

Revised WIC Food Package and Children's Diet Quality

June M. Tester, MD, MPH,^a Cindy W. Leung, ScD, MPH,^b Patricia B. Crawford, DrPH, RD^c

abstract

BACKGROUND AND OBJECTIVES: In October 2009, the Special Supplemental Nutrition Program for Women, Infant, and Children (WIC) food package was revised to include more fruits, vegetables, whole grains, and lower-fat milk. We examined the impact of the WIC food package revisions on the diet quality of children in households using WIC.

METHODS: A total of 1197 children aged 2 to 4 years from low-income households were studied from before and after the policy implementation (using the 2003–2008 and 2011–2012 National Health and Nutrition Examination Survey). The Healthy Eating Index–2010 (HEI-2010) was calculated using two 24-hour diet recalls. Linear regression was used to examine the difference in HEI-2010 score attributable to the food package change, adjusting for baseline and secular trends among WIC participants and nonparticipants, as well as child and household characteristics. Component scores of the HEI-2010 index were analyzed with generalized linear models.

RESULTS: Average HEI-2010 scores for participants and nonparticipants were 52.4 and 50.0 at baseline, and 58.3 and 52.4 after the policy change, respectively. The WIC food package revisions were associated with an adjusted average of 3.7 additional HEI-2010 points (95% confidence interval, 0.6–6.9) for WIC participants compared with nonparticipants. In particular, the revisions were associated with a 3.4-fold relative increase (95% confidence interval, 1.3–9.4) in the Greens and Beans component score for WIC participants compared with nonparticipants.

CONCLUSIONS: Results from this national sample indicate that the WIC food package revisions were associated with higher diet quality for children participating in WIC.



^aDepartment of Endocrinology, University of California San Francisco (UCSF) Benioff Children's Hospital Oakland, Oakland, California; ^bCenter for Health & Community, University of California, San Francisco, San Francisco, California; and ^cNutrition Policy Institute, Agriculture and Natural Resources, University of California, Berkeley, Berkeley, California

Dr Tester conceptualized and designed the study, conducted the statistical analyses, and drafted the manuscript; Dr Leung calculated the Healthy Eating Index–2010 scores, assisted with design and statistical analysis, and reviewed and revised the manuscript; and Dr Crawford assisted with content expertise regarding the Supplemental Nutrition Program for Women, Infants, and Children program, interpretation of study findings, and suggestions and edits for the manuscript. All authors approved the final manuscript as submitted.

DOI: 10.1542/peds.2015-3557

Accepted for publication Jan 27, 2016

Address correspondence to June M. Tester, MD, MPH, UCSF Benioff Children's Hospital Oakland, 747 52nd St, Oakland, CA 94609. E-mail: jttester@chori.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2016 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

WHAT'S KNOWN ON THIS SUBJECT: In 2009, the Special Supplemental Nutrition Program for Women, Infant, and Children food package was revised. Key improvements included the increased provision of fruits, vegetables, whole grains, and lower-fat milk. Evidence thus far has been limited to regional samples.

WHAT THIS STUDY ADDS: This study is the first to report on the significant improvements in diet quality in young children associated with the food package change using a nationally representative sample and the first to do so with the updated Healthy Eating Index–2010.

To cite: Tester JM, Leung CW, Crawford PB. Revised WIC Food Package and Children's Diet Quality. *Pediatrics*. 2016; 137(5):e20153557

The United States Department of Agriculture (USDA) Food and Nutrition Service Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is an important federal program in existence since 1975. It was designed to support the health and nutrition of low-income pregnant women, infants, and children up to the age of 5 years.¹ In December 2007, the interim rule revised the WIC benefits package to more closely align with dietary recommendations from the Institute of Medicine,² and changes were required to be in effect by October 2009.³ This revision represented a sweeping change, as the WIC program had not changed its food package significantly in several decades. The changes to WIC included: addition of more fruits, vegetables, and whole grains; a switch toward lower fat milk; and a decrease in allotment for juice to one-half the previous amount. In the time since the policy change, there has been evidence of regional improvement in terms of healthy food availability at stores participating in the WIC program.⁴⁻⁹

