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Effect of WIC Food Package Changes on Dietary Intake of Preschool Children in New Mexico

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Abstract

Objectives—This study examined WIC policy change effects on dietary intake of preschool children from WIC-participating households in rural New Mexico communities.

Methods—Dietary intake of children enrolled in Head Start in 8 communities was compared before and after 2009 WIC food package changes.

Results—Following the policy change, participants reported significantly increased consumption of lower-fat milk, reduced consumption of saturated fat (grams), and decreased consumption of vegetables without potatoes. No significant differences in fruit, fruit juice, vegetables including potatoes, whole-grains and saturated fat (percent-energy) consumption were observed.

Conclusions—WIC policy changes have the potential to improve children's saturated fat intake. More research with robust designs is necessary to examine long-term effects of WIC policy changes.

Keywords

policy; child; preschool; dietary intake; American Indians; Hispanic Americans

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), administered by the US Department of Agriculture (USDA), is one of the largest food

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Human Subjects Approval Statement

This study, including all data collection tools and consent forms, was approved by the University of New Mexico Health Sciences Center Human Research Review Committee (document number 06-040).

Conflict of Interest Declaration

The authors of this paper report no conflicts of interest.

assistance programs in the US and serves as a key entry point to the public health system for low-income families.¹ Since 1974, WIC has been serving low-income pregnant and postpartum women, infants, and children younger than 5 years by providing supplemental foods, nutrition education, breastfeeding support, and referrals to health and social services.¹ Supplemental foods offered through WIC were originally selected based on a concern over malnutrition among low-income mothers and children, and were meant to provide the nutrients most limited in their diets at the time: protein, iron, calcium, vitamin A and vitamin C.¹ Authorized WIC foods originally included milk, cheese, eggs, juice, cereals and infant formula. Beans, peas, peanut butter, carrots, tuna, and limits on sugar in adult cereal were added later. Participants were able to redeem their WIC benefits for an allowed quantity of authorized foods based on their eligibility. WIC foods were provided in the form of supplemental food packages, which are combinations of foods based on the category of participant and determined by nutritional need.

In 2007, USDA published the first major update to the WIC food packages since the program's inception. The updates served to align the food packages with the 2005 Dietary Guidelines for Americans and with infant feeding guidelines by the American Academy of Pediatrics, as well as to be more responsive to changing nutritional risks in WIC target populations.^{1,2} The update reflected recommendations by the Institute of Medicine (IOM) in its report *WIC Food Packages: Time for a Change*, with some modifications to ensure cost neutrality.³⁻⁵ Three new categories were included in the food packages: (1) fruits and vegetables; (2) whole-grain cereals and bread; and (3) infant foods. In addition, maximum purchase quantities of milk, cheese, eggs and 100% juice were decreased for women and children; milk fat content was limited to 2% or less for women and children at least 2 years old; juice was eliminated from infant food packages; and the quantity of infant formula was reduced for breastfed and older infants. The WIC benefit redemption model was altered through the introduction of cash-value vouchers for fruits and vegetables worth \$6 to \$10 per month, redeemable for a dollar amount of these foods, whereas other foods were to be redeemed based on an allowed quantity as before.

These new policy changes were implemented in New Mexico on October 1, 2009. Approximately 6 months prior to the implementation date, New Mexico WIC also implemented changes in WIC nutrition education to introduce participants to the new foods included in the food packages, and to provide training in shopping for allowable foods.

The 2009 WIC food package update presented a welcome policy change with potential to have a positive impact on the diets and health of preschool-age children. Most children in the US do not meet the recommended number of servings of fruits and vegetables, and preschool children in particular do not consume enough fiber or a sufficient variety of vegetables, and consume too much saturated fat and sodium.⁶⁻⁸ Because early childhood is a crucial period for development of children's food preferences and eating habits, as well as a window of opportunity for prevention of obesity, interventions with this age group have a considerable potential for impact.^{9,10}

This study explores whether policy changes in the WIC food package resulted in changes in fruit, vegetable, whole grain, fruit juice, type of milk, and saturated fat intake among preschool children from WIC-participating households in rural New Mexico communities.

METHODS

Study Design

Dietary intake of preschool children who were enrolled in Head Start centers in rural communities in New Mexico, and who lived in WIC-participating households, was compared before and after the 2009 policy change in the WIC food package.

