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Trends in Food Consumption Among Children Aged 1–4 Years by Participation in the Special Supplemental Nutrition Program for Women, Infants, and Children, United States, 2005–2018

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Abstract

Background: In 2009, the US Department of Agriculture Food and Nutrition Service's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) food packages were revised to include more whole fruits, vegetables, whole grains, and lower-fat milk.

Objective: The aim of this study was to describe trends over time in the consumption of fruits (total and whole), vegetables, whole grains, milk (whole, reduced fat, low-fat or nonfat (LFNF), and flavored), and added sugars, including breakfast cereals, by WIC participation status (current WIC recipient, WIC income-eligible nonrecipient, and WIC income-ineligible nonrecipient).

Methods: Dietary intakes on a given day for 1- to 4-y-old children (n = 5568) from the 2005–2018 National Health and Nutrition Examination Survey (NHANES) were analyzed to examine trends in the percentage of individuals consuming and amounts consumed over time using linear regression adjusted for age, sex, and race and Hispanic origin.

Results: From 2005 through 2018, the percentage of WIC recipients or WIC income-eligible nonrecipients consuming fruits and vegetables on a given day did not change, but the percentage of fruit consumed as whole fruit increased significantly among WIC recipients (36.4%–62.1%), but not among income-eligible nonrecipients. Among the WIC recipients, the percentage of consumption (5.5%–29.3%), the amount of LFNF milk servings consumed (0.1–0.4 cups), and the percentage of the total milk consumed as LFNF milk (4.8%–27%) significantly increased from 2005 to 2018. Conversely, the percentage of energy (12.3%–10.8%) and servings (11.4–10.6 teaspoons) from added sugars declined significantly. Among WIC-eligible nonrecipients, the servings of whole grains increased significantly, whereas servings and percentage of energy from added sugars declined significantly.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tjnut.2023.01.016.

Author disclosures

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Conclusions: From 2005 through 2018, changes in dietary patterns for WIC recipients did not always mirror those of US children of the same age. The percentage of fruit consumed as whole fruit, and the percentage and quantity of milk consumed as LFNF milk increased significantly among WIC recipients, but not among income-eligible nonrecipients.

Keywords

NHANES; WIC; nutrition; diet; toddlers

Introduction

The 2020–2025 US Dietary Guidelines for Americans (DGAs) recommend following a healthy dietary pattern at every life stage [1]. USDA Food and Nutrition Service's (FNS) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) supports pregnant and postpartum women, infants, and children age 1–4 y who are low-income and at risk of poor nutrition [2]. WIC provides supplemental foods ("food packages"), nutrition education including breastfeeding support, and referrals to health and social services. WIC food packages are designed to supplement participants' diets with specific nutrients and food groups and to contribute to an overall healthy dietary pattern. In 2005, the Institute of Medicine recommended that WIC food packages align with the 2005 DGAs and infant-feeding practice guidelines of the American Academy of Pediatrics [3]. An interim rule allowed for USDA to move forward with changes to the WIC packages, and they were implemented by October 2009. These changes, which included more whole fruits and vegetables, whole grains, and lower-fat milk, were the first comprehensive revisions to the WIC food packages since the nutrition program began in the early to mid-1970s [4].

Several studies on dietary intakes in the pediatric population and among WIC recipients have reported a positive association between WIC participation and improved dietary intakes [5–13]. However, studies have not evaluated trends in dietary intake among children who participate in WIC compared with children who are eligible but do not participate. Therefore, using 2005–2018 data, the objective of this study was to examine trends over time in the consumption of fruits, vegetables, whole grains, and low-fat milk and other dietary components among 1- to 4-y-old children who were WIC recipients, income-eligible nonrecipients, and those not eligible for WIC.

Methods

Data from seven 2-y cycles (2005–2006 through 2017–2018) of the cross-sectional National Health and Nutrition Examination Survey (NHANES) were used for these analyses. NHANES is a complex, stratified, multistage probability sample of the US civilian, noninstitutionalized population administered by the National Center for Health Statistics (NCHS). The survey combines an in-home interview and a standardized physical examination, including a dietary interview, at a mobile examination center (MEC). Details of the NHANES study design, implementation, datasets, analytic considerations, and other documentation are published or available on the Web [14, 15]. The NHANES protocol was approved by the NCHS Ethics Review Board. For children and adolescents <18 y, written

parental consent was obtained. The sample design included oversampling to obtain reliable estimates of health and nutritional measures for population subgroups. During 2005–2018, various subgroups were oversampled, including non-Hispanic Black, Mexican American, and low-income White persons, and persons of other races and ethnicities. For young children (age 1–5 y), the NHANES examination response rates ranged from 86.9% to 55.2% from 2005–2006 to 2017–2018 [16].

Two 24-h dietary recall interviews were attempted for each survey participant; the first recall was conducted in person at the MEC, and the second was conducted by telephone 3–10 d later [14, 15, 17, 18]. Data from day 1 24-h dietary recall interview were used for this study. Trained interviewers, using the USDA's data collection instrument, automated multiple pass method (AMPM) with standardized probes, collected the type and quantity of foods and beverages consumed during the previous 24 h [14]. Proxies reported dietary intakes for children 5 y of age or younger. Only records deemed reliable were used in the current analysis. The dietary data quality control criteria and methods are described in detail elsewhere [17].