There has also been evidence regarding positive changes in dietary intake according to regionally based data.⁴ Telephone surveys with WIC participants in California¹⁰ and administrative records from millions of WIC visits in the state of New York¹¹ showed increases in reported consumption of whole-grain foods and decreases in consumption of whole milk, with increased consumption of fruits and vegetables. This shift from whole milk to lower fat milk, with a concomitant decrease in consumption of saturated fats, was also reported in low-income, preschool-aged children in New Mexico.¹² In another study, Hispanic and African-American mothers in Illinois were asked to report on the diets of their children who were participating in WIC. Six months after the policy change, there was

a shift away from consumption of whole milk to lower fat milk for all children and greater availability of whole grains in the home.¹³ Eighteen months after the policy change, statistically significant improvements in diet (decreased total and saturated fat, increased dietary fiber, and overall dietary quality) was seen but only among Hispanic children.¹⁴

However, there have been no nationally representative studies examining the impact of this policy on the diets of low-income children. The National Health and Nutrition Examination Survey (NHANES) continuously collects household information and detailed 24-hour diet recalls on children and adults in the United States. Recently released data about WIC participation in the 2011–2012 cycle of the NHANES permits comparison of diet quality by using the Healthy Eating Index–2010 (HEI-2010) before and after the policy change to evaluate the impact on its intended population target. The HEI-2010 is an overall measure of diet quality with 12 components that are derived from diet recall data; this index was revised in 2012 to reflect the 2010 Dietary Guidelines for Americans.¹⁵

We hypothesized that the WIC package change would be associated with an increase in diet quality compared with earlier quality ratings. We also hypothesized that given the nature of the changes to the WIC package, there would be improvements in 4 specific HEI components: “Whole Fruit” (which, unlike “Total Fruit,” does not include juice); “Greens and Beans” (which excludes potatoes that are counted in “Total Vegetables”); “Whole Grains” (as a reflection of the new whole-grain items included in the package); and “Fatty Acids” (with the shift to lower fat milk contributing to an improved score).

METHODS

Study Population

We examined participants from the NHANES, which is a complex, multistage probability cross-sectional sample designed to be representative of the US civilian, noninstitutionalized population. This analysis combined data from the 3 cycles before the WIC package change (2003–2004, 2005–2006, and 2007–2008) and 1 cycle that occurred fully after implementation (2011–2012). Analysis was limited to children from households with incomes at or below 185% of the federal poverty level (FPL) in accordance with the Department of Health and Human Services’ poverty guidelines.¹⁶ The study included 1197 children who were aged 2 to 4 years at the time of the household interview, with complete data on household WIC participation and dietary intake.

Measures

Household WIC participation

WIC participation assessed at the level of the household was used as the primary predictor of interest for this analysis. Household WIC participation was assessed with the following single question that was asked throughout the entire analytic period of all individuals: “In the last 12 months, did you [the child] or any member of the household receive benefits from the WIC program, that is, the Women, Infants and Children program?” For our analysis, this question was preferable to the question “Is [child] now receiving benefits from the WIC program?” because of the higher rate of missing data for that individual-level question (with which sample size would have been $N = 768$, keeping all other inclusion criteria). These children with missing data (36%) were significantly different from the 768 children with nonmissing data in terms of key demographic characteristics (eg, proportion

<100% FPL vs 100%–185% FPL, proportion Hispanic, proportion with household respondent having at least a high school diploma [all, $P < .01$]). These findings indicate that missing the child-specific WIC item was nonrandom and using it could lead to other biases in the data.

Dietary Recall Data

A 24-hour diet recall was conducted in-person at the mobile examination center with the person most knowledgeable about the child's dietary intake. Since 2003, participation has included a second recall conducted over the telephone after the in-person visit. The average of 2 recalls was used for this analysis. Overall diet quality was assessed by using the HEI-2010, a measure developed by the USDA Center for Nutrition Policy and Promotion, to measure conformance to the 2010 Dietary Guidelines for Americans. The HEI-2010 score is the sum of 12 component scores (Total Fruit, Whole Fruit, Total Vegetables, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Fatty Acids, Refined Grains, Sodium, and Empty Calories), with a maximum score of 100 points.¹⁵ The MyPyramid Equivalents Database (for NHANES 2003–2004) and the Food Patterns Equivalents Database (for NHANES 2005 and later) convert foods and beverages reported in NHANES to USDA food pattern components, and they were used to estimate component scores for the HEI-2010.¹⁷

