

A Summary of Evidence Related to Key Food Groups Targeted in the Proposed WIC Revisions

Research Review, January 2023

Introduction

On November 17, 2022, the U.S. Department of Agriculture (USDA) announced major food package revisions to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (USDA/FNS, 2022). This proposed rule adopts many recommendations from an expert panel of the National Academies of Sciences, Engineering, and Medicine (NASEM) and is the first major revision of the WIC food benefits in over a decade (NASEM, 2017). Before these changes can be implemented, a public comment period will be open through February 21, 2023. This is an opportunity for USDA to gather feedback from practitioners and researchers on their proposal, and then revise the final WIC food package, which impacts the nutrient intake and dietary quality of millions of women, infants, and children from low-income families in the United States.



Among other changes, the proposed rule suggests removing juice from the food package, reducing the maximum allowance for milk, and requiring whole grain criteria in breakfast cereal. Therefore, this brief focuses on three food groups in the WIC food package: juice, milk, and breakfast cereal. A narrative review of the peer-reviewed literature, published between January 1, 2009, and October 31, 2022, was conducted to examine the evidence to answer three specific questions:

- 1) How did WIC participants' juice consumption behaviors and health outcomes change after the 2009 food package revision, which reduced the 100% juice allowance?;
- 2) What are current milk consumption behaviors among WIC participants and their association with health outcomes?; and
- 3) How do preferences for breakfast cereals vary by race and ethnicity, particularly among the Hispanic population, which accounted for over 35% of the participants in 2019 (USDA, 2021)?

These questions were developed by researchers during a workshop hosted by the Healthy Eating Research (HER) and Nutrition & Obesity Policy Research & Evaluation Network (NOPREN) WIC Learning Collaborative in response to the proposed WIC food revisions.

PubMed and Google Scholar were used to search the related literature published from 2010 to 2022. A set of keyword searches was developed for all three food categories (juice, milk, and breakfast cereal) through discussion among the researchers. Two researchers independently searched for and identified relevant articles by screening the titles and the abstracts. Included articles were then assessed with a full-text review. The group discussion resolved different opinions about the inclusion of any articles. The references of the included articles were also assessed for their relevancy to the narrative review.

The Evidence

The evidence related to the research questions is summarized in Tables 1, 2, and 3, which list only research question-relevant outcomes, comparison groups, and findings.

Juice

In general, following the 2009 WIC food package revisions, the consumption of 100% juice was reduced among WIC children, although the significance and magnitude of the reduction varied across outcomes and study populations (Ishdorj et al., 2017; Kong et al., 2015; Morshed et al., 2015; Ng et al., 2017). A summary of key study findings follows, while all evidence reviewed for this research question is presented in Table 1, in which the articles are ordered by the first author's last name.

- WIC children consumed similar amounts of, or more, 100% juice than eligible non-participants (Ng et al., 2017; Vercammen et al., 2018).
- Intake of 100% juice was not significantly related to body weight status (underweight/normal weight vs. overweight/obese) (Charvet et al., 2018).
- Children from food-insecure households were more likely to consume an additional serving of 100% juice daily than children from food-secure households (Chaparro et al., 2022).
- There were conflicting views towards 100% juice among some Latino parents: Some treated 100% juice as healthy since WIC provides it, while others thought it should be avoided or moderated (Beck et al., 2014).

Milk

The proposed WIC food package reduces the maximum allowance for milk; thus, it is important to examine the participants' preferences for and consumption of milk in the current food package. Although WIC program participants believed milk was a healthy beverage for children and overwhelmingly preferred whole milk to reduced-fat (2%), low-fat (1%), or skim milk (Beck et al., 2017; Weber et al., 2018), the 2009 WIC food revision significantly changed participants' milk consumption. The prevalence of participants consuming reduced-fat, low-fat, or skim milk significantly increased after the 2009 WIC revision, while the prevalence of participants consuming whole milk significantly decreased, especially in children (Ishdorj et al., 2017; Kong et al., 2015; Meiqari et al., 2015; Morshed et al., 2015). These patterns were consistent across race/ethnicity. Other key findings related to WIC participant milk consumption include:

- Food insecurity was associated with higher daily milk consumption (Chaparro et al., 2022).
- Daily milk intake was not significantly different across body weight status or race/ethnicity (Charvet et al., 2018).
- Intake of saturated fat (grams) declined by 10% after the 2009 WIC food package revision (Morshed et al., 2015).
- The volume of higher-fat milk purchased was reduced more in WIC children than in WIC-eligible non-participating children (37% vs. 13% decline) (Ng et al., 2018).
- Based on state-level analyses, full redemption of the monthly allowance for milk was low overall. For example, only 33.6% and 19.8% of West Virginia WIC households redeemed more than 90% of the monthly allowance for whole milk and low-fat milk, respectively (Zhang et al., 2021).