Defining food categories

Each food and beverage reported by NHANES participants is coded to correspond to the USDA's Food and Nutrient Database for Dietary Studies (FNDDS) food codes. FNDDS food codes are accompanied by food descriptions, ingredient lists, gram weights, and nutrient and energy values. These FNDDS food codes also link to the USDA's Food Patterns Equivalents Databases (FPED), which disaggregates each food code into ounce-equivalents (oz.- eq), cup equivalents, teaspoon equivalents, or grams of 37 distinct food pattern food groups used to model the Dietary Guidelines food pattern recommendations [14, 19, 20]. For these analyses, the following FPED food groups are presented: cup equivalents of total vegetables, cup equivalents of fruit [total (including 100% fruit juice) and whole fruit], cup equivalents of milk and cup equivalents of whole grains. Additionally, teaspoons of added sugars and food groups from USDA's What We Eat in America (WWEIA) food categories are presented and include cup equivalents of milk (whole, reduced fat, nonfat and low-fat, and flavored) and grams of breakfast cereals (ready-to-eat, high sugar, and ready-to-eat low sugar). WWEIA Food Categories categorize the FNDDS food codes into ~15 broad food categories and 150 subcategories. More information on WWEIA Food Categories is available elsewhere [21].

The contribution of whole fruit to total fruit, the contribution of different milk categories to total milk intake, the contribution of whole grains to total grains intake and the contribution of the cereal categories to total breakfast cereals intake, were estimated using the mean ratios approach described previously [22]. The approach entailed summing the cup equivalents of whole fruit, cup equivalents of milk by category, cup equivalents of whole grains and grams of breakfast cereal by category, and dividing that by the total cup equivalents of fruit, total cup equivalents of milk, total cup equivalents of total grains and total grams of breakfast cereals, respectively, and then multiplying by 100. The contribution of added sugars to total energy intake was determined by converting teaspoon equivalents to energy based on 16 kcal/teaspoon.

WIC participation

WIC participation was categorized into 3 groups on the basis of family annual income and a positive response to the question, "is participant now receiving benefits from the WIC program." *WIC recipients* were defined as children who were reported to be currently receiving WIC benefits. *WIC-eligible nonrecipients*, a more vulnerable group, were defined as children from families with annual income at or below 185% of the Department of Health and Human Services (DHHS) poverty guideline (the cutoff for WIC participation) [23] and did not report currently receiving WIC benefits. *WIC-ineligible nonrecipients* were higher income nonparticipants defined as children from families with annual income >185% of the poverty guideline and did not report currently receiving WIC benefits.

Covariates

Demographic variables included sex, age (y), and self-reported race and Hispanic origin. Race and Hispanic origin groups included non-Hispanic White, non-Hispanic Black, and Mexican American persons. Because all Hispanic persons were not oversampled in NHANES until 2007, only Mexican American persons are reported separately. Totals include all other race and Hispanic origin groups not reported separately, including those reporting multiple races.

Statistical analysis

Demographic characteristics of the study population were described by WIC participation status. Pairwise differences in WIC participation status by sex, age, and race and Hispanic origin were evaluated using a t statistic. The predicted prevalence of food group/category intake and the amount of intake, adjusted for sex, age, and race and Hispanic origin were estimated from linear regression. Unadjusted trends are provided in Supplemental Tables 2 and 3. Tests for linear and quadratic trends across survey years were evaluated using the Satterthwaite-adjusted F-test in linear regression. The National Cancer Institute's Joinpoint software [24] was used to evaluate change points for quadratic trends. If a change point was detected, piecewise linear regression was used to evaluate the change between slopes.

A sensitivity analysis was conducted in which WIC eligibility was defined by income and adjunctive eligibility through participation in Medicaid or Supplemental Nutritional Assistance Program (SNAP). No direct question for currently receiving SNAP was available on public files for survey years 2007–2010, unlike for other survey cycles. Rather, currently receiving SNAP during 2007–2010 was derived on the basis of receiving SNAP within the last 31 d from the date of interview.

NHANES survey design variables and day 1 dietary sample weights that account for differential probabilities of selection, nonresponse, noncoverage, and day of the week were used to obtain estimates representative of the civilian noninstitutionalized US population. Standard errors of the percentages were estimated using Taylor series linearization, a method that incorporates the NHANES sampling design [25]. All reported estimates were evaluated either using the NCHS data presentation standards for proportions [26] or relative standard error <30% for means.

The significance for statistical testing was P <0.05. Statistical analyses were performed using SAS (version 9.4, SAS Institute Inc) [27] and SUDAAN version 11.0 (RTI International) [28].

Results

The analysis sample included 1- to 4-y-old children with reliable dietary recalls (n = 5922) from the 2005–2006 through 2017–2018 NHANES cycles. Based on proxy reports, participants who were consuming breastmilk (n = 155) or were missing information on WIC participation status (n = 199) were excluded, resulting in a final analytic sample of 5568 children (Supple-mental Figure 1).

More than 30% of US children 1–4 y of age were WIC recipients (30.3%) and another 24% of the children were WIC eligible but did not participate in the program during the study period from 2005 through 2018 (Table 1). During this time, overall participation in the WIC program was similar for boys and girls, decreased with age, and varied by race and Hispanic origin. Mexican American (59.2%) children were more likely to be WIC recipients than non-Hispanic Black (45.0%) and non-Hispanic White (16.0%) children and non-Hispanic Black children were more likely than non-Hispanic White children to be WIC recipients. Similar patterns of WIC participation were seen for each 2-y cycle of the study period (Supplemental Table 1).

