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Student Acceptance of Plain Milk Increases Significantly 2 Years after Flavored Milk Is Removed from School Cafeterias: An Observational Study

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ABSTRACT

Background Previous studies document decreases in lunchtime milk consumption immediately after flavored milk is removed. Less is known about longer-term effects.

Objective Plain milk selection and consumption were measured the first year flavored milk was removed in a school district (2010 to 2011 [Time 1]) and 2 years later (2012 to 2013 [Time 2]). Four behavioral economic interventions to promote milk were tested in one school at Time 2.

Design This was a longitudinal, observational study.

Participants/Setting Participants were kindergarten through grade 8 students in two schools in an urban district. Primary data were collected 10 times per school year at Time 1 and Time 2, yielding 40 days of data and 13,883 student observations. The milk promotion interventions were tested on 6 additional days.

Main outcome measures Outcomes were the percentage of students selecting milk at lunch, the ounces of milk consumed per carton, and the ounces of milk consumed school-wide per student.

Statistical analyses Logistic regressions were used to assess how sex, grade, time, availability of 100% juice, and behavioral interventions affected milk selection and consumption.

Results At Time One, 51.5% of students selected milk and drank 4 oz (standard deviation=3.2 oz) per carton, indicating school-wide per-student consumption of 2.1 oz (standard deviation=3.0 oz). At Time Two, 72% of students selected milk and consumed 3.4 oz per carton (standard deviation=3.2 oz), significantly increasing the school-wide per-student consumption to 2.5 oz (standard deviation=3.1 oz). Older students and boys consumed significantly more milk. Availability of 100% fruit juice was associated with a 16–percentage point decrease in milk selection. None of the behavioral economic interventions significantly influenced selection.

Conclusions These data suggest that after flavored milk is removed from school cafeterias, school-wide per-student consumption of plain milk increases over time. In addition, the presence of 100% juice is associated with lower milk selection.
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LIMITING ADDED SUGARS IN CHILDREN'S DIETS IS AN important public health target. The 2015 US Department of Agriculture Dietary Guidelines recommend that added sugars make up no more than 10% of daily calories[1] and the American Heart Association recently released a scientific statement recommending children and adolescents consume <25 g/day of added sugars.[2] Reducing intake to these low levels is an extremely ambitious goal, as youth consume an average of 80 g/day of added sugars.[2] Encouragingly, the nutritional quality of all foods and beverages sold in schools has improved significantly in recent years, which has the potential to help improve children's diets overall and decrease added sugars to some extent. National meal and snack standards have been updated; sugary drinks such as soda and fruit drinks have been removed; new calorie maximums for meals and snacks have been set; and flavored milks are restricted to nonfat varieties.[3] It is in the context of school nutrition changes and the call to focus on added sugars that flavored milk has come under scrutiny.[4,5]

Flavored milk has been a staple of the National School Lunch Program (NSLP). It was available in 99% of schools in 2003 to 2004,[6] and 2005 data suggest that 47% of elementary school students and 30% of middle school students consumed flavored milk at school on a typical day.[7] In addition, the majority of flavored milk consumed by children overall is consumed at school.[8] It has been suggested that flavored milk falls into a special category of nutrient-dense foods that can be made more palatable through the judicious use of added sugars.[2,4,9] Research has found that school-aged children who consume any type of milk at lunch are more likely to meet recommended levels of calcium intake than children who consume nonmilk beverages,[10] and flavored milk in schools increases milk selection and promotes dietary quality.[11,12] In addition, correlational studies have found that flavored milk consumption is not associated with higher body mass index.[13]

An alternative point of view is that flavored milk should not be served in schools for a variety of reasons.[5] Even one serving of flavored milk that meets the Institute of Medicine's recommended limit of 10 g added sugars[14] represents 40% of a child's daily allowance.[2] A second criticism of flavored milk is that many formulations also contain added sodium, artificial colors, flavors, and sweeteners, which are ingredients that concern many parents.[15] Finally, research suggests that children learn how sweet a food is supposed to taste during childhood, and early exposure to sweetened water predicts a preference for sweetened water later in life.[16] Therefore, an additional argument against introducing flavored milk in kindergarten and serving it daily in school is that it may reinforce children's preferences for sweet beverages as a category, and interfere with creating a social norm of drinking water and plain milk.