Statistical Analyses

Survey weights were used to account for the complex, multistage probability sampling design used in NHANES in accordance with recommendations from the National Center for Health Statistics.^{16,18} SEs were estimated by using jackknife replication. NHANES data from 2003–2008 (3 cycles) were pooled to ensure a sufficient representation of WIC participants and income-eligible

nonparticipants before the WIC food package change. To confirm the absence of a statistically significant trend in the HEI-2010 score during this period, adjusted linear regression analysis was conducted by using the covariates and an ordinal variable denoting the survey cycle (2003–2004, 2005–2006, and 2007–2008). Absence of a trend in total HEI-2010 score was confirmed with $P > .05$ for this ordinal variable. For sensitivity analysis, the 2011–2012 cycle was compared with only the cycle immediately before the intervention (2007–2008) as well as with the 2 previous cycles (2005–2006 and 2007–2008).

Multivariate linear regression analysis was conducted to evaluate the associations between HEI-2010 score and household WIC participation. Models were adjusted for the following covariates: age, race/ethnicity, gender, weight status (normal weight, overweight, or obese) and average total energy intake of the child; education (less than high school graduate versus high school graduate) and marital status (partnered/married versus single) of the household respondent; and the household income-to-poverty ratio and household food security status. The model included household WIC participation, a dichotomous variable denoting whether the survey cycle was preintervention (2003–2008) or postintervention (2011–2012), and an interaction term between household WIC participation and intervention period. This interaction term represents the “extra” association between household WIC and HEI-2010 during the 2011–2012 period, and thus the difference in diet quality among WIC participants attributable to the food package change.

There was skewness in the HEI-2010 subcomponent scores. Supplemental Table S4 provides the medians and proportions with nonzero scores for components with at least 25%

of children scoring zero at baseline. To examine changes in individual components of the HEI-2010, component scores were analyzed by using a generalized linear model (GLM), assuming a γ distribution and a log-link. The use of the log-link allows us to directly model diet quality component scores and obtain interpretations in terms of the ratio of the relative changes between groups.¹⁹ The use of the γ distribution reflects the fact that the diet component data were nonnegative and skewed to the right. Models included the same variables as the multivariate regression model for the overall HEI-2010. In the GLM model, we interpreted the interaction coefficient as the log-transformed ratio of change in component scores among WIC participants compared with the change in component scores among nonparticipants.

Analyses were conducted by using SAS version 9.3 for HEI-2010 calculations (SAS Institute, Inc, Cary, NC) and Stata version 12.1 (Stata Corp, College Station, TX) for all other analyses.

RESULTS

Demographic Characteristics

Characteristics of the sample are shown in Table 1. There were some differences between WIC participants and nonparticipants. For WIC participants, a higher proportion were Hispanic (39.9% vs 21.8%) and a smaller proportion were non-Hispanic white (30.4% vs 51.3%) compared with nonparticipants ($P < .01$). WIC participants were also less likely to have a caregiver with at least a high school diploma ($P < .01$). WIC participants were younger (2.9 vs 3.1 years; $P < .05$) and were from households with lower household income (84% vs 106% of the FPL; $P < .05$). There were no statistically significant differences with respect to gender, total energy intake, or weight status of the child or with respect to

TABLE 1 Characteristics of the Sample (*N* = 1197) Comprising Children Aged 2 to 4 Years From Low-Income Households in the NHANES 2003–2008 and 2011–2012

Characteristic	WIC Nonparticipants (<i>n</i> = 478)	WIC Participants (<i>n</i> = 719)	<i>P</i>
Gender			.10 ^a
Male	257 (56.2)	364 (48.3)	
Female	221 (43.8)	355 (51.7)	
Race/ethnicity			<.01 ^a
Non-Hispanic white	150 (51.3)	130 (30.4)	
Hispanic	157 (21.8)	352 (39.9)	
Non-Hispanic black	136 (21.0)	194 (22.4)	
Other/mixed	35 (5.9)	43 (7.3)	
Education (household respondent)			<.01 ^a
Less than high school graduate, no GED	170 (28.7)	341 (43.9)	
High school graduate or higher	308 (71.3)	378 (56.1)	
Marriage/partner status			.47 ^a
Single/unmarried/unpartnered	156 (31.8)	245 (35.5)	
Married/partnered	322 (68.2)	474 (64.5)	
Food security			.06 ^a
Food secure	259 (56.8)	304 (46.3)	
Marginally food secure	72 (16.8)	152 (17.4)	
Food insecure	147 (26.4)	263 (36.3)	
Weight category (child)			.65 ^a
Normal weight	361 (74.8)	525 (73.3)	
Overweight	65 (15.2)	99 (14.4)	
Obese	52 (10.0)	95 (12.3)	
Age, mean ± SE, y	3.07 ± 0.05	2.91 ± 0.04	.02 ^b
Income (%FPL), mean ± SE	106 ± 4.0	84 ± 2.4	<.01 ^b
Total energy, mean ± SE, kcal	1556 ± 32	1555 ± 22	.98 ^b