This study is an ancillary study to, and uses a sub-sample of data from, the Child Health Initiative for Lifelong Eating and Exercise (CHILE).¹¹ CHILE was a 5-year study aimed at developing and evaluating a multi-level obesity prevention intervention among preschool children enrolled in rural New Mexico Head Start centers. CHILE utilized a group-randomized trial design, where 16 Head Start centers were randomized to intervention and comparison groups after being stratified by ethnicity (Hispanic or American Indian) and median Head Start pre-intervention body mass index (BMI) (lower-BMI ≤ 16.4 or higher-BMI > 16.4). The engagement, recruitment and retention of participants in the CHILE study are described in detail elsewhere.¹²

CHILE's 2-year dietary intake data collection period (fall 2008 to spring 2010) coincided with the 2009 policy change in the WIC food package and offered a unique opportunity to evaluate the effect of the policy change on the dietary intake of low-income preschool children in rural New Mexico. Fall 2008 data collected prior to WIC nutrition education modifications (spring 2009) or food package implementation (fall 2009) were used as a baseline measurement. Spring 2010 data, collected approximately 6 months after the implementation of the new food package in New Mexico, were used for follow-up.

The present study examines data from the 8 comparison sites of the CHILE study. Three Head Start centers were located in American Indian Pueblo communities and 5 were located in predominantly Hispanic communities.

Participants

Parents or other caregivers from participating Head Start centers were recruited to provide study data on behalf of their preschool children. A local representative of the CHILE study, who was also a member of the community, used a list of primary caregivers of Head Start preschool children to recruit responders using convenience sampling. A standardized recruitment script and manual of procedures were used for recruitment and scheduling of interviews with the caregivers who "spent the most time with each child," with a goal of 20 responders per site. For follow-up data collection, respondents who had previously been interviewed were prioritized for recruitment. Data collection occurred following informed consent. Participants received an incentive of \$20 after each interview.

For the present study, participants were included if they, or someone in their household, received WIC benefits. For data collected before the implementation of WIC food package

changes, before October 1, 2009, participants were asked if they or someone in their household received WIC benefits anytime during the past 3 years, and they were included if they answered “yes.” For data collected after the WIC food package changes, in spring 2010, participants were asked if they or someone in their household received WIC benefits in the last 6 months, that is since October 2009, and they were included if they answered “yes.” These questions aimed to identify WIC-eligible families before and after the policy change, regardless of duration on WIC.

Of the 260 caregiver interviews reporting on 237 children conducted in fall 2008 or spring 2010, 162 interviews, 74 in fall 2008 and 88 in spring 2010, were with members of households that participated in WIC. The interviews reported on 149 children, of which 9% had repeat interviews at both time points. These were used for analysis in the present study.

Dietary Measures

Proxy interviews about children’s home environment, dietary intake and behavior, physical activity, and family demographic characteristics were collected from caregivers due to the age of the children. Interviews lasted 1 to 2 hours and were conducted in English or Spanish by trained data collection personnel.

A modified version of the Block Kids 2004 Hispanic Food Frequency Questionnaire (FFQ) was used to assess the usual intake of children over the previous week.¹³ The Hispanic version of the Block FFQ was used because no validated FFQ for American Indian children or for preschool-age children was available at the time, and foods consumed by Hispanic and American Indian populations in New Mexico are similar. The Block Kids 2004 Hispanic FFQ was modified as part of formative assessment using a multiple-pass 24-hour dietary recall. The 24-hour recall was used to identify foods or food categories typically consumed by the study population and these were added to the Block FFQ, as necessary. Examples of culture-specific changes included addition of sour cream as many foods in the southwest are accompanied by sour cream, sopapillas or fried dough popular in New Mexican cuisine, and breakfast burritos that were added to a question regarding egg sandwiches. Smaller portion size options were also included to better reflect portions consumed by preschool-age children, as the Block Kids 2004 FFQ was designed for school-age children.

Caregivers were asked about the amount of food the child consumed each day and on how many days in the previous week the food was consumed. Food categories included fruits, vegetables, dairy, grains, sugar-sweetened beverages, juice, mixed dishes and other foods. Caregivers were instructed to recall the foods eaten by the child when away from Head Start. The collected dietary intake data were analyzed using NutritionQuest, and were expressed as daily intake of foods, food groups, and nutrients. Outcome variables were directly related to the 2009 changes to the WIC food packages and included fruit in cups per day (excluding fruit juice), vegetables in cups per day, vegetables excluding potatoes in cups per day, fruit juice in cups per day, whole grains in ounce-equivalents, whole grains as a proportion of all grains, and consumption of lower fat milk (0 = whole; 1 = 2%, 1% , or skim). In addition, saturated fat in grams and saturated fat as a proportion of energy were included as outcome variables to measure the change in the type of milk allowable through WIC, and because

decreases in saturated fat were part of the rationale behind reduction in quantities of milk and cheese available through WIC.⁴

