

Federal Food Package Revisions

Effects on Purchases of Whole-Grain Products

Tatiana Andreyeva, PhD, Joerg Luedicke, MS

Background: In 2009, the U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) implemented revisions to the composition and quantities of WIC-provided foods. New whole-grain products such as whole-wheat bread and allowable substitutes were added to encourage increased intake of whole grains and fiber among WIC participants.

Purpose: This paper assesses how the WIC revisions affected purchases of bread and rice among WIC-participating households in Connecticut and Massachusetts.

Methods: Scanner data from a regional supermarket chain were used to examine bread and rice purchases of 2137 WIC households. Purchased volume of bread and rice was compared before and after implementation of the WIC revisions (2009–2010) using generalized estimating equation models. Data were analyzed in 2013.

Results: Before the WIC revisions, when no bread or rice was provided through WIC, white bread dominated bread purchases among WIC households (78% of volume), and almost all rice purchased was white (94%). As a result of the WIC revisions, the share of 100% whole-grain bread in total bread purchases tripled (from 8% to 24%), replacing purchases of white bread; the share of brown rice rose to 30% of rice purchases. WIC households used WIC benefits to change some of their bread purchases, rather than to buy more bread overall, whereas total rice purchases increased.

Conclusions: The 2009 WIC revisions significantly increased purchases of whole-grain bread and rice among WIC-participating families. The likely increase in whole-grain and fiber intake among low-income communities could have important public health implications.

(Am J Prev Med 2013;45(4):422–429) © 2013 American Journal of Preventive Medicine

Introduction

One of the key federal food assistance and nutrition programs, the U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) serves approximately half of the infants born in the U.S., 25% of children aged <5 years, 29% of pregnant women, and 26% of postpartum women.¹ WIC services to participants include the provision of supplemental nutrient-dense foods in the WIC food packages, health-care referrals, and nutrition education. The program's broad reach to a vulnerable population of low-income

women, infants, and young children offers important opportunities for early intervention to establish healthy eating habits and prevent obesity. Recent WIC changes launched a natural experiment that has the potential to affect dietary outcomes among millions of economically disadvantaged families.

On the basis of the IOM recommendations, the WIC food packages were revised in 2007 to align them with the 2005 Dietary Guidelines for Americans and current infant feeding practice guidelines of the American Academy of Pediatrics (AAP). Implemented in all states by October 2009, the revisions provided support for the establishment of long-term breastfeeding and increased consumption of fruit, vegetables, and whole grains while reducing intake of saturated fat, cholesterol, and sugar.² The main changes included the addition of new whole-grain products (whole-wheat bread and allowable substitutes); cash-value vouchers for fruits and vegetables; reductions in milk, cheese, and juice; and restrictions on the fat content of milk. A new focus on promoting whole-grain

From the Rudd Center for Food Policy and Obesity (Andreyeva, Luedicke), Yale University, New Haven, Connecticut; and Department of Psychology (Luedicke), University of Florida, Gainesville, Florida

Address correspondence to: Tatiana Andreyeva, PhD, Director of Economic Initiatives, Rudd Center for Food Policy and Obesity, Yale University, 309 Edwards Street, PO Box 208369, New Haven CT 06520-8369. E-mail: tatiana.andreyeva@yale.edu.

0749-3797/\$36.00

<http://dx.doi.org/10.1016/j.amepre.2013.05.009>

consumption was one of the major aims in the revision of the WIC food packages.