Figures 1–4 show the 2-y trends in the percentage of children (proxies) reporting intake, on a given day, of the examined food groups, and the amount consumed, by WIC participation status from 2005–2006 to 2017–2018, adjusted for age, sex, and race and Hispanic origin. Unadjusted trends are provided in Supplemental Tables 2 and 3.

Fruits and vegetables

From 2005–2006 to 2017–2018 (Supplemental Table 4), the adjusted percentage of children 1–4 y of age who consumed any fruit or whole fruit only on a given day did not change significantly for WIC recipients, WIC income-eligible nonrecipients, or WIC income-ineligible nonrecipients (Figure 1A and C). The mean amount of total fruit consumed decreased among WIC recipients (1.7–1.4 cups, P = 0.05) (Figure 1B). The trend in whole fruit consumed was not statistically significant (0.6–0.9 cups, P = 0.17) (Figure 1D) but may have contributed to the significant increase in the mean percentage of fruit consumed as whole fruit among children receiving WIC (36.4%–62.1%, P < 0.001) (Figure 1E). The percentage also increased among those who were WIC income-ineligible (54.6%–73.8%, P < 0.001) but not among children who were income-eligible for WIC but not participating in the program. During the same period, the adjusted percentage of children who consumed any vegetables did not change for WIC recipients or income-eligible non-recipients but decreased among children who were WIC income-ineligible nonrecipients (95.3%–87.0%, P = 0.03) (Figure 1F). No significant trends were observed in the cups of vegetables consumed for any group (Figure 1G).

Milk consumption

Among WIC recipients (Supplemental Table 5), on a given day, the adjusted percentage of children consuming (5.5%–29.3%, $P < 0.001$) (Figure 2A) and mean cups consumed (0.1–0.4 cups, $P < 0.001$) (Figure 2B) of low-fat or nonfat (LFNF) milk, as well as the percentage of the total milk consumed as LFNF milk (4.8%–27.0%, $P < 0.001$) (Figure 2C) significantly increased from 2005–2006 to 2017–2018. No changes in milk consumption were observed for those who were income-eligible for WIC but not participating in the program except a decrease in the mean percentage of the total milk consumed as LFNF milk from 2011–2012 to 2017–2018 (10.3%–2.3%, $P = 0.01$) (Figure 2C). During this time, among WIC recipients only, the adjusted percentage of children consuming reduced fat milk increased until 2009–2010 (29.6%–43.2%, $P = 0.001$) and then decreased through 2017–2018 (17.7%, $P < 0.001$) (Figure 2D). The adjusted percentage of WIC recipients consuming whole milk decreased from 2005–2006 to 2009–2010 (51.0%–26.7%, $P < 0.001$) and then did not change through 2017–2018 (28.6%, $P = 0.85$) (Figure 2G). Among WIC income-ineligible non-recipients, the only changes observed were significant decreases in the mean cups of whole (Figure 2H) and flavored milk (Figure 2K) consumed from 2005–2006 to 2017–2018.

Cereals and whole grains

From 2005 through 2018 (Supplemental Table 6), on a given day, the percentage of WIC recipients consuming lower sugar, ready-to-eat cereal (30.7%–15.2%, $P = 0.001$) (Figure 3A), mean grams (7.7–3.4 g, $P = 0.004$) (Figure 3B), as well as the mean percentage contribution to total cereal intake (46%–27.5%, $P = 0.01$) (Figure 3C) decreased significantly. During this period, no significant trends in cereal consumption were observed among WIC income-eligible nonrecipients. Among the WIC income-ineligible children, the adjusted percentage of children consuming lower sugar, ready-to-eat cereal did not change significantly from 2005–2006 to 2009–2010 (18.5%–25.1%, $P = 0.09$) before significantly decreasing to 11.1% ($P < 0.001$) in 2017–2018 (Figure 3A). From 2005 through 2018, lower sugar, ready-to-eat cereal (3.8–2.2 g, $P = 0.03$) (Figure 3B) and higher sugar, ready-to-eat cereal consumption percentage (Figure 3D) and grams (Figure 3E) decreased among WIC income-ineligible children.

Among WIC recipients, on a given day, the adjusted percentage of children consuming whole grains remained stable from 2005–2006 to 2011–2012 (66.3%–70.0%, $P = 0.07$) and then decreased significantly through 2018 (59.3%, $P = 0.01$) (Figure 3G). Conversely, the mean cups of whole grains consumed increased from 0.4 cups in 2005–2006 to 0.7 cups in 2011–2012 ($P < 0.001$), and then did not change significantly through 2018 (0.6 cups, $P = 0.26$) (Figure 3H). Among WIC income-eligible nonrecipients and WIC income-ineligible non-recipients, the mean cups of whole grains consumed increased significantly from 2005 through 2018. The mean increase was 0.5–0.7 cups ($P = 0.02$) among WIC income-eligible nonrecipients and 0.5–0.8 cups ($P < 0.001$) among WIC income-ineligible nonrecipients.

Added sugars

From 2005–2006 to 2017–2018 (Supplemental Table 7), on a given day, the adjusted percentage of children consuming added sugars did not change (Figure 4A); however, both

the teaspoons of added sugars consumed (Figure 4B), and the percentage of energy intake from added sugars (Figure 4C) decreased among WIC recipients, WIC income-eligible nonrecipients, and WIC-ineligible nonrecipients.