One important empirical question is: How will students respond if schools offer only plain milk? One hypothesis is that students will not switch to plain milk, and consequently will experience deficiencies in calcium, vitamin D, and potassium. Supporting this point, some research has found a reduction in both milk selection and/or consumption as measured by food waste immediately after flavored milk was removed. For example, Cohen and colleagues[17] found that the first year after flavored milk was removed, milk selection dropped from 80% to 55% and consumption of each 1-cup serving dropped from 64% to 54%. Another study by the same research group, however, found that milk selection and consumption were not significantly different between schools where flavored milk was available daily vs twice a week.[18] Specifically, this study found that in the school that served flavored milk only twice a week, overall milk consumption was not significantly different between flavored milk and plain-milk-only days, suggesting that students were just as likely to drink plain milk when it was the only option.[18] In another study, Hanks and colleagues[19] assessed milk selection in a school district for 1 year when flavored milk was available and again the following year after it had been removed. They observed a decrease in overall milk selection from 78% to 71%. Viewed another way, 90% of the decrease in chocolate milk sales was made up by an increase in sales of plain milk, suggesting that most students are willing to accept plain milk as a substitute.[19]

Understanding how the passage of time impacts milk selection is an important consideration when weighing the short and long-term costs and benefits of a policy to remove flavored milk. To date, little is known about student plain milk consumption over time after flavored milk is removed. One relevant variable may be the availability of alternative drinks in school. Historically, if a school elected to remove flavored milk, plain milk was potentially competing with other sugary drinks in the school building, such as sport drinks or soft drinks. But today, the only competitive beverages permitted for sale in elementary and middle school buildings are plain water (with or without carbonation), and 100% fruit juice (full strength or diluted; with or without carbonation; and with no added sweeteners).[20] In addition, an emerging body of research suggests that behavioral economic strategies may increase selection and consumption of healthier foods in school cafeterias, but limited work has tested these with plain milk in schools where flavored milk has been removed.[21]

The aim of the present study was to assess plain milk selection and consumption in two kindergarten through grade 8 schools in a school district where flavored milk was removed in the 2010 to 2011 school year.

METHODS

Selection and consumption of milk were assessed immediately after the policy change (Time 1: 2010 to 2011) and 2 years later (Time 2: 2012 to 2013). Selection and consumption were compared on days during which fruit juice was offered and not offered. In one of the schools, during 6 days in the spring of the 2012 to 2013 school year, four behavioral economic strategies were tested: marketing, multiple locations, rewards, and automatic placement.

Setting

At the start of the 2010 to 2011 school year, a small urban district in New England elected to remove flavored milk and offer only 1% plain and nonfat milk. More than 80% of the students in this district qualify for free/reduced-price lunch, and universal free breakfast and lunch are served in all schools. This district has a history of strong wellness policies and had already removed many sources of added sugars from school buildings during the previous decade (ie, soda and sport drinks, all competitive foods). The district had also significantly changed its foodservice program to incorporate more "from scratch" cooking and fresh ingredients. District leadership believed that in the context of this commitment to student nutrition and health, flavored milk no longer fit into their vision for the lunch program.

Participants

Two kindergarten through grade 8 public schools were invited by the district foodservice director to participate in the study. Student characteristics at each school are presented in Table 1. The first cohort of kindergarten through grade 8 students was assessed at Time 1 (2010 to 2011) and the second cohort was assessed at Time 2 (2012 to 2013). There was partial overlap between the two cohorts because the students in kindergarten at Time 1 were in second grade at Time 2, students in first grade at Time 1 were in third grade at Time 2, and so on. On data-collection days, the mean number of students who were in the lunch line (and therefore participated in the study) was 369 (79% of total enrollment) from school A and 391 (71% of total enrollment) in school B. No personally identifying information was collected from the students; therefore, the behavior of individual students over time was not assessed.

Procedure

The Yale University Institutional Review Board approved all procedures. Letters were sent home with all students

Table 1. Demographic characteristics of two kindergarten through grade 8 schools in an urban New England school district participating in a study of plain milk acceptance across two observation periods

	School A		School B	
Characteristic	Time 1[a]	Time 2[b]	Time 1[a]	Time 2[b]
	←n→			
Total enrollment	467	467	549	553
	←n (%)→			
Free-reduced meal eligibility	395 (85)	397 (85)	398 (73)	378 (68)
Race/ethnicity	←%→			
Black/African American	5.6	4.1	59.9	57.9
Latino/Hispanic	92.5	92.7	19.7	23.7
White	1.3	2.4	19.7	17.7
Asian American	0.6	0.4	0.4	0.5
Other	0.0	0.4	0.4	0.2

[a]2010 to 2011.
[b]2012 to 2013.

informing parents about the study and providing opt-out information. No parents elected to opt out of the study.