Because caregivers were asked to recall food consumption on partial days (ie, outside of Head Start), and the FFQ method often results in a high amount of misreporting,^{14,15} both of which may introduce variation and error in the total amount of food that was reported, 2 methods were identified to account for possible differences in reporting. First, a variable describing the daily length of time the child was in Head Start (full-day or part day) was created and used to adjust the analysis models. Second, a misreporting measure was calculated using the total energy reported on the FFQ (rTE) and predicted child basal metabolic rate (BMR). Predicted child BMR was calculated using the equations developed by IOM for normal-weight and overweight or obese boys and girls.¹⁶ A rTE:BMR ratio was calculated as an approximate measure of systematic over- and underreporting. The present study did not use the conventional Goldberg cut-off method to identify and exclude implausible reporters from the analysis,¹⁷ because a measure of energy expenditure through physical activity of the children was not available, and because respondents were reporting on incomplete days. Rather, the rTE:BMR measure was included in the analysis models for continuous outcome variables to crudely adjust for within-person systematic misreporting.

Demographic Measures

The following child demographic measures were included in the study: age at interview in months, sex, ethnicity (Hispanic, Non-Hispanic), and race (White, American Indian, Asian, Other). Preferred language of the interview was defined as a dichotomous variable (English, Spanish). All American Indian respondents were fluent in English. Mother's education was defined as the highest level of education attained by the child's mother, which was either reported by the mother herself if she was interviewed or another caregiver if the mother was not interviewed. Respondents were asked what their relationship to the child was and responses were expressed as a categorical variable. Child BMI status at baseline was based on child height and weight measures, which were collected by trained research staff at Head Start centers using a standardized protocol, converted to BMI percentiles using the Centers for Disease Control and Prevention (CDC) program based on 2000 CDC growth charts, and categorized into underweight, normal weight, overweight, and obese according to CDC definitions for children.¹⁸

Data Analysis

Differences in sample characteristics at baseline versus follow-up were examined using the Mann-Whitney test for child age, and the chi-square test for categorical variables.

Continuous outcome measures were log-transformed to improve the normality and homoscedasticity of residuals. Multilevel, mixed-model analysis of variance was used to compare changes in continuous variables over time. The analysis models included adjustment for repeated measures among participants within sites, as a random variable, as well as the effect of Head Start site, length of day the child spent at Head Start, and rTE:BMR as fixed variables. Child age, sex, race, ethnicity, and BMI category, and mother's education were included in the model all as fixed effects based on improvement of the

statistical models as measured by the log-likelihood statistic. Adjusted geometric means and means ratios, due to the log-transformed analysis, were calculated to compare change over time with baseline as the reference period. A sensitivity analysis was conducted to examine seasonal variation in fruit and vegetable intake in this study. Fruit and vegetable consumption measures in fall and spring were compared using the corresponding time points preceding the implementation of the WIC policy change: fall 2008 and spring 2009.

The generalized estimating equation method was used to compare changes in the type of milk consumed by the child, a dichotomous variable, over time. The model was adjusted for repeated measures among participants, a random variable, and the effect of Head Start center, a fixed variable. None of the other aforementioned covariates improved the model, and thus, they were omitted from the final analysis. Prevalence of intake of lower-fat milk (ie, 2%, 1%, or skim) and odds ratio over time, with baseline data as the reference, were calculated to compare changes over time. All analyses were conducted using the Statistical Analysis Systems (SAS) statistical software package version 9.3 (SAS Institute, Cary, NC, USA).

RESULTS

Descriptive Characteristics

Table 1 displays the descriptive characteristics of the children participating in the study. The sex, race and ethnicity distributions of participating children were similar at baseline and follow-up. Approximately half were female, and the majority was Hispanic. One-third of participating children were American Indian at baseline, increasing to two-fifths at follow-up. Head Start centers enroll children from 3 to 5 years of age. Children included at baseline were younger than children at follow-up because baseline data were collected at the beginning of the school year and follow-up was conducted at the end of the school year. A higher proportion of children were classified as overweight or obese at follow-up than at baseline.

The majority of the interviews were conducted with the mother of the child and in English. The majority of mothers achieved a high school diploma or equivalent.