Sensitivity analysis

WIC eligibility in our study is defined by income only and does not account for adjunctive eligibility by programs such as Medicaid or SNAP. A sensitivity analysis of trends in consumption of foods, accounting for WIC eligibility through participation in Medicaid or SNAP, was conducted. Results were similar to those reported above except, among WIC-eligible nonrecipients, the adjusted percentage of children consuming, on a given day, whole fruit and reduced fat milk, and cups consumed of vegetables and reduced fat milk significantly decreased from 2005 to 2018. Among WIC income-ineligible nonrecipients, the adjusted percentage and cups consumed of whole fruit significantly increased (data not shown).

Discussion

Results from NHANES show that on a given day, from 2005–2006 to 2017–2018, WIC recipients consumed an increased percentage of total fruit as whole fruit and an increased percentage of milk as LFNF milk, changes not observed among WIC income-eligible nonrecipients. The increase in the mean percentage of fruit consumed as whole fruit could be because of a reduction in total fruit (whole fruit and 100% fruit juice) consumption, an increase in whole fruit consumption, or a combination of both. No changes, however, were seen in the percentage of children consuming, on a given day, any fruits or vegetables or the total amounts of whole fruits and vegetables consumed by both WIC recipients and income-eligible nonrecipients. The percentage of WIC recipients who consumed whole grains did not change from 2005 through 2012 but declined from 2013 through 2018, whereas among WIC income-eligible nonrecipients, the amount of whole grain consumption increased from 2005 through 2018. No changes were found in the percentage of children consuming added sugars, but the amount of added sugars and percentage of energy from added sugars significantly declined between 2005 and 2018 for all children 1–4 y of age.

Although studies have not evaluated trends in dietary intake among children who participated in WIC compared with children who are eligible but did not participate, several others have looked at changes in dietary patterns among WIC participants before and after the 2009 food package change [8, 13, 29–31]. A 2014 systematic review of literature [8] on the impact of the 2009 WIC food package change concluded that the revised food package was associated with improved dietary intake. Similar to dietary patterns seen in our trends study, 1 study reported increases in the amount of fruit and low-fat dairy consumption among Hispanic and African-American WIC-enrolled mothers and children [29]. However, this study was conducted only 6 mo after the food package change in 2009. Another study of the New York State WIC program evaluated WIC-enrolled participants from 2008 to 201l and reported an increase in daily consumption of fruit, vegetables, and whole grains among 1- to 4-y-old children [31]. A recent study [13] using NHANES data found increased intake of fiber, whole grains, and legumes and decreased intake of starchy vegetables among

WIC participants 2–4 y of age between 2005–2008 and 2011–2014 during which time there were revisions to the WIC food package. No significant changes were observed in dairy or fruit intake [13]. The study did not compare these changes to changes in consumption among children not participating in WIC. The current study shows trends in consumption among WIC recipients along with trends among nonrecipient counterparts including those income-eligible and ineligible. In addition to including a wider age range of 1- to 4-y-old children, the current analysis disaggregates WIC food package categories, such as milk and fruit categories to examine the percent of milk consumed as low-fat/nonfat and the percentage of fruit consumed as whole fruit. This analysis also presents both the mean intake and percentage of children consuming each food category. Finally, exploring a longer period until 2018 can reveal whether any immediate changes after the food package revision led to long-term changes.

There have been other periodic studies evaluating dietary patterns by WIC participation status [6, 7, 9]. A study using NHANES 2011–2016 examined dietary patterns by race and ethnicity for WIC recipients and income-eligible and ineligible nonrecipients [9] and reported that Hispanic WIC recipients consumed less added sugar than their higher income counterparts. Hispanic WIC recipients consumed more fiber than income-eligible and income-ineligible nonrecipients. No differences in dietary patterns were observed by WIC participation status for non-Hispanic White and Black children. Our study does not report trends in dietary patterns by race and Hispanic origin but did control for race and Hispanic origin in the trend models.

Improved health outcomes have been associated with the food package change. Several studies of WIC-enrolled children have reported a decline in obesity after the food package change [32–35]. Daepp et al. [32] reported that before the 2009 WIC food package change, the prevalence of obesity across states among 2- to 4-y-old WIC participants was increasing by 0.23 percentage points annually. After 2009, the trend was reversed. Changes in sociodemographic and other obesity risk factors did not account for the declining trend. However, the decline in obesity after 2009 among children receiving WIC benefits reported in these studies was not observed among US children in general [36]. One difference between these studies and ours is the age groups. We analyzed change among children 1–4 y of age, whereas other studies have included 2–4 y or birth to 4 y of age children.

Our study is not without limitations. Children 1–4 y of age are unable to report food and beverage consumption for themselves, additionally, because they may be in childcare, the person reporting intake may not be the person most familiar with intake. Also, dietary intake was measured as intake on a given day and does not necessarily reflect usual intake. Limitations associated with self-reported dietary data, such as misreporting, have been described [14, 37, 38]. Finally, data may have been underpowered to detect significant trends for some groups.

Despite these limitations, the strengths of the study include the use of a nationally representative sample, including the more recently available data. Also, 24-h dietary recall data in NHANES were collected evenly across days of the week and seasons of the year, to account for day-to-day variation and random errors, hence they are representative of mean

population intake. Finally, dietary data in NHANES are collected using the USDA's AMPM method, which has cues to prompt respondent memory while reducing the respondent burden to obtain accurate recalls [39].