More details on the studies reviewed for this research question can be found in Table 2, in which the articles are ordered by the first author's last name.

Cereal

The proposed WIC food revision updates the whole grain criteria to require that WIC-eligible whole grain breakfast cereals contain a whole grain as the first ingredient and requires all WIC-approved breakfast cereals to meet the new criteria for whole grains. Prior to the 2009 WIC food package revisions, there was a concern (in the 2007 interim rule) that the whole grain requirements might remove corn or rice-based cereals, which could be culturally relevant to the Hispanic population. A recent panel of experts convened in April 2022 from academia, non-profit organizations, and industry raised similar concerns: the whole grain requirement may exclude several corn or rice-based cereals preferred by Hispanic participants (Slavin, et al., 2022). However, the literature has little evidence about cereal consumption among Hispanic WIC participants. Therefore, the narrative review conducted for this project included literature exclusively on cereal consumption and knowledge among low-income Hispanic individuals, including Hispanic women and children. Key findings follow:

- Hispanic and non-Hispanic participants did not have significant differences in correctly identifying whole grain vs. refined grain products, including whole grain and refined grain cereals (Chea et al., 2019).
- Prevalence of consumption of non-whole-grain-rich cereal and presweetened cereal was lower in Hispanic children (< 4 years old) than non-Hispanic black children (Welker et al., 2018).
- There were no significant differences in the prevalence of children (< 4 years old) consuming whole grain-rich cereals by race and ethnicity (Welker et al., 2018).
- Hispanic ethnicity did not affect cereal purchasing and substitution decisions (whole grain, fortified, fiber-content, high-sugar, or high-fat) in an adjusted demand estimate model (Li et al., 2016).
- Hispanic infants (6-12 months) consumed more ready-to-eat cereal (not including infant cereals) than non-Hispanic Black infants (Roess et al., 2018).

A full summary of the literature reviewed on cereals is included in Table 3, in which the articles are ordered by the first author's last name.

Conclusions and Policy Implications

Based on the evidence summarized in this brief, we can conclude that WIC children reduced their intake of 100% juice after the 2009 WIC food package revision. However, it is not clear whether the WIC food revision caused these reductions. It is notable that 100% juice consumption did not vary by body weight status, but consumption did vary by food security status. Removing 100% juice from the WIC package may reduce confusion among parents by aligning the package with the nutrition counseling they receive from WIC, which recommends reducing or not serving children 100% fruit juice.

Overall, WIC participants still preferred whole milk to other non-whole milk varieties (reduced fat, 1%, or skim); however, the restriction of whole milk in the WIC food package did change participants' milk consumption behaviors, especially in children, towards more low-fat milk. Similar to 100% juice, food-insecure participants consumed more milk daily. The full redemption of either whole- or low-fat milk was still low among program participants.

Finally, although there has been concern among some stakeholders about eliminating non-whole-grain breakfast cereal from the program, which Hispanic groups may prefer, the limited evidence available suggests that these concerns may not be justified. Additionally, the new proposed whole grain criteria requiring whole grains as the first ingredient would potentially allow for the inclusion of different types of whole-grain cereal, such as corn- or rice-based products, with less fiber than whole wheat.

In general, the evidence available supports the WIC food package changes proposed in 2022 regarding specific food groups (juice, milk, and cereal).

- **Juice:** More restrictions on 100% juice may further change participants' consumption behavior, bringing them closer to recommendations. More research is needed on the association between reductions in 100% fruit juice intake and health outcomes.
- **Milk:** The proposed reduction of the milk allowance may not significantly change participants' view of the food package since the redemption rate was relatively low, especially for low-fat milk.
- **Whole Grains:** The whole grain requirement may not preclude the use of benefits for purchasing cereals comprised of culturally-relevant whole grains, such as corn, if the requirement is based on the whole grain-rich criteria.

