should expand on these findings by exploring whether they hold true in multivariate regression analyses. Future research should also further explore findings presented in chapter 7 to better understand whether the observed differences are statistically significant and potentially associated with the WIC food package changes.

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