In conclusion, Changes in dietary patterns for WIC recipients did not always mirror those among other US children of the same age. From 2005 to 2018, although the percentage of 1- to 4-y-old children who consumed any fruits or vegetables on a given day did not change, the amount of fruit consumed as a percentage of whole fruit increased among children receiving WIC benefits, but not among WIC income-eligible nonrecipients. In 2017–2018, >62% of fruit consumed by WIC recipients was whole fruit compared with ~53% for WIC-eligible nonrecipients and almost 74% of WIC-ineligible children, all above DGA's guidelines that at least half of the recommended amount of fruit come from whole fruit [1]. The percentage of children who consumed LFNF milk and the quantity of these kinds of milk consumed also increased significantly among WIC recipients but not among eligible nonrecipients, in line with the DGA's recommendation of replacing full-fat dairy with low or nonfat alternatives for this age group [1].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data Availability

Data described in the manuscript and codebook is publicly and freely available without restriction at the NCHS' NHANES website (https://wwwn.cdc.gov/nchs/nhanes/Default.aspx). Analytic code will be made available upon request from the corresponding author.

Abbreviations:

AMPM	automated multiple pass method
DHHS	Department of Health and Human Services
FNDDS	Food and Nutrient Database for Dietary Studies
FNS	Food and Nutrition Service

FPED	Food Patterns Equivalents Databases
LFNF	low-fat or nonfat
MEC	mobile examination center
SNAP	Supplemental Nutritional Assistance Program
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children
WWEIA	What We Eat in America
NHANES	National Health and Nutrition Examination Survey
NCHS	National Center for Health Statistics

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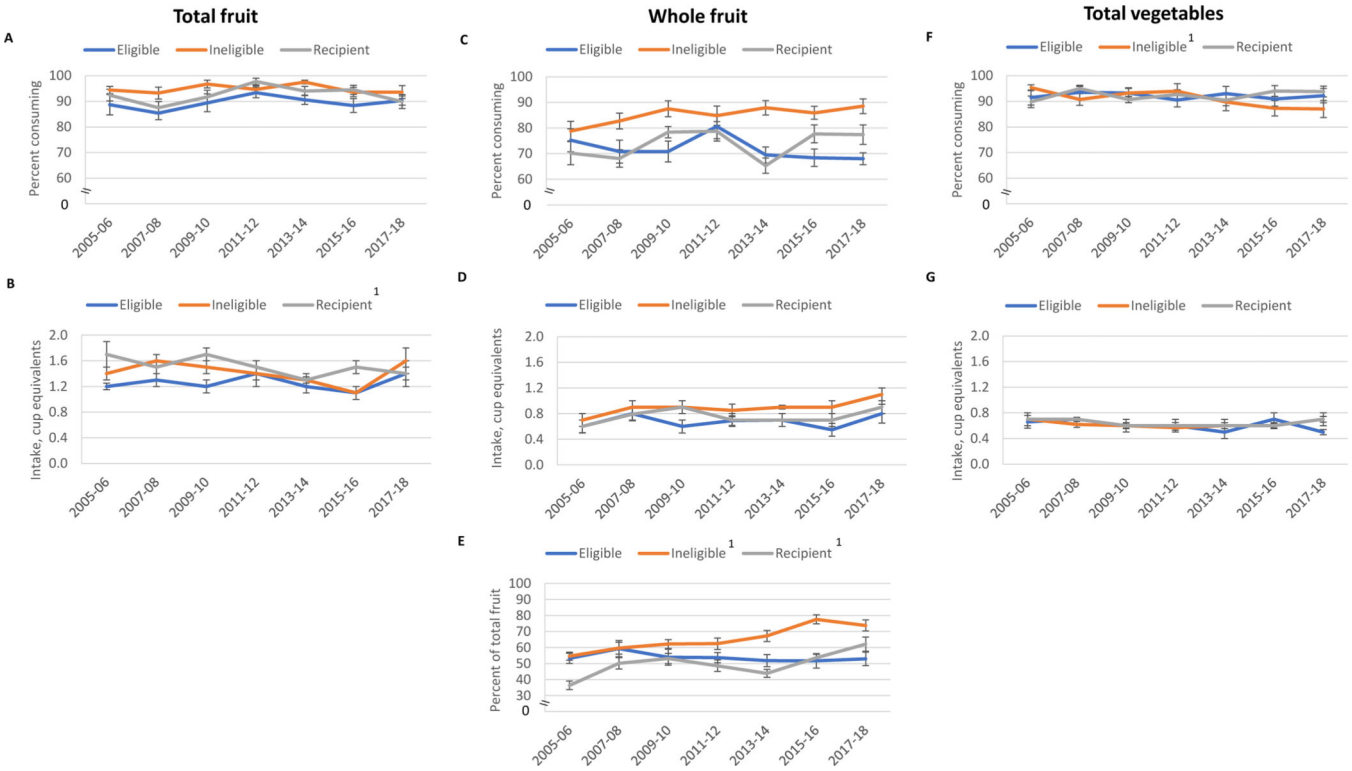

FIGURE 1.