Unless otherwise indicated, data are presented as *n* (%). GED, General Educational Development test.

^a *P* value from design-based χ^2 test.

^b *P* value for unadjusted linear regression with each continuous variable as the outcome and WIC status as the lone predictor.

marital status or food security status in the household.

Overall Effect of WIC Package Change in HEI-2010

Of 100 points, the survey-weighted (unadjusted) mean HEI-2010 score at baseline for WIC participants was 52.4 compared with 50.0 for nonparticipants. After the policy implementation,

the mean HEI-2010 score was 58.3 for WIC participants in 2011–2012 compared with 52.4 for nonparticipants (Table 2).

Adjusting for child and household characteristics, the WIC food package revisions were significantly associated with 3.7 additional HEI-2010 points (95% confidence interval [CI], 0.6–6.9) in children in a WIC household compared with their

peers. Sensitivity analyses comparing the postintervention period with smaller baseline periods found comparable results (3.7 points [95% CI, 0.5–7.0] compared with data from 2005–2008, and 4.7 points [95% CI, 1.0–8.5] compared with data from 2007–2008).

Changes in Component Scores

Survey-weighted preintervention and postintervention means in components are shown in Table 3. The 3 components that exhibited the greatest relative change between preintervention and postintervention scores for WIC participants were Greens and Beans (in which there was an adjusted increase of 111%), Whole Grains (adjusted increase of 64%), and Fatty Acids (adjusted increase of 47%) (data not shown). For nonparticipants, the component with the greatest relative change was Greens and Beans (in which there was an adjusted 38% decrease [data not shown]).

The interaction term in our GLM model, after exponentiation, represented the ratio of the changes in component scores among WIC participants compared with nonparticipants. This ratio was statistically significant for Greens and Beans (3.4 [95% CI, 1.3–9.4]), meaning that the change in Greens and Beans score for WIC participants after the policy change was 3.4 times greater than the corresponding change in nonparticipants. The adjusted increases in component

TABLE 2 HEI-2010 and WIC Participation in Children From Low-Income Households in NHANES Before (2003–2008) and After (2011–2012) the Policy Change

	HEI-2010 Before WIC Food Package Change (2003–2008), <i>n</i> = 881		HEI-2010 After WIC Food Package Change (2011–2012), <i>n</i> = 316		Effect of WIC Food Package Change ^a		
	Mean	Median	Mean	Median	β^b	95% CI	<i>P</i>
Nonparticipants (<i>n</i> = 478)	50.0	49.1	52.4	50.2	Ref	NA	NA
WIC participants (<i>n</i> = 719)	52.4	52.5	58.3	58.2	3.7 ^b	0.6–6.9	0.02

NA, not applicable.

^a Model was adjusted for the following covariates: age, race/ethnicity, gender, and weight status and energy intake of the child; education and marital status of the household respondent; and household income-to-poverty ratio and household food security status. The model included household WIC participation, a variable denoting preintervention versus postintervention period, and an interaction between WIC and intervention period.

^b Estimated difference in the change in HEI-2010 for the WIC participants and nonparticipants.