Milk selection and consumption data were collected 1 day per month per school for each of the 10 months of the 2010 to 2011 and 2012 to 2013 school years, for a total of 40 days of data collection and 13,883 student observations. Data collections took place Tuesdays through Fridays. In this district, 100% fruit juice was on the menu as a fruit option two or three times each week. As a result, 15 days of data collection included 100% fruit juice ("juice days") and 25 days included only whole or cut fruit options ("non-juice days"). The presence or absence of juice was recorded for each day of data collection.

All students who ate the school lunch in the cafeteria on data-collection days were included in the study. While waiting in line, students were given a card indicating their sex and grade, and asked to place it on their tray. After the meal, students were asked to leave their cards and their milk cartons (if they had one) on the table at their place. Research staff entered the data from the cards and, for those who had taken milk, marked the student's grade and sex on each carton. The cartons were then weighed (in grams) on a digital scale. Consumption was calculated by subtracting this weight from the weight of a full carton of milk and adjusting for the weight of the empty carton. Milk selection was determined for boys and girls separately in each grade by dividing the number of collected milk cartons by the total number of student cards. Milk consumption was calculated in two ways: "per-carton" among only students who selected milk, as well as "per-student," averaging across all children who took a school lunch.

Behavioral Economic Interventions

To examine the potential of behavioral economic strategies to increase milk selection, four interventions were tested on 6 additional days during Time 2 in school A. (School B was not included in these interventions due to limited resources.) Only one intervention was tested on any given day and the intervention days were compared with the mean of nonintervention days in school A, matched for juice availability. The interventions were as follows: (1) marketing—school administrators were photographed with a "milk moustache" and pictures were placed on the cafeteria walls near the line; (2) multiple locations—milk was placed at both the beginning and the end of the lunch line in prominent locations; (3) rewards—students were told that some milk cartons had stickers on the bottom and if the carton they chose had a sticker, they would get a prize, and at the end of lunch small prizes were distributed; and (4) automatic placement—instead of waiting for students to pick up the milk, a carton of milk was placed on each tray at the beginning of the line by the cafeteria staff.

Data Analysis Strategy

Four hypotheses were tested in the present study: (1) plain milk selection will increase after 2 years; (2) plain milk consumption per carton will increase after 2 years; (3) students will exhibit lower selection and consumption of plain milk on days when 100% fruit juice is on the menu as a fruit option (ie, juice days) compared with days when only fruit is available (ie, non-juice days); and (4) students will increase their selection of plain milk on days when behavioral economic interventions are implemented. In addition to these hypotheses, we tested the effect of sex and grade on milk selection and consumption based on previously documented sex and grade effects on milk consumption.[22]

To test each hypothesis, data were analyzed using logistic regressions (PROC GLIMMIX) using Statistical Analysis Software.[23] School was included as a control variable in all analyses. The two dependent variables in this study were milk selection and milk consumption. The independent variables were time, sex, grade, juice availability, and exposure to a behavioral intervention.

Because milk selection is a binary variable (0 or 1), binomial logistic regressions were used to test the effects of time, sex, grade, juice availability, and exposure to a behavioral intervention. The effects of the binary predictors are reported as odds ratios with *F* tests for significance. The effect of grade is reported with an *F* test for significance. To better understand the behavior of boys and girls in different grades, χ^2 tests were used to evaluate changes over time for each sex and grade subgroup.

Milk consumption was measured as the proportion of the carton that was consumed. Initial examination of the milk consumption outcome variable indicated that it was not normally distributed and the values clustered around 0 and 1, meaning the students tended to drink very little of the milk or nearly all of the milk. Therefore, a binomial logistic regression with a random residual was used to test each of the key predictors of milk consumption. The random residual allows values between 0 and 1 to be estimated as appropriate for a proportion outcome. *F* tests of significance for each of the predictor variables are reported as estimates (β) and accompanying CIs. To better understand the behavior of boys and girls in different grades, *t* tests were used to test changes over time for each sex and grade subgroup.

RESULTS

Hypothesis 1: Plain Milk Selection Will Increase After 2 Years

Overall, there was an increase in milk selection from Time 1 to Time 2 (odds ratio [OR]=2.52; 95% CI 2.26 to 2.60; F[1, 13,835]=645.97; P<0.001). At Time 1, 51.5% took milk. At Time 2, 72.3% took milk, a >20-percentage point increase.