Table 1: Summary of the evidence on the 100% juice benefit in the WIC food package changes

Author Last Name	Year	Instrument and Data Source	Study Sample	Relevant Outcomes	Comparison	Relevant Finding
Beck	2014	Qualitative interviews	29 WIC parents	The decision to serve 100% juice and sweetened beverages to children	Latino parents (no comparison group).	Some parents considered avoiding or moderating the consumption of 100% juice because of the sugar content, but others considered 100% juice healthy. Some parents were confused that WIC counsels them not to give their children juice but provides it in the package.
Borger	2022	24-hour dietary recall	1,233 WIC mothers	Meeting recommendations for added sugar (AS) intake each day at age 3	Continuous participation in WIC at ages 1-3 years versus intermittent participation, participation for year one only, and participation for years 1-2 only.	Longer duration of WIC participation increased the likelihood of meeting the AS recommendation on a given day at age 3.
Chaparro	2022	Survey	9,929 WIC children	Frequency of consumption of 100% juice, juice drinks, & other sweetened beverages	Children in WIC-participating households with food insecurity compared to those in food-secure households.	Food insecurity was associated with a higher frequency of 100% fruit juice, juice drinks, & other sweetened beverage (bivariate analyses) consumption; in adjusted analyses, food-insecure children were 7% more likely to consume an additional serving of 100% fruit juice per day.
Charvet	2018	FFQ	197 WIC children	Daily intake (oz) of 100% fruit juice, juice drinks, SSBs, and other beverages	Comparison by weight status (underweight/average weight vs. obese/overweight) and race/ethnicity among 3-5-year-old children participating in WIC in Florida.	WIC children aged 3 to 4.9 years consumed more than 2 times the amount of 100% juice, recommended by the American Academy of Pediatrics. Non-Hispanic Black children consumed more 100% fruit juice than Hispanic/Latino children (13.5 oz/day v. 10.4 oz/day). Intake of SSB was correlated with 100% fruit juice intake, although this association was not significant in adjusted models. The intake of 100% juice was not significantly different between children with underweight/normal weight and obese/overweight status. However, SSB and fruit drink consumption was higher among children with overweight/obesity.
Ishdorj	2017	Survey	2,782 WIC children	Change in frequency and probability of consumption of 100% fruit juice, SSBs, and artificially sweetened beverages	Pre- and post-WIC package revision among WIC-participating 2-4-year-olds in Texas.	The percentage of children consuming 100% juice (orange, apple, and tomato) one or two times a day increased after the WIC juice allowance was reduced in 2009. However, after the 2009 revision, the probability of never consuming 100% juice increased, while the likelihood of never consuming sugar-sweetened beverages decreased. Overall, 100% juice consumption frequency was higher than other sweetened beverages.
Kong	2015	24-hour dietary recall	209 mothers and 164 of their children participating in WIC	Change in 100% fruit juice and SSB consumption	Pre- and post-revision among WIC-participating mother-child dyads, stratified by race/ethnicity (Hispanic, African American).	Intake of SSBs increased among African American children. Intake of 100% fruit juice declined among Hispanic mothers. Changes for other groups were not statistically significant.
Morshed	2015	FFQ	149 WIC-participating preschoolers	Change in dietary intake of fruit juice	Pre- and post-WIC package revision among preschool-age children in WIC households.	Consumption of fruit juice decreased over time, but the decline was not statistically significant.

Author Last Name	Year	Instrument and Data Source	Study Sample	Relevant Outcomes	Comparison	Relevant Finding
Ng	2017	Household panel scanner data	4,537 WIC-eligible households with preschoolers	Change in household purchase volume of 100% juice, juice drinks, and SSBs	1) Pre- and post-WIC package revision among WIC households and non-WIC households; 2) pre- and post-revision among WIC households compared to non-WIC households (Diff-in-Diff).	Purchase volume of 100% juice and SSBs declined for both WIC & non-WIC households, but there was no significant difference between changes in WIC & non-WIC households.
Vercammen	2018	24-hour dietary recall	1,576 children aged 2-4 years	Intake of 100% fruit juice	WIC-participating 2-4-year-olds compared to income-eligible 2-4-year-olds not participating in WIC.	WIC participants consumed more 100% fruit juice ($\beta = 0.22$ cup equivalents/day, 95% CI = 0.04, 0.40) than income-eligible non-participants. WIC participants had 1.51 times greater odds (95% CI = 1.06, 2.14) of exceeding the age-specific American Academy of Pediatrics maximum intake for juice.