TABLE 3 Relative Changes in HEI-2010 Component Scores in Children From Low-Income Households in the NHANES Comparing Scores Before (2003–2008) and After (2011–2012) the Policy Change

Mean HEI-2010 Component (Maximum Score)	Nonparticipants (<i>n</i> = 478)		WIC Participants (<i>n</i> = 719)		Ratio of Relative Changes in Respective Component Scores Comparing WIC Participants With Nonparticipants		
	Before (2003–2008)	After (2011–2012)	Before (2003–2008)	After (2011–2012)	Ratio of Changes (WIC to Non-WIC)	95% CI	<i>P</i>
Total Fruit (5)	3.2	3.6	3.7	3.8	1.0	0.8–1.2	.73
Whole Fruit (5)	2.5	2.8	2.8	3.2	1.1	0.8–1.4	.62
Total Vegetables (5)	2.3	2.2	2.3	2.4	1.1	0.9–1.3	.47
Greens and Beans (5)	0.7	0.6	0.8	1.5	3.4	1.3–9.4	.02
Whole Grains (10)	2.0	2.2	1.8	3.0	1.6	0.9–2.6	.08
Dairy (10)	8.0	7.4	8.2	7.9	1.1	0.9–1.2	.53
Total Protein Foods (5)	3.6	3.6	3.6	3.8	1.1	0.9–1.3	.46
Seafood and Plant Proteins (5)	1.6	1.2	1.5	1.7	1.3	0.9–2.1	.18
Fatty Acids (10)	3.2	3.7	2.8	4.3	1.3	1.0–1.8	.06
Refined Grains (10)	6.2	6.8	6.3	6.3	0.9	0.8–1.1	.21
Sodium (10)	5.7	6.1	6.1	6.3	1.0	0.9–1.1	.84
Empty Calories (20)	11.0	12.4	12.4	14.0	1.0	0.9–1.2	.69

Model was adjusted for the following covariates: age, race/ethnicity, gender, and weight status and energy intake of the child; education and marital status of the household respondent; and household income-to-poverty ratio and household food security status. The model included household WIC participation, a variable denoting preintervention versus postintervention period, and an interaction between WIC and intervention period.

scores for WIC participants (compared with nonparticipants) were 56% greater for Whole Grains and 32% greater for Fatty Acids, but these potentially positive findings did not reach statistical significance in this sample ($P=0.08$ and $P=0.06$, respectively).

DISCUSSION

The findings from the present analysis suggest that revisions to the WIC package in 2009 were associated with a significant improvement in diet quality among children participating in this program across the United States. Using rigorous methods of dietary assessment and a nationally representative sample from NHANES, our study results are consistent with earlier findings from regional studies.^{4,10,12–14}

It has been shown that WIC participation is associated with better nutrient intake among preschool-aged children compared with their peers who are also from low-income households.^{20–22} In this analysis, children in WIC households between 2003 and 2008 had a diet quality score that was higher than that of their peers by >2 points.

These findings suggest that even after taking into account the more favorable baseline diet quality among WIC participants, as well as secular changes, the policy change was associated with nearly 4 additional points in score. Thus, the amplitude of impact from this change was even greater than the differential between WIC participants and their peers at baseline, suggesting that the impact of the WIC policy change has not been trivial. This finding was consistent when various baseline periods were used as the reference group, suggesting that the dietary improvement observed in the postintervention period was robust.

These findings suggest that the WIC package change in particular was associated with an increase in Greens and Beans scores during a time when consumption seemed to decrease for children not participating in WIC. Although the WIC fruit and vegetable voucher can ultimately supply only a modest number of servings of green vegetables in a given calendar month, this small dollar amount appeared to have, for many children in the WIC program, translated into consumption of “some instead of none.”

Whole Grains scores were low for both WIC participants and nonparticipants at baseline, and package revisions specifically targeted increasing consumption of whole grains. Although there was a modest increase for nonparticipants, the change was much larger among WIC participants. These results are consistent with findings from a study evaluating scanner data from a supermarket chain, which showed that WIC-participating households seemed to be purchasing whole-grain bread instead of white bread.²³

The WIC package change also included a shift toward offering lower fat milk, and previous studies demonstrated a favorable effect on children’s saturated fat intake that may be attributable to this change.^{10,12–14,23} Dairy intake was high at baseline, and did not go down with the mandated shift in the kind of milk offered. Of note, Fatty Acids scores increased more for WIC participants than for nonparticipants, presumably due to substitutions away from high-fat milk. Future analyses including more waves of participants after the policy change will add statistical power and more confident analysis of these trends.

The WIC package change included incentive for purchases of fruits as well, and a hypothesized outcome would also have been an increase in fruit consumption. However, WIC participants did not significantly increase their Whole Fruit component scores more than nonparticipants. Mean scores suggest a trend toward a greater percent increase in the whole fruit component score (which does not include juice) than the total fruit score (which includes juice). A larger sample including a greater proportion of children after the policy change will be required to examine this trend more fully.