Effect of WIC Policy Change on Dietary Intake

Table 2 shows the differences over time in dietary intake of preschool-age children from WIC-participating households. A significantly higher proportion of children consumed lower fat milk after the WIC policy change compared to before. Additionally, consumption of saturated fat as measured in grams was significantly lower after the WIC policy change compared to before. The consumption of saturated fat measured as a proportion of total energy also decreased over time, but not significantly.

Consumption of vegetables excluding potatoes decreased significantly over time, contrary to what the WIC policy change aimed to effect. When potatoes were included in the vegetable measurement, the decrease was not significant. To examine the possibility that the difference was due to a seasonal effect, fall 2008 vegetable consumption measures were compared to

spring 2009 measures in a sensitivity analysis. They were not found to be significantly different (data not shown).

Consumption of fruit remained the same over time. Consumption of fruit juice decreased over time, but the difference was not significant. Consumption of whole grains remained the same over time when measured in ounce-equivalents, and increased slightly over time when measured as a proportion of all grains, though the increase was not significant.

DISCUSSION

The purpose of this study was to examine the intake of fruits, vegetables, whole-grains, saturated fat, and milk type among preschool-age children from WIC-participating households in rural New Mexico before and after the 2009 WIC policy change. Following the policy change, the proportion of children consuming lower-fat milk (2%, 1%, or skim) significantly increased, and participating children consumed significantly fewer grams of saturated fat. Contrary to expectations, children also consumed fewer cups of vegetables excluding potatoes following the WIC policy change. No significant differences were observed over time in consumption of fruit, fruit juice, vegetables including potatoes, whole grains, and saturated fat as a percentage of energy.

The significant changes in saturated fat and the proportion of participants consuming lower-fat milk suggest that the policy change in the WIC food package may have the potential to influence preschool-age children's intake of saturated fat from dairy. Preschool-age children currently exceed the recommended saturated fat limit of no more than 10% of total energy by an average of 2 to 4 grams per day, assuming an average intake of 1300 kcal per day.^{6,19,20} This means that the modest decrease of 2.32 grams per day observed in the present study has the potential to align participants' intake with recommended levels. No significant difference in saturated fat as a proportion of total energy was observed in this study, possibly because through adjustment for rTE:BMR the analysis models were already partially adjusted for energy.

Switching from whole milk to 2% milk equates to an approximate decrease in 2.25 grams per day for a child who consumes 1.5 cups of milk per day, which was the median milk intake of children in this study. This is consistent with the decrease in saturated fat intake found in the present study. Although the 2009 WIC food package allows 2% milk, the 2010 Dietary Guidelines for Americans recommends consumption of 1% or skim milk for people over the age of 2 years.^{5,19} As only approximately 12% of children in the present study consumed 1% or skim milk at follow-up (data not shown) better alignment of the WIC food package with the 2010 Dietary Guidelines for Americans would likely further decrease the consumption of saturated fat among preschool-age children.

The significant decrease over time in vegetable consumption observed in this study, though modest at 0.15 cups, is puzzling. The 2009 WIC food package changes aimed to increase vegetable intake through the provision of a monthly cash-value voucher for purchase of fruits and vegetables, and expansion of the allowable types. It is unlikely that the observed difference was due to fall-to-spring seasonal differences in consumption of vegetables,

because the sensitivity analysis comparing fruit and vegetable intake in fall 2008 and spring 2009, prior to the implementation of the new WIC policy, found no difference in intake of vegetables between seasons. One explanation for the results may be that the 2009 economic downturn during the study period affected the purchasing power of rural households in New Mexico and resulted in a decrease in consumption of vegetables in spring 2010. In a systematic review of research on the price elasticity of food demand, Andreyeva, Long, and Brownell²¹ found that food price elasticity for demand of fruit and vegetables is high to moderate at 0.70 (0.66, 0.78) and 0.58 (0.44, 0.71). During the study period, households may have relied more than usual on WIC benefits, meant to provide only supplemental income for food purchases. This may have affected both fruit and vegetable intake as purchasing of these items has been found to be sensitive to household income.²¹⁻²³ However, without additional data collection, it is difficult to explain the observed results with certainty.