Regular consumption of whole-grain foods by adult men and nonpregnant women has been associated with a reduced risk of major chronic illnesses such as cardiovascular disease, stroke and hypertension,^{3,4} type 2 diabetes,⁵ obesity,⁶ and certain cancers,⁷ as well as a favorable role in weight regulation^{8,9} and a reduction in premature death.^{10,11} The Dietary Guidelines for Americans¹² recommend that healthy individuals consume at least three servings of whole grains daily. Although health benefits of whole grains are observed at relatively low levels of intake, very few Americans meet dietary recommendations for whole grains.^{13–15} Instead, most of the grains consumed are refined,¹⁶ which are not associated with health benefits but are abundant, convenient, and cheap. Children particularly favor refined over whole grains, and the presence of children in the home reduces adults' whole-grain consumption.¹⁶ Whole-grain intake has increased in recent years, but whole grains are still less popular than refined grains: average intake of whole grains rose 20% in 2005–2008, with the biggest change found among adults aged 18–34 years (38%).¹⁷

To reduce the gap between dietary recommendations and inadequate whole-grain intake levels, the WIC revisions included whole-wheat bread or allowable substitutions, requiring that at least 50% of WIC-approved cereals be whole grain and that WIC-authorized stores stock whole-wheat bread and whole-grain cereal at all times. Acceptable substitutions for whole-wheat bread, on an equal-weight basis, are whole-grain bread, brown rice, bulgur, oatmeal, whole-grain barley, and soft corn or whole-wheat tortillas. States selected the acceptable bread substitutions. The only source of WIC-provided grains prior to the revisions was breakfast cereals. After the revisions, children received 32 ounces of whole-wheat bread (or substitutions) monthly; pregnant and breastfeeding women received 16 ounces.¹⁸ These amounts translate into approximately 18 monthly servings of whole grains for children and nine for women (16 g of whole grains is one serving).

It is currently unknown how the provision of new whole-grain products in the revised WIC packages affected purchases and consumption of whole grains, as well as substitution with refined grains among WIC participants. One possible result is that WIC participants did not offset refined grains with increased purchases of WIC-provided whole grains but rather added to the total grain intake. Another possibility is that WIC participants used WIC-provided whole grains to substitute for whole grains previously purchased using non-WIC funds such as cash, credit cards, or other sources, so that only the

method of payment would change. It is also plausible that WIC participants learned to like the taste of whole grains and increased whole-grain purchases using non-WIC funds. The current study describes the effect of the WIC food package revisions on supermarket purchases of bread and rice among WIC-participating families in two New England states.

Methods

Scanner Data

The data were obtained from a supermarket chain with more than 60 stores in two New England states. The store has a loyalty card system that provides promotions and discounts to customers who use them. At least 90%–95% of all purchases at the grocery chain include the use of a loyalty card. Purchases made without a loyalty card are not part of this analysis. Each loyalty card is assumed to represent one household, although in practice some families might have multiple cards. The store provided de-identified data, so that household sociodemographic characteristics, size, and multiple card information were not available.

The current data have complete information about all purchases made by households using loyalty cards, including products and amounts purchased and prices paid. Every purchase is also linked to a payment method, which can include (1) benefits of the Supplemental Nutrition Assistance Program (SNAP) via electronic benefit transfer (EBT); (2) WIC benefits via paper-based vouchers; (3) EBT cash assistance (welfare type of payments); and (4) personal funds (cash, credit cards). The use of SNAP, WIC, and/or cash assistance benefits indicates household participation in the respective program at the time of the purchase. Program participation of each household is assessed based on multiple purchases during each month of the analysis. WIC participants virtually always use personal funds for at least some of their grocery purchasing throughout the month, with additional purchases using SNAP benefits or EBT cash assistance among households also participating in these programs. All of the federal programs increase household funds available for grocery shopping; however, WIC does so by allowing only certain healthy foods for purchase.

Participants

The sample is a policy-relevant subset of low-income WIC-participating families who reside in Connecticut or Massachusetts. All households using WIC benefits at any store of the chain during January 2009–June 2011 were selected. Specifically, households with at least one WIC purchase in January 2009 were flagged as WIC and were included, even if they no longer used WIC benefits. The same approach identified new WIC households in the following months; these households were carried forward, but their purchases prior to joining the sample were not available. About half of WIC households were also SNAP participants. No data were provided by the grocery chain for households that never participated in WIC.