Strengths of the present study include its use of nationally representative data on both WIC participants as well as nonparticipants to examine the impact of this federal policy change. To the best of our knowledge, it is the first study evaluating the impact of WIC changes on children's diet quality using the most updated version of the HEI-2010 instead of the earlier Healthy Eating Index-2005 with its outdated diet quality ratings. Limitations are that findings from this cross-sectional

population data cannot be used to describe changes at the individual level; longitudinal data would be required for such an analysis. Although the dietary methodology used by NHANES is state-of-the-art for this purpose, there are known limitations with diet recall data. For example, it is possible that caregivers, because of desirability bias, reported intakes that were more favorable than accurate.^{24,25} However, this scenario would have been true at any time point and would not have differentially affected the report of children's dietary intake specifically after the policy implementation. Our analytic approach relies on the general assumption that, aside from the revisions outlined in the WIC package change, there were no systematic revisions that occurred to WIC participants, but not to nonparticipants, during the study period, or vice versa. However, although there were clear factors that would have affected low-income families during the study period, including the Great Recession in 2008, we have no reason to suspect that there were systematic changes other than the WIC package revision that would have affected WIC

participants differentially from their peers.

CONCLUSIONS

The federal WIC food package was revised in 2009 to offer participants in low-income households healthy foods that better aligned with the Dietary Guidelines for Americans. Results from this nationally representative sample show that our nation's children participating in the WIC program have seen improvements in the quality of their diet as a result of the 2009 WIC policy changes.

ABBREVIATIONS

CI: confidence interval
FPL: federal poverty level
GLM: generalized linear model
HEI-2010: Healthy Eating Index-2010
NHANES: National Health and Nutrition Examination Survey
USDA: United States Department of Agriculture
WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

FUNDING: Supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (1K23HD075852 [Dr Tester] and 1K99HD084758 [Dr Leung]). Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Public Law 94-105, 94th Congress, October 7, 1975. Available at: www.gpo.gov/fdsys/pkg/STATUTE-89/pdf/STATUTE-89-Pg511.pdf. Accessed September 10, 2015
2. National Research Council. *WIC Food Packages: Time for a Change*. Washington, DC: The National Academies Press; 2005
3. Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): revisions in the WIC food packages. Code of Federal Regulations (CFR) 7 CFR 246. Available at: <https://www.federalregister.gov/articles/2007/12/06/E7-23033/special-supplemental-nutrition-program-for-women-infants-and-children-wic-revisions-in-the-wic-food>. Accessed September 10, 2015
4. Schultz DJ, Byker Shanks C, Houghtaling B. The impact of the 2009 Special Supplemental Nutrition Program for Women, Infants, and Children Food Package revisions on participants: a systematic review. *J Acad Nutr Diet*. 2015;115(11):1832-1846
5. Hillier A, McLaughlin J, Cannuscio CC, Chilton M, Krasny S, Karpyn A. The impact of WIC food package changes on access to healthful food in 2 low-income urban neighborhoods. *J Nutr Educ Behav*. 2012;44(3):210-216
6. Zenk SN, Odoms-Young A, Powell LM, et al. Fruit and vegetable availability and selection: federal food package revisions, 2009. *Am J Prev Med*. 2012;43(4):423-428
7. Andreyeva T, Luedicke J, Middleton AE, Long MW, Schwartz MB. Positive influence of the revised Special Supplemental Nutrition Program for Women, Infants, and Children food

- packages on access to healthy foods. *J Acad Nutr Diet*. 2012;112(6):850–858
8. Rose D, O'Malley K, Dunaway LF, Bodor JN. The influence of the WIC food package changes on the retail food environment in New Orleans. *J Nutr Educ Behav*. 2014;46(suppl 3):S38–S44
 9. Andreyeva T, Luedicke J, Tripp AS, Henderson KE. Effects of reduced juice allowances in food packages for the women, infants, and children program. *Pediatrics*. 2013;131(5):919–927
 10. Whaley SE, Ritchie LD, Spector P, Gomez J. Revised WIC food package improves diets of WIC families. *J Nutr Educ Behav*. 2012;44(3):204–209
 11. Chiasson MA, Findley SE, Sekhobo JP, et al. Changing WIC changes what children eat. *Obesity (Silver Spring)*. 2013;21(7):1423–1429
 12. Morshed AB, Davis SM, Greig EA, Myers OB, Cruz TH. Effect of WIC food package changes on dietary intake of preschool children in New Mexico. *Health Behav Policy Rev*. 2015;2(1):3–12
 13. Odoms-Young AM, Kong A, Schiffer LA, et al. Evaluating the initial impact of the revised Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) food packages on dietary intake and home food availability in African-American and Hispanic families. *Public Health Nutr*. 2014;17(1):83–93
 14. Kong A, Odoms-Young AM, Schiffer LA, et al. The 18-month impact of special supplemental nutrition program for women, infants, and children food package revisions on diets of recipient families. *Am J Prev Med*. 2014;46(6):543–551
 15. Guenther PM, Casavale KO, Reedy J, et al. Update of the healthy eating index: HEI-2010. *J Acad Nutr Diet*. 2013;113(4):569–580
 16. Johnson CL, Paulose-Ram R, Ogden C, et al. National Health and Nutrition Examination Survey: analytic guidelines, 1999-2010. *Vital Health Stat*. 2013;2(161):1–24
 17. US Department of Agriculture. Food patterns equivalents database (FPED). Available at: www.ars.usda.gov/Services/docs.htm?docid=23871. Accessed May 8, 2015
 18. National Center for Health Statistics. National Health and Nutrition Examination Survey: analytic guidelines, 2011-2012. Available at: www.cdc.gov/nchs/data/nhanes/analytic_guidelines_11_12.pdf. Accessed May 11, 2015
 19. McCullagh P, Nelder JA. *Generalized Linear Models*, vol. 37. Boca Raton, Florida: Chapman & Hall/ CRC press; 1989
 20. Siega-Riz AM, Kranz S, Blanchette D, Haines PS, Guilkey DK, Popkin BM. The effect of participation in the WIC program on preschoolers' diets. *J Pediatr*. 2004;144(2):229–234
 21. Rose D, Habicht JP, Devaney B. Household participation in the Food Stamp and WIC programs increases the nutrient intakes of preschool children. *J Nutr*. 1998;128(3):548–555
 22. Rush D, Leighton J, Sloan NL, et al. The National WIC Evaluation: evaluation of the Special Supplemental Food Program for Women, Infants, and Children. VI. Study of infants and children. *Am J Clin Nutr*. 1988;48(suppl 2):484–511
 23. Andreyeva T, Luedicke J. Federal food package revisions: effects on purchases of whole-grain products. *Am J Prev Med*. 2013;45(4):422–429
 24. Hebert JR, Clemow L, Pbert L, Ockene IS, Ockene JK. Social desirability bias in dietary self-report may compromise the validity of dietary intake measures. *Int J Epidemiol*. 1995;24(2):389–398
 25. Kristal AR, Andrilla CHA, Koepsell TD, Diehr PH, Cheadle A. Dietary assessment instruments are susceptible to intervention-associated response set bias. *J Am Diet Assoc*. 1998;98(1):40–43

Revised WIC Food Package and Children's Diet Quality

June M. Tester, Cindy W. Leung and Patricia B. Crawford

Pediatrics 2016;137;

DOI: 10.1542/peds.2015-3557 originally published online April 7, 2016;

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/137/5/e20153557
Supplementary Material	Supplementary material can be found at: http://pediatrics.aappublications.org/content/suppl/2016/04/05/peds.2015-3557.DCSupplemental
References	This article cites 18 articles, 3 of which you can access for free at: http://pediatrics.aappublications.org/content/137/5/e20153557.full#ref-list-1
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Nutrition http://classic.pediatrics.aappublications.org/cgi/collection/nutrition_sub Public Health http://classic.pediatrics.aappublications.org/cgi/collection/public_health_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: https://shop.aap.org/licensing-permissions/
Reprints	Information about ordering reprints can be found online: http://classic.pediatrics.aappublications.org/content/reprints

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since . Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2016 by the American Academy of Pediatrics. All rights reserved. Print ISSN:

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Revised WIC Food Package and Children's Diet Quality

June M. Tester, Cindy W. Leung and Patricia B. Crawford

Pediatrics 2016;137;

DOI: 10.1542/peds.2015-3557 originally published online April 7, 2016;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/137/5/e20153557>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since . Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2016 by the American Academy of Pediatrics. All rights reserved. Print ISSN:

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