The results for saturated fat, dairy and fruit juice intake observed in this study are consistent with other literature, though others have also observed significant changes in other reported eating and food purchasing behaviors. Whaley et al²⁴ surveyed a large sample of adult California WIC participants and found that after the WIC policy change, frequency of fruit consumption increased, frequency of vegetable consumption remained the same, and more participants consumed lower-fat milk. Odoms-Young et al²⁵ found modest increases in mothers' daily intake of fruit, mothers' and children's intake of low-fat dairy, and home availability of low-fat dairy and whole grains following the WIC policy change among participants of 12 WIC clinics in Chicago, though the effects vary by ethnic group. In a large study of WIC administrative data in the State of New York, Chiasson et al²⁶ found an increase in prevalence of children consuming at least some fruit, vegetables, and whole grains daily, and low-fat or non-fat milk after the WIC policy change. Tucker²⁷ found that consumption of fruit juice by children whose mothers participated in Atlanta WIC clinics did not change following the WIC policy change. A series of studies of 60 stores in Connecticut and Massachusetts found decreased purchasing when using WIC benefits of whole milk, cheese, and 100% fruit juice, and increased purchasing of 100% whole-wheat bread and brown rice among WIC-participating households following the WIC policy change.²⁸⁻³⁰

Although some of the results found in this study are encouraging and are in line with other research, this study found mixed results overall regarding the effect of the WIC policy changes on children's dietary intake. This study observed expected changes in consumption of lower-fat milk and saturated fat, but consumption of vegetables excluding potatoes decreased counter to the intention of the policy change, and no significant changes were observed in consumption of fruit, fruit juice, vegetables including potatoes and whole grains. These mixed findings must be clarified using robust study designs and different contexts before conclusions can be made regarding the effect of the WIC policy changes on altering dietary intake of participants.

We utilized existing data to explore the effect of the WIC policy changes in rural, low-income, predominantly Hispanic and American Indian communities, often underrepresented in public health nutrition research, and therefore, make a valuable contribution to literature. However, the use of data that were intended to answer the research questions for the CHILE

study rather than this one created several limitations in the present study; therefore, the results should be interpreted with caution. First, no sample size calculations specific to this study's analyses were made, which may have resulted in inadequate power to detect differences in outcome measures. Second, because the WIC policy change affected families statewide, no control group was available. The observed changes in this study may have resulted from other contextual factors unrelated to the WIC policy change. Third, the convenience sampling at the community level and cross-sectional nature of the data limit the generalizability of the results. Fourth, this study did not measure WIC package redemption rates or the duration of the respondents' participation in WIC, which would have indicated how much WIC nutrition education the respondent received, or how recently the respondents' households participated in WIC. Variation in these variables may have influenced the analysis.

Another limitation of this study is the time period used for comparing the outcome measures. Although the baseline data were collected well before any implementation of the WIC policy changes, including the changes in nutrition education, the follow-up measures were collected approximately 6 months after the implementation of the WIC food package changes. Participants may not have had sufficient time to learn how the new food package could be used. In addition, given that WIC is meant to provide only supplemental income for purchasing of food, changes in the food package may take a longer time to influence overall household shopping and eating behaviors. A 6-month period may not have been long enough to detect impact at the household level.

Finally, use of the modified Block FFQ is a limitation, as it was not validated for this study population that included preschool-age and American Indian children, but rather, adapted based on 24-hour recall data as described above. Further, the use of an FFQ to measure dietary intake and use of proxy reporting due to the age of the children may have introduced measurement error. Although the rTE:BMR variable was added to the model to adjust for systematic within-person over-reporting, selective misreporting such as over-reporting of healthy foods or underreporting of unhealthy foods could have been present and affected the results.

Implications for Health Behavior or Policy

National WIC policy changes have the potential to change dietary intake in participating households, including those in rural, under-resourced American Indian and predominantly Hispanic communities. The increased consumption of lower-fat milk and corresponding reduction in intake of saturated fat has the potential to bring young children into alignment with the 2010 Dietary Guidelines for Americans.¹⁸ While this study capitalized on an opportunity to use existing data to examine the effects of changes in WIC policy, further research with more robust designs is needed to clarify the mixed findings from this study, account for spurious effects that may have contributed to the results, and determine the long-term impact on family shopping and eating behaviors, especially those involving fruits, vegetables, and whole grains.