The current study used data for households that participated in WIC both before and after implementation of the WIC revisions in October 2009. Households were selected if they used WIC benefits

each quarter during January–September 2009 (pre-revision) and each quarter in January–September 2010 (post-revision). A 3-month transition period after October 2009 was excluded to avoid data noise, as the pre-revision WIC checks were accepted for redemption for up to 3 months after the implementation date. The final sample included 2137 WIC households providing 36,051 observation months. The study was exempt from IRB review because of the de-identified nature of the data.

Product Identification and Categorization

The grocer provided a description of all products sold at the chain, using almost 400,000 Universal Product Codes (UPCs) and Price-Look Ups (PLUs). Included in the study were 1130 bread UPCs and two allowable bread substitutions in the study states: rice (194 UPCs) and tortillas (58 UPCs). Using data from the product description, ingredient lists in the Gladson Nutrition Database,¹⁹ Internet searches, and the My Pyramid Equivalents Database (MPED),²⁰ grain products were coded for container size and whole-grain content. Bread was categorized as “100% whole grain,” “between 51% and 99% whole grain,” “between 1% and 50% whole grain,” and “not whole grain” (i.e., white bread). Rice was classified as brown or white. Whole-grain tortillas included whole-wheat and soft corn tortillas. Bread products and rice mixes that contained additional ingredients (e.g., beans and rice); couscous; quinoa; and Spanish rice were excluded.

Outcome Variables

The main outcome was total weight of bread, rice, and tortillas (in ounces) purchased by a household in a given month. Grain purchases were distinguished by payment type, including purchases made with WIC benefits and non-WIC funds. Each household's purchases were aggregated at the monthly level.

Independent Variables

The main predictor was a binary variable indicating pre- and post-implementation periods of the WIC revisions. Household-level controls included indicators for monthly household SNAP participation and receipt of cash assistance, a continuous variable of household total monthly expenditure on groceries purchased at the chain, and number of transactions per month. A set of store-level variables (Table 1) was included to capture differences in the socioeconomic composition of the store areas, which may reflect neighborhood differences in prices, product selection, and marketing; they also serve as proxies for unobserved household socio-demographics. Each store location was linked to a census tract with data from the 2006–2010 American Community Survey.²¹ For households shopping in multiple stores, the average of census-tract measures was calculated.

Model

Because of the non-negative and positively skewed outcomes, regression modeling was based on generalized linear models from the Poisson family with a logarithmic link function.²² To account for repeated observations within households, generalized estimating equations (GEEs) were used with exchangeable working correlation and robust SEs.²³ The model estimated the adjusted

mean difference between the two periods, controlling for covariates:

$$E[Y_{it}|X_i, X_{it}] = \exp(\beta_0 + \beta_1 * \text{PERIOD}_{it} + \beta_2 * \text{SNAP}_{it} + \beta_3 * \text{EBT}_{it} + \beta_4 * \text{TOTEXP}_{it} + \beta_5 * \text{NTRANS}_{it} + \beta_6 * T_{it} + \beta_7 * S_{it}), \quad (1)$$

where PERIOD_{it} is an implementation indicator (0 for pre- and 1 for post-implementation); SNAP_{it} indicates a household i that used SNAP benefits at time t ; EBT_{it} is receipt of cash assistance by household i at time t ; TOTEXP_{it} is total grocery expenditure at the chain for household i at time t ; and NTRANS_{it} is the number of transactions at time t . T_{it} denotes a set of eight binary variables indicating the month of purchase, and S_{it} is a vector of store-area sociodemographic covariates.

Results

Prior to the WIC revisions implementation, WIC households purchased on average 75 oz of bread per month (Table 1). Most of this bread (78%) was white, with 100% whole-grain bread accounting for only 8%, and other breads for 14%, of the purchased bread volume. Rice purchases were on average 5 oz per month, and almost all were for white rice (94%). Very few households purchased tortillas, so their average monthly purchase was about 1 oz, including 0.2 oz of whole-grain tortillas. All purchases were paid with cash, SNAP benefits, or other funds, as WIC did not provide any of these grains prior to the revisions.