Fruit and vegetable consumption on a given day among 1- to 4-y-old children, adjusted for age, sex, and race/Hispanic origin, by WIC participation status, US 2005–2018. (A) Percentage consuming total fruit, (B) mean cup equivalents of total fruits consumed, (C) percentage consuming whole fruit, (D) mean cup equivalents of whole fruit consumed, (E) percentage of total fruit consumed as whole fruit, (F) percentage consuming vegetables, and (G) mean cup equivalents of vegetables consumed. Values in panels (A–G) are percentages or means ± standard errors from linear regression. Unweighted sample size: WIC recipient, $n = 2272$; WIC eligible, nonrecipient, $n = 1488$; WIC ineligible, nonrecipient, $n = 1808$. Estimates are shown in Supplemental Table 4. [1]*P*-linear trend < 0.05. Data Source: NHANES. US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

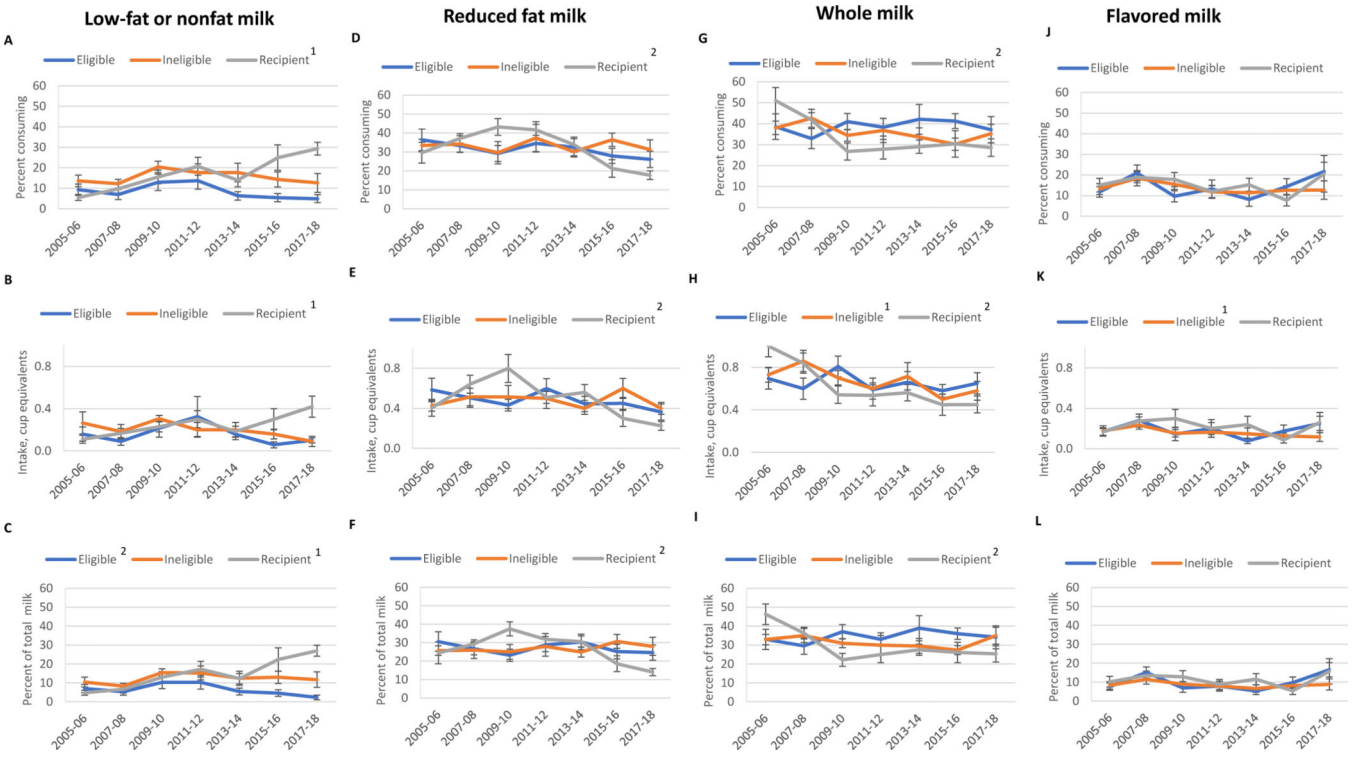

FIGURE 2.

Milk consumption on a given day among 1- to 4-y-old children, adjusted for age, sex, and race/Hispanic origin, by WIC participation status, US 2005–2018. (A) Percentage consuming low-fat or nonfat (LFNF) milk, (B) mean cup equivalents of LFNF milk consumed, (C) percentage of total milk cup equivalents consumed as LFNF milk, (D) percentage consuming reduced fat milk, (E) mean cup equivalents of reduced fat milk consumed, (F) percent of total milk cup equivalents consumed as reduced fat milk, (G) percentage consuming whole milk, (H) mean cup equivalents of whole milk consumed, (I) percentage of total milk cup equivalents consumed as whole milk, (J) percentage consuming flavored milk, (K) mean cup equivalents of flavored milk consumed, and (L) percentage of total milk cup equivalents consumed as flavored milk. Values in panels (A–L) are percentages or means ± standard errors from linear regression. Unweighted sample size: WIC recipient, $n = 2272$; WIC eligible, nonrecipient, $n = 1488$; WIC ineligible, nonrecipient, $n = 1808$. Estimates are shown in Supplemental Table 5. [1]*P*-linear trend < 0.05. [2]*P*-quadratic trend < 0.05. Data Source: NHANES. US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