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Table 1

Characteristics of Preschool Children from WIC-Participating Households in the Comparison Arm of the Child Health Initiative for Lifelong Eating and Exercise (CHILE) Study

Characteristic	Fall 2008 ^a N = 74	Spring 2010 ^a N = 88
Female, %	48.7	50.0
Age, Mean ± SD, Months	43.4 ± 4.67	53.9 ± 6.92 ***
Ethnicity		
Hispanic	56.8	53.4
Non-Hispanic	43.2	46.6
Race		
White	59.5	48.9
American Indian	32.4	44.3
Asian	2.7	0.0
Mixed Race	5.4	6.8
Language of Interview		
English	90.5	93.2
Spanish	9.5	6.8
BMI		*
BMI < 5th percentile	12.2	3.0
5th Percentile BMI < 85th Percentile	66.2	58.0
85th Percentile BMI < 95th Percentile	5.4	16.0
BMI 95th Percentile	16.2	11.0
Relationship of Respondent to Child		
Mother	78.4	71.6
Step-mother	1.4	1.1
Father	4.1	14.8
Grandmother	10.8	6.8
Grandfather	0.0	1.1
Aunt	2.7	1.1
Uncle	0.0	1.1
Cousin	0.0	1.1
Foster-mother	1.4	0.0
Other	1.4	1.1
Mother's Education^b		
8th grade or less	4.2	4.0
Some high school	9.9	17.0
High school graduate or GED	63.4	38.0
Some college	14.1	18.0
Associate's degree	7.0	7.0
Bachelor's degree or higher	1.4	2.0

* p < .05,

**
p < .01,

p < .001

Note.

BMI refers to body mass index. SD refers to standard deviation.

^aFall 2008 refers to measurements done before the WIC policy change effective in New Mexico on October 1, 2009 and before any WIC nutrition education changes were initiated (spring 2009). Spring 2010 refers to the measurements done approximately 6 months after the WIC policy change.

^bThe variable mother's education has 7 missing values.

Table 2

Effect of the WIC Policy Change on the Intake of Fruits, Vegetables, Whole Grains, Saturated Fat and Lower Fat Milk (ie, 2%, 1%, or skim) among Preschool Children from WIC-Participating Households in the Comparison Arm of the Child Health Initiative for Lifelong Eating and Exercise (CHILE) Study^a

Outcome	Fall 2008	Spring 2010		Spring 2010 vs Fall 2008				
	Adjusted Mean Estimate ^b	SE	Adjusted Mean Estimate ^b	SE	Means ratio ^c	(95% CI)	Percent difference	
Fruit (cups)	1.79	0.07	1.79	0.07	1.00	0.89	1.13	0.2
Fruit juice (cups)	0.75	0.07	0.61	0.06	0.92	0.82	1.03	−8.2
Vegetables (cups)	0.95	0.05	0.81	0.05	0.93	0.86	1.01	−7.2
Vegetables, without potatoes (cups)	0.80	0.05	0.66	0.05	0.92	0.85	1.00	−8.0 [*]
Whole grains (ounce equivalent)	0.45	0.05	0.45	0.05	1.00	0.92	1.10	0.3
Whole grains (proportion of all grains)	0.10	0.02	0.12	0.02	1.01	0.98	1.04	1.1
Saturated fat (grams)	22.31	0.05	19.99	0.05	0.90	0.84	0.97	−10.0 ^{**}
Saturated fat (percent energy)	0.12	0.00	0.11	0.00	1.00	0.99	1.00	−0.4
	Proportion	SE	Proportion	SE	Odds ratio ^d	(95% CI)		
Milk type (0=whole; 1=2%, 1%, skim)	0.60	0.05	0.81	0.05	2.94	1.37	6.25	^{**}

* p < .05,

** p < .01,

*** p < .001

Note.

SE refers to standard error of the estimate. CI refers to confidence interval.

The analysis models for continuous variables are multi-level, mixed-methods analyses of variance and consist of the time variable (pre/post), site as a fixed variable, child ID as a random variable within site; models are further adjusted for misreporting (rTE:BMR), length of day at Head Start, child age, child sex, child BMI category, child race, child ethnicity and mother's education level. The analysis model for milk type (dichotomous variable) is a generalized estimating equation model and consists of child ID as a random variable and site as a fixed variable, with whole milk as the reference.

^aThe sample size for the analyses of continuous variables is N = 155. The sample size for the analysis of milk type consumption is N = 161.

^bDue to the log-transformed analysis, the adjusted mean estimate was back-transformed to a geometric mean.

^cDue to the log-transformed analysis, a means ratio (instead of a means difference) is calculated to statistically compare the changes in outcome variables over time, with baseline measurements as reference.

^dThe odds ratio refers to the ratio of proportions of children consuming lower fat milk before and after the policy change, with the baseline measure as a reference.