After implementation of the new packages, bread purchases showed a notable shift away from refined toward whole grains. Although it is still the most popular, white bread in average monthly household purchases was reduced from 58 to 50 oz (Table 1). At the same time, purchases of 100% whole-grain bread tripled from 6 to 18 oz, and the rest of the breads remained unchanged. Purchases made using WIC benefits explained all of the growth in 100% whole-grain bread purchases. It does not appear that the WIC revisions prompted a spillover into buying healthier bread using private funds, at least in the short term. Purchases of whole-grain bread using non-WIC funds declined slightly, and the same was observed for purchases of white bread.

Purchases of brown rice made with WIC funds led to an increase in brown rice purchases from almost zero (0.3 oz) to 2.4 oz after the revisions (30% of all rice purchased). In contrast to lower purchases of white bread, purchases of white rice (all paid with non-WIC funds) increased slightly, so that there was no offset of white rice purchases with WIC-provided brown rice. Similarly, purchases of white-flour tortillas did not change, but whole-wheat tortilla purchases doubled from 0.2 to 0.4 oz. Given the very low levels of tortilla purchases, only bread and rice purchases are examined in regression analyses.

Table 1. Descriptive statistics: purchasing of whole-grain products in 2009 and 2010

	Pre-implementation period January–September 2009		Post-implementation period January–September 2010	
	M (SD)	Min, Max	M (SD)	Min, Max
PURCHASED AMOUNTS OF BREAD, OUNCES PER HOUSEHOLD PER MONTH				
Total bread				
Paid by WIC benefits	N/A		15.0 (19.8)	0, 192
All payment types	74.8 (90.6)	0, 1036	77.2 (82.8)	0, 1000
100% whole-grain bread				
Paid by WIC benefits	N/A		14.1 (19.4)	0, 192
All payment types	6.0 (21.8)	0, 624	18.5 (26.6)	0, 568
Bread with 51%–99% whole grains				
Paid by WIC benefits	N/A		0.5 (3.5)	0, 96
All payment types	2.1 (10.9)	0, 276	2.0 (9.0)	0, 160
Bread with 1%–50% whole grains				
Paid by WIC benefits	N/A		0.5 (3.4)	0, 64
All payment types	8.6 (22.0)	0, 480	7.1 (19.5)	0, 442
White bread				
Paid by WIC benefits	N/A		N/A	
All payment types	58.1 (78.7)	0, 1012	49.7 (68.2)	0, 787
PURCHASED AMOUNTS OF RICE, OUNCES PER HOUSEHOLD PER MONTH				
Total rice				
Paid by WIC benefits	N/A		2.1 (7.5)	0, 112
All payment types	5.4 (43.1)	0, 2880	7.7 (52.5)	0, 3536
Brown rice				
Paid by WIC benefits	N/A		2.1 (7.5)	0, 112
All payment types	0.3 (3.5)	0, 192	2.4 (8.1)	0, 112
White rice				
Paid by WIC benefits	N/A		N/A	
All payment types	5.1 (42.8)	0, 2880	5.3 (51.8)	0, 3520
PURCHASED AMOUNTS OF TORTILLA, OUNCES PER HOUSEHOLD PER MONTH				
Total tortilla				
Paid by WIC benefits	N/A		0.3 (2.5)	0, 112
All payment types	0.9 (5.3)	0, 256	1.1 (5.4)	0, 128
Whole-wheat tortilla				
Paid by WIC benefits	N/A		0.3 (2.5)	0, 112
All payment types	0.2 (2.4)	0, 96	0.4 (3.3)	0, 112
White-flour tortilla				
Paid by WIC benefits	N/A		N/A	
All payment types	0.7 (4.3)	0, 160	0.7 (4.2)	0, 80

(continued on next page)

Table 1. Descriptive statistics: purchasing of whole-grain products in 2009 and 2010 (continued)