Table 2: Summary of the evidence on whole or low-fat milk benefit in the WIC food package changes

Author Last Name	Year	Instrument and Data Source	Study Sample	Relevant Outcomes	Comparison	Relevant Finding
Beck	2017	Qualitative interviews	29 WIC parents	Latino parents' beliefs on the health effects of beverages (milk, water, juice) on infants and toddlers	Latino parents (no comparison group).	Parents believed that water and milk were healthy beverages for children.
Chaparro	2022	Survey	9,929 WIC children	Frequency of consumption of milk and other sweetened drinks	Children in WIC-participating households with food insecurity compared to those in food-secure households.	On average, dairy was consumed 2.7 times per day. Food insecurity was associated with higher milk consumption among WIC-only (non-SNAP) participants (RR: 1.04, 95% CI: 1.01, 1.07). Children in food-insecure households were 4% more likely than children in food-secure households to consume milk an additional time per day.
Charvet	2018	FFQ	197 WIC children	Daily intake (oz) of low-fat/skim milk and other beverages	Comparison by weight status (underweight/normal weight vs. obese/overweight) and race/ethnicity among 3-5-year-old children participating in WIC in Florida.	The average daily milk intake did not differ by weight status and was not significantly different by race/ethnicity. Approximately 80% of children with overweight/obesity consumed low-fat or fat-free milk most often (of all types of milk), compared to 59% of normal/underweight children.
Ishdorj	2017	Survey	2,782 WIC children	Change in volume and probability of consumption of whole milk, reduced-fat milk, and low-fat or skim milk	Pre- and post-WIC package revision among WIC-participating 2-4-year-olds in Texas.	The percentage of children consuming whole milk decreased from 61.4% to 8.7%, while the percentage of children consuming reduced-fat milk increased from 32.6% to 81.5%. Children with Black caregivers were more likely to consume whole milk and less likely to drink reduced-fat and low-fat/skim milk than children with non-Hispanic white caregivers. Total milk consumption declined significantly from 2.63 to 2.33 cups per day after the 2009 WIC food package change.
Kong	2015	24-hour dietary recall	209 mothers and 164 of their children participating in WIC	Change in reduced-fat and whole-milk intake	Pre- and post-revision among WIC participating mother-child dyads, stratified by race/ethnicity (Hispanic, African American).	Prevalence of reduced-fat milk intake significantly increased for African American and Hispanic children (African American, 35% to 55%, $p < 0.05$; Hispanic: 55% to 84%, $p < 0.001$), and whole milk intake significantly decreased (African American, 37% to 8%, $p < 0.001$; Hispanic: 59% to 10%, $p < 0.001$). The percentage of mothers drinking low-fat milk increased from 35% to 50% but was not statistically significant, while the prevalence of mothers drinking whole milk decreased significantly.
Meiqari	2015	Survey	77 women with their oldest children who are participating in WIC	Change in prevalence and frequency of consumption of reduced-fat milk	Pre- and post-WIC package revision (1 week and 4 weeks) among WIC participating mother-child dyads.	The prevalence of consumption of low-fat milk significantly increased in children (41.3% at baseline, 58.8% at week one, and 79.5% at week four [$p < .001$]). The change was not significant among mothers in adjusted analyses. The odds of mothers reporting that they preferred low-fat milk for their family had increased significantly over the four weeks following the new WIC package implementation (OR = 5.16; 95% CI: 2.21–12.07) in unadjusted analyses.

Author Last Name	Year	Instrument and Data Source	Study Sample	Relevant Outcomes	Comparison	Relevant Finding
Morshed	2015	FFQ	149 WIC-participating preschoolers	Change in dietary intake of lower-fat milk and saturated fat	Pre- and post-WIC package revision among preschool-age children in WIC households.	The odds of consuming reduced-fat milk post-revision were 2.94x the odds of consuming condensed-fat milk in the pre-revision period. Intake of saturated fat (grams) declined by 10% after the revision.
Ng	2017	Household panel scanner data	4,537 WIC-eligible households with preschoolers	Change in household purchase volume of higher-fat milk and low-fat milk	1) Pre- and post-WIC package revision among WIC households and non-WIC households; 2) pre- and post-revision among WIC households compared to non-WIC households (Diff-in-Diff).	Volume purchases of higher-fat milk decreased after the WIC revision; WIC households purchased 24 mL (37%) less higher-fat milk per capita per day in the late-revision period compared with pre-revision period, while higher-fat milk purchases declined by 8 mL (13%) for non-WIC households over the same period.
Odoms-Young	2014	24-hour dietary recall	273 Hispanic and African WIC children and their mothers	Change in dietary intake of lower-fat milk and whole milk; Change in home availability of lower-fat and whole milk	Pre- and post-revision among WIC participating mother-child dyads, stratified by race/ethnicity (Hispanic, African American).	Low-fat milk intake increased among children and Hispanic mothers and whole milk intake decreased for all groups. Inverse correlations between change in reduced fat and whole milk consumption were observed. Saturated fat as a percentage of total energy decreased for Hispanic mothers and children. Home food availability of low-fat dairy increased.
Weber	2018	Survey and qualitative interviews	150 WIC participants in the study and 31 WIC participants in the interview	Perceptions of whole milk and low-fat/skim milk provision by WIC (favorable or unfavorable)	None	Children participating in WIC+SNAP had greater consumption of all food items examined, except for milk, when compared to children participating in WIC only.
Zhang	2021	WIC Electronic Benefits Transfer (EBT) data	23,050 WIC households	Prevalence of full redemption of WIC milk benefits (reduced-fat and whole milk)	WIC app users vs. non-app users.	Prevalence of full redemption (> 90%) for low-fat milk was 21.2% for app users vs. 17.2% for non-app users (average was 19.8%), and for whole milk, it was 28.7% for app users and 35.9% for non-app users (33.6%).