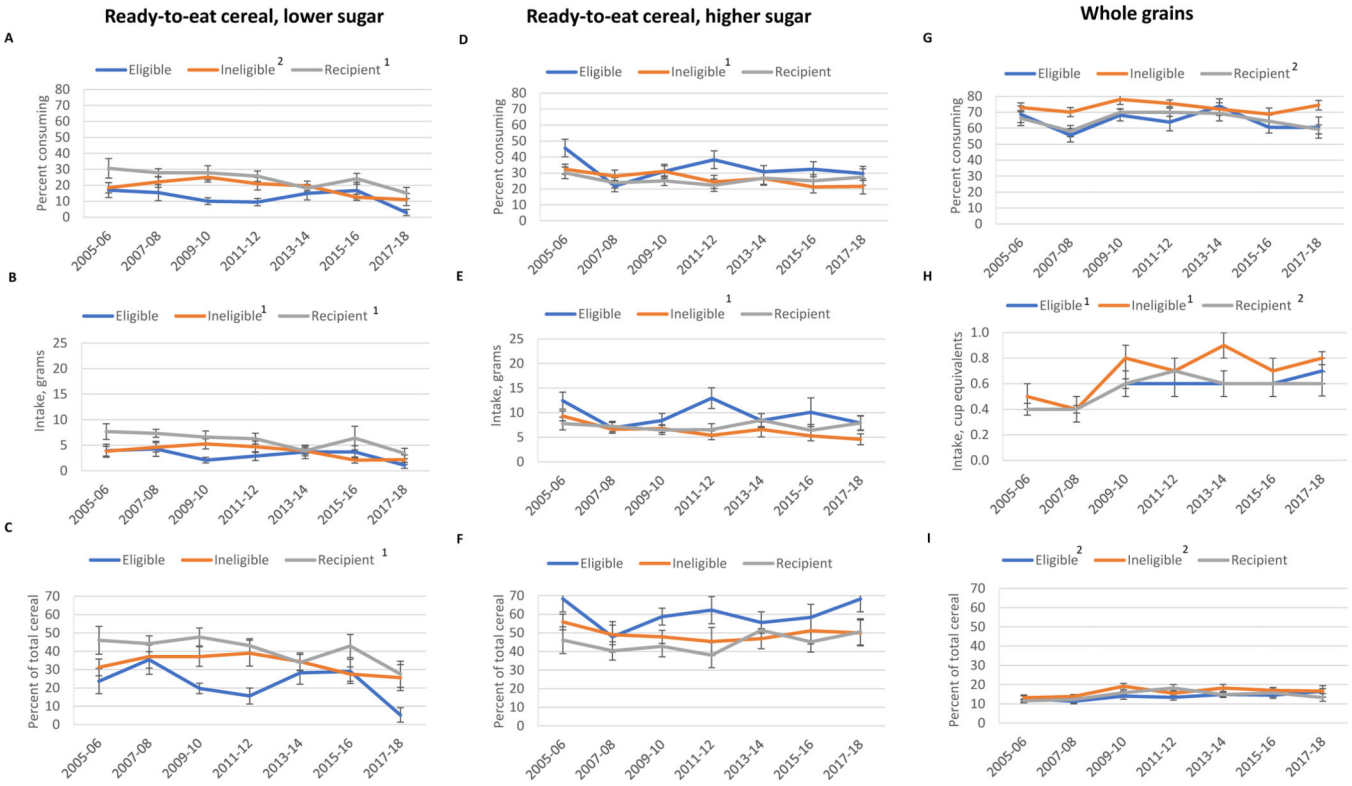

FIGURE 3.

Breakfast cereal and whole grain consumption on a given day among 1- to 4-y-old children, adjusted for age, sex, and race/Hispanic origin, by WIC participation status, US 2005–2018; (A) percentage consuming ready-to-eat cereal, higher sugar, (B) mean grams of ready-to-eat cereal, higher sugar consumed, (C) percentage of total grams of breakfast cereals consumed as ready-to-eat cereal, higher sugar, (D) percentage consuming ready-to-eat cereal, lower sugar, (E) mean grams of ready-to-eat cereal, lower sugar consumed, (F) percentage of total grams of breakfast cereals consumed as ready-to-eat cereal, lower sugar, (G) percentage consuming whole grains, (H) mean cup equivalents of whole grains consumed, and (I) percentage of total cup equivalents of grains consumed as whole grains. Values in panels (A–I) are percentages or means ± standard errors from linear regression. Unweighted sample size: WIC recipients, $n = 2272$; WIC eligible, nonrecipient, $n = 1488$; WIC ineligible, nonrecipient, $n = 1808$. Estimates are shown in Supplemental Table 6. [1]*P*-linear trend < 0.05. [2]*P*-quadratic trend < 0.05. Data Source: NHANES. US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