	Pre-implementation period January–September 2009		Post-implementation period January–September 2010	
	M (SD)	Min, Max	M (SD)	Min, Max
HOUSEHOLD-LEVEL COVARIATES				
SNAP participation, %	45		52	
Receipt of cash assistance, %	5		5	
State (Connecticut), %	23		24	
Total monthly grocery expenditure (\$)	235 (190)	0, 1821	219 (183)	0, 1620
Total number of transactions per household	105 (60)	12, 566	107 (63)	11, 500
STORE AREA-LEVEL SOCIODEMOGRAPHIC COVARIATES				
Household income (in 10K \$)	5.6 (1.6)	2.0, 12.2	5.6 (1.6)	2.0, 12.2
High-school graduates, %	33.6 (7.1)	10.2, 46.0	33.6 (7.1)	10.2, 46.0
College graduates, %	15.9 (5.8)	4.9, 32.7	15.9 (5.8)	4.9, 32.7
Non-English use at home, %	15.9 (12.0)	4.0, 50.5	16.0 (12.0)	4.0, 50.5
Unemployed, %	8.1 (2.8)	1.5, 16.5	8.1 (2.8)	1.5, 16.5
SNAP participants, %	11.1 (8.4)	0.4, 33.3	11.2 (8.4)	0.4, 33.3
Households in poverty, %	8.5 (6.4)	0.0, 26.5	8.6 (6.4)	0.0, 26.5
Non-Hispanic white, %	83.5 (13.3)	20.6, 97.7	83.5 (13.2)	20.6, 97.7
Non-Hispanic Black, %	3.8 (5.3)	0.0, 36.0	3.7 (5.1)	0.0, 36.0
<i>n</i> (observations)	17,740		18,311	
<i>n</i> (households)	2,137		2,137	

N/A, not applicable; SNAP, Supplemental Nutrition Assistance Program; WIC, U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children

Table 2 presents estimation results of the pre–post implementation differences in bread and rice purchases. The regression coefficients are exponentiated coefficients from the Poisson models, which give a percentage change in the outcome between the two periods after adjusting for household- and store-level covariates. Following the revisions, WIC participants reduced purchases of white bread by 11.5%, from an adjusted monthly 60 to 53 oz. Purchases of bread with 1%–50% whole grains went down by 12.1%; there was no change for bread with 51%–99% whole grains. The biggest change occurred for 100% whole-grain bread that more than tripled in purchases from adjusted monthly 6 oz to almost 20 oz. All of the growth in whole-grain bread purchases was driven by WIC-funded purchases. In fact, there was a significant reduction in purchases made with non-WIC funds for all bread varieties, including whole-grain bread (about 21%–26%) and white bread (11.5%). Appendix A (available online at www.ajpmonline.org) provides additional estimation results.

Discussion

This study suggests that WIC-participating households in New England purchased significantly more 100% whole-grain bread and brown rice after implementation of the WIC revisions, which likely improved their whole-grain intake. There was also an offset of refined grains with whole grains, so that purchases (and presumably consumption) of refined grains declined soon after the WIC revisions. The increase in whole-grain purchases was driven completely by the WIC policy to provide more whole grains.

Another important finding was that WIC households used WIC benefits to change some of their bread purchases rather than to buy more bread overall. Participants appeared to accept WIC-provided whole-wheat bread as a substitute for white bread and saved some of their disposable income by lowering non-WIC purchases of both white and whole-wheat bread. This substitution in the method of payment did not happen

Table 2. Bread and rice purchases before and after implementation of the WIC revisions

	Pre-post differences in purchased volume		Marginal M (oz)	
	Exp(B) (95% CI)		2009	2010
ANY PAYMENT TYPE				
Bread				
White bread	0.885*** (0.863, 0.908)		59.5	52.7
Bread with 1%–50% whole grains	0.879*** (0.830, 0.931)		8.6	7.5
Bread with 50%–99% whole grains	0.978 (0.864, 1.108)		2.1	2.0
100% whole-grain bread	3.119*** (2.850, 3.413)		6.3	19.6
Rice				
White rice	1.034 (0.872, 1.226)		5.5	5.7
Brown rice	8.376*** (6.621, 10.596)		0.3	2.4
NON-WIC PAYMENT				
Bread				
White bread	0.885*** (0.863, 0.908)		59.5	52.7
Bread with 1%–50% whole grains	0.823*** (0.776, 0.873)		8.6	7.1
Bread with 50%–99% whole grains	0.735*** (0.647, 0.836)		2.1	1.5
100% whole-grain bread	0.786*** (0.725, 0.852)		6.2	4.9
Rice				
White rice	1.034 (0.872, 1.226)		5.5	5.7
Brown rice	0.997 (0.772, 1.288)		0.3	0.3
<i>n</i> (observations)	36,051			
<i>n</i> (households)	2,137			