Sex and grade were examined as predictors of milk selection. The proportion of students selecting milk by sex and grade is presented in Table 2. At Time 1, there were significantly lower rates of milk selection among girls (48.0%) than boys (55.5%) (OR=0.72; 95% CI 0.66 to 0.80; F[1, 6,888]=44.57; P<0.001). Grade was also significantly related to milk selection (F[8, 6,883]=71.14; P<0.001), exhibiting a U-shaped pattern where the youngest and oldest students selected milk more frequently than the students in the middle grades. Two years after policy implementation, there were still significantly lower selection rates among girls (67.3%) than boys (76.3%) (OR=0.60; 95% CI 0.54 to 0.67; P<0.001). The grade effect also remained significant (F[8, 6,935]=21.15; P<0.001); however, as indicated in Table 2, older children were less likely to select milk than younger children.

Hypothesis 2: Plain Milk Consumption Will Increase After 2 Years

Overall, the mean percent of milk consumed per carton decreased significantly from Time 1 to Time 2 (50.1% of carton consumed vs 42.8% of carton consumed; β=−.28; 95% CI −.35 to −.21; F[1, 8,566]=64.78; P<0.001). At Time 1, students who selected milk consumed a mean of 50.1% (standard deviation [SD]=39.4%) of the carton, or approximately 4 oz of the 8-oz carton. At Time 2, students who selected milk consumed a mean of 42.8% (SD=39.4%) of each carton, which corresponds to 3.4-oz of the 8-oz carton. Sex and grade were examined predictors of consumption. At Time 1, boys consumed significantly more than girls (mean=56.0%, SD=39.4% and mean=44.0%; SD=38.6%, respectively; β=−.48; 95% CI −.58 to −.37; F[1, 3,548]=81.11; P<0.001); and older students consumed significantly more milk than younger students (F[8, 3,542]=40.04; P<0.001). At Time 2, the pattern was the same; boys consumed significantly more than girls (mean=47.2%; SD=40.3% and mean=37.1%; SD=37.4%, respectively; β=−.40; 95% CI −.49 to −.31; F[1, 4,999]=76.16; P<0.001), and students in older grades consumed significantly more milk than younger grades (F[8, 5,007]=39.36; P<0.001. Data on milk consumption at Time 1 and Time 2 are presented in Table 3, with the values translated from percentage of the carton consumed to ounces consumed for ease of interpretation.

Because milk selection increased while milk consumption per carton decreased, an ancillary analysis was conducted including both milk takers and nontakers to see whether the overall amount of milk consumed (ie, percent consumed per student on average by setting nontakers consumption at 0) differed from Time 1 to Time 2. This difference was significant (β=.25; 95% CI .19 to .32; F[1, 13,817]=62.38; P<0.001), and indicated an increase in per-capita milk consumption from Time 1 to Time 2 (25.8% vs 30.8%). Table 4 presents per-capita consumption by grade and year, converted from percentage of the carton into ounces of milk consumed for ease of interpretation.

Hypothesis 3: Students Will Decrease Their Selection and Consumption of Plain Milk on Days When 100% Fruit Juice Is on the Menu as a Fruit Option, Compared to Days When Only Fruit (and No 100% Fruit Juice) Is Available

At Time 1, the likelihood of students selecting milk on juice days (44.2%) was 16 percentage-points lower compared with

Table 2. Mean percent of students selecting milk by grade and sex across observation days in the two kindergarten through grade 8 study schools in an urban New England school district in 2010 to 2011 and 2012 to 2013[a]

	Overall (n_{obs}[b]=13,883)		Boys (n_{obs}=6,919)		Girls (n_{obs}=6,941)	
Variable	Time 1[c]	Time 2[d]	Time 1[c]	Time 2[d]	Time 1[c]	Time 2[d]
Kindergarten	77.2	90.7**	77.9	90.3**	76.6	90.9**
Grade						
1	54.1	72.0**	62.2	74.2**	46.3	69.4**
2	53.5	68.1**	55.2	73.1**	52.2	64.0**
3	53.2	69.0**	61.2	72.3**	46.6	65.7**
4	41.4	73.3**	40.9	77.1**	42.0	68.8**
5	36.4	69.6**	42.6	79.1**	29.5	61.4**
6	21.4	71.5**	21.5	78.1**	21.1	64.5**
7	48.6	64.2**	60.9	70.7**	34.4	54.1**
8	68.0	61.2*	75.9	68.6	63.6	52.8**

[a]χ^2 analyses were used to test for significant differences between time periods for each sex and grade subgroup.
[b]obs=observed.
[c]2010-2011.
[d]2012-2013.
*P<0.05.
**P<0.01.