SNAP: Supplemental Nutrition Assistance Program

Table 3: Summary of the evidence on cereal benefit in the WIC food package changes

Author Last Name	Year	Instrument and Data Source	Study Population	Relevant Outcomes	Cereal Category	Comparison	Relevant Finding
Chea	2019	Mixed methods: Quantitative questionnaire, short qualitative interview	Low-income adults	1) Correct identification of 4+/5 whole grain foods; 2) Factors of the identification & consumption of whole grains	5 whole-grain & 6 refined-grain products (1 whole-grain & 1 refined grain cereal, & oatmeal)	Hispanic v. non-Hispanic participants; White v. Black v. Other race participants	There were no statistically significant differences in the odds of correctly identifying 4+ whole-grain products by race or ethnicity. In the qualitative interviews, sugar content and product appearance led some participants to misclassify whole-grain cereal as refined-grain; similarly, protein content led some participants to misclassify refined-grain cereal as whole-grain. Finally, the lack of explicit labeling as whole-grain led to uncertainty about whether oatmeal was whole-grain.
Li	2016	Household purchasing (scanner) data	Households with children	Demand for RTE breakfast cereals	Ready-to-eat breakfast cereal	Purchasing decisions by cereal attributes (whole-grain, fortified, fiber-content, high-sugar, or high-fat)	Hispanic ethnicity did not affect cereal purchasing decisions in adjusted models. Households were less responsive to price changes for whole-grain cereals, although they were also less responsive to price changes among high-sugar or high-fat cereals. If prices increased, households tended to substitute cereals with similar fiber and whole-grain content.
Roess	2018	24-hour dietary recall	Children aged <2 in the U.S.	Percentage of consumers and energy from grains among children aged 0 to<2 y	RTE cereal (not including infant cereal)	Differences in consumption by Hispanic v. Non-Hispanic White v. Non-Hispanic Black toddlers	Non-Hispanic Black infants (aged 6-12 mo.) were less likely than Non-Hispanic White and Hispanic infants to consume ready-to-eat cereal (5% compared with 13–16%; OR: 0.33; 95% CI: 0.14, 0.77).
Slavin	2022	Expert Roundtable	WIN	Advantages and implications of revising the WIC food package to include only "whole-grain-rich" breakfast cereals	Breakfast cereal	NA	Using the "whole grain-rich" criteria could increase the variety of eligible cereals by making it easier to include non-wheat whole grains like corn and rice in breakfast cereals, which may not meet the necessary fiber levels to be considered "whole grain" (which are based on standards for whole grain wheat of 11 g/100 g). This is important as wheat, and oat-based cereals may be unfamiliar or less preferred in some cultures. The exclusion of rice- and corn-based cereals, which are traditional components in Hispanic and African cultures, could lead to lower redemption.
Welker	2018	24-hour dietary recall	Children aged <4 in the U.S. (1/4 participating in WIC; ~30% participating in SNAP)	Percentage of consumers and energy from grains among children aged 0 to<4 y	Family cereal (RTE or hot), pre-sweetened cereal, whole-grain-rich cereal, non-whole-grain-rich cereal	Differences in consumption by Hispanic v. Non-Hispanic White v. Non-Hispanic Black toddlers	Fewer Hispanic children (51%) consumed family cereal (RTE or hot) than Non-Hispanic Black children (69%). The prevalence of consumption of non-whole-grain-rich cereal (24%) and presweetened cereal (36%) among Hispanic children was also significantly lower than among Non-Hispanic Black children (40% and 53%, respectively). There were no differences in the percentage of children consuming whole-grain-rich cereals by race and ethnicity. Among consumers, Hispanic children consumed fewer kilocalories from family cereal (91 v. 127 kcal/consumer) and non-whole-grain-rich cereal (69 v. 99 kcal/consumer) than Non-Hispanic Black children.

RTE: Ready-to-eat

SNAP: Supplemental Nutrition Assistance Program

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