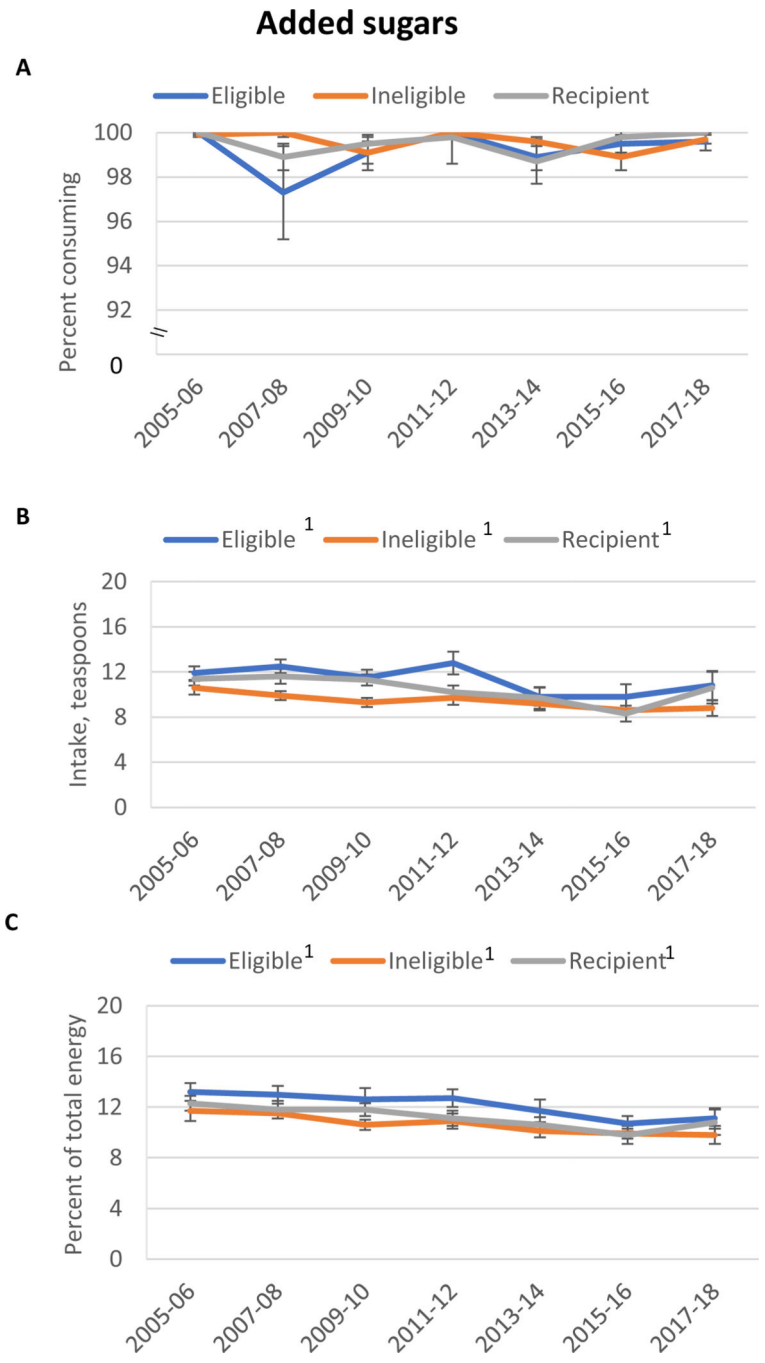

FIGURE 4.

Added sugars consumption on a given day among 1- to 4-y-old children, adjusted for age, sex, and race/Hispanic origin, by WIC participation status, US 2005–2018; (A) Percentage consuming added sugars, (B) mean teaspoons of added sugars consumed, and (C) percentage of total energy from added sugars. Values in panels (A–C) are percentages or means ± standard errors from linear regression. Unweighted sample size: WIC recipient, *n* = 2272; WIC eligible, nonrecipient, *n* =1488; WIC ineligible, nonrecipient, *n* = 1808. Estimates are

shown in Supplemental Table 7. [1]*P*-linear trend < 0.05. Data Source: NHANES. US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

TABLE 1

Characteristics of the study population of 1- to 4-y-old children, by WIC participation, United States, 2005–2018[1]

Characteristics	n [2]	Recipient (n^2 = 2272)	Eligible, nonrecipient (n^2 = 1488)	Ineligible, (n^2 = 1808)
		Percent[3] (SE)		
Total[5]	5568	30.3 (1.2)	24.1 (0.9)	45.6 (1.5)
Age (y)				
1	1542	38.8 (1.9)[4]	18.6 (1.3)[5]	42.6 (2.1)
2	1697	31.8 (1.8)	24.2 (1.5)	44.0 (1.9)
3	1127	26.5 (1.8)	23.6 (1.7)	49.9 (2.4)
4	1202	24.7 (1.8)	29.6 (1.8)	45.7 (2.2)
Sex				
Female	2723	30.9 (1.4)	23.9 (1.3)	45.3 (1.8)
Male	2845	29.8 (1.4)	24.4 (1.1)	45.9 (1.8)
Race and Hispanic origin				
Non-Hispanic White	1270	45.0 (2.1)[7]	35.7 (1.8)[7]	19.3 (1.7)
Non-Hispanic Black	1720	16.0 (1.3)[6,7]	22.6 (1.3)[6]	61.4 (2.0)[6,7]
Mexican American	1387	59.2 (2.1)	21.8 (1.6)	19.1 (1.7)

SE, standard error; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

[1] Data Source: NHANES, 2005–2018.

[2] Unweighted sample size includes responses from all reliable and complete recalls.

[3] Weighted percentages may not add up to 100% due to rounding.

[4] Total includes all other race and Hispanic origin groups not reported separately.

[5] Significant linear trends by age.

[6] Significantly different from non-Hispanic Black.

[7] Significantly different from Mexican American.