Table 3. Mean ounces of milk consumed by students selecting milk by grade and sex across observation days in two kindergarten through grade 8 study schools in an urban New England school district in 2010 to 2011 and 2012 to 2013[a]

	Overall (n_{obs}[b]=8,587)		Boys (n_{obs}=4,595)		Girls (n_{obs}=3,975)	
Variable	**Time 1**[c]	**Time 2**[d]	**Time 1**[c]	**Time 2**[d]	**Time 1**[c]	**Time 2**[d]
Kindergarten	2.5	2.4	3.0	2.7	2.0	2.0
Grade						
1	4.1	3.0**	4.6	3.2**	3.4	2.8*
2	3.8	3.0**	4.4	3.2**	3.2	2.8
3	4.1	2.9**	4.7	3.3**	3.4	2.5**
4	3.7	4.7**	3.8	5.0**	3.7	4.2
5	5.0	3.4**	5.0	4.0**	5.0	2.8**
6	5.4	3.7**	5.5	4.2**	5.4	3.0**
7	4.7	4.7	5.2	5.0	3.6	4.3
8	5.4	4.6**	5.9	4.9**	5.0	4.1**

[a]*T* tests were used to test for significant differences between time periods for each sex and grade subgroup.
[b]obs=observed.
[c]2010 to 2011.
[d]2012 to 2013.
*$P<0.05$.
**$P<0.01$.

non-juice days (60.3%), which was a significant difference (OR=.50; 95% CI .45 to .55; F[1, 6,890]=197.13; $P<0.001$). At Time 2, even though the overall rate of selecting milk was higher, the juice effect remained, with significantly fewer students selecting milk on juice days (66.2%) than non-juice days (73.6%) (OR=.69; 95% CI .59 to .76; F[1, 6,942]=39.13; $P<0.001$).

At Time 1, students who took milk consumed significantly less of the milk in the carton on juice days (44.8%) than non-juice days (55.8%) ($\beta=-.40$; 95% CI $-.50$ to $-.29$; F[1, 3,549]=55.88; $P<0.001$). This effect also remained at Time 2, with students consuming significantly less milk per carton on juice days (39.8%) than non–juice days (43.5%) ($\beta=-.15$; 95% CI $-.27$ to $-.04$; $P<0.01$).

Table 4. Mean per-capita milk consumption in ounces for all students across observation days in two kindergarten through grade 8 study schools in an urban New England school district in 2010 to 2011 and 2012 to 2013[a]

	Overall (n_{obs}[b]=13,883)		Boys (n_{obs}=6,919)		Girls (n_{obs}=6,941)	
Variable	**Time 1**[c]	**Time 2**[d]	**Time 1**[c]	**Time 2**[d]	**Time 1**[c]	**Time 2**[d]
Overall mean	2.3	2.7**	2.7	3.2**	1.7	2.2**
Kindergarten	2.1	2.4*	2.6	2.7	1.7	2.0
Grade						
1	2.4	2.4	3.1	2.6*	1.7	2.2*
2	2.2	2.2	2.7	2.5	1.8	2.0
3	2.4	2.2	3.2	2.6*	1.8	1.8
4	1.7	3.8**	1.7	4.3**	1.7	3.2**
5	2.0	2.6**	2.4	3.5**	1.6	1.9
6	1.3	2.8**	1.3	3.5**	1.3	2.1**
7	2.5	3.3**	3.5	3.9	1.4	2.5**
8	4.1	3.1**	5.0	3.7**	3.5	2.4**

[a]*T* tests were used to test for significant differences between time periods for each sex and grade subgroup.
[b]obs=observed.
[c]2010 to 2011.
[d]2012 to 2013.
*$P<0.05$.
**$P<0.01$.

Hypothesis 4: Students Will Increase Their Selection of Plain Milk on Days When Behavioral Economic Interventions Are Implemented

The percentage of students selecting milk during each intervention was compared with nonintervention days that were matched for juice availability. The percentage of students selecting milk during the marketing intervention was 74.1%. This was not significantly different than the nonintervention day rate of 77.3% (F[1, 1,070]=1.31; P=0.25). The multiple-location intervention led to a selection rate of 73.6%, which was not significantly different than the nonintervention rate of 82.9% (F[1, 4,054]=32.23; P=0.32). The reward game intervention selection rate was 81.4%, which was not significantly different than the nonintervention rate of 84.4% (F[1, 2,969]=1.97; P=0.16). Finally, the automatic placement intervention was tested on separate days for kindergarten through grade 4, and grades 5 through 8. For kindergarten through grade 4 students, the automatic placement intervention led to a