Note: Full model results are available from the authors on request. Presented are exponentiated coefficients (Exp(B)) and 95% CIs for the binary variable indicating the time periods before (January–September 2009) and after (January–September 2010) the WIC food package revisions from separate GEE regression models for longitudinal data with a logarithmic link function (Poisson family); all models included control variables as shown in Equation 1.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

GEE, generalized estimating equations; WIC, U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children

for rice, possibly because rice purchases make up a considerably smaller proportion than bread purchases in the total grocery budget of WIC participants.

This study focused only on several grain products, so it was not possible to determine where the “saved” bread funds were redirected and how that affected overall grocery purchases and the diet of WIC households. One possibility is that spending less of non-WIC funds on bread led to reduced expenditure on groceries overall. Alternatively, households could be buying more non-WIC foods such as desserts or, by contrast, produce. The public health implications of these two choices would be very different. Future research on changes in all groceries purchased is necessary to rule out the possibility that the WIC revisions had unintended negative consequences for the composition of food purchases and the diet quality of WIC participants.

If the observed improvements in whole-grain purchases reflect changes in whole-grain consumption among WIC participants nationwide, the effects on public health could be substantial. The increase in whole-grain intake is associated with a range of improvements in health outcomes, including cardiovascular disease and type 2 diabetes.^{24,25} Similar results on the effectiveness of food policy changes are available for other products and policies. A study of juice purchases after the WIC revisions showed that WIC participants purchased about one quarter less of 100% juice, and there was little compensation from non-WIC funds.²⁶ In 2004, New York City public schools removed whole milk and switched from low-fat to fat-free chocolate milk that led to serving 5960 fewer calories and 619 fewer grams of dairy fat to students drinking milk in 2009.²⁷ There is

also substantial evidence documenting the positive effect of the WIC revisions on the availability of healthy foods in low-income communities.^{28–30}

Strengths and Limitations

There are a number of strengths in this study, including the use of scanner data on grocery purchases in the pre–post implementation period for more than 2000 WIC-participating families. Data on the method of payment allowed assessment of the use of WIC benefits, personal funds, and other funds to pay for groceries. The study also had limitations. Data were from two New England states that may differ from other states. Another limitation was lack of household-level characteristics, yet all households were WIC participants and therefore low-income. It is also unknown how purchases made without loyalty cards differed from those made with the cards. Data on nonloyalty card receipts were not provided by the grocery chain. Finally, the study assessed purchase behaviors at a single grocery chain, which might not represent all household grain purchases or overall dietary intake of WIC participants.

Conclusion

The revised WIC food packages had a positive impact on purchases of whole-grain bread and rice by WIC-participating households. Increased purchases of whole-grain bread provided by WIC have led to an offset of refined grains with whole grains. On a population level, such a shift in grain purchase patterns could substantially affect health outcomes due to inadequate whole-grain consumption and overconsumption of refined grains.

The study was funded by a grant from the Economic Research Service (ERS) at the U.S. Department of Agriculture. The views expressed in this article are those of the authors and do not necessarily represent the official views of ERS or the U.S. Department of Agriculture.

The authors thank Amanda Tripp, Khadija Turay, Victoria Lemmon, and Victoria Zigmont for excellent research assistance. Special thanks go to the confidential grocery store chain for sharing their data.

No financial disclosures were reported by the authors of this paper.

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Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.amepre.2013.05.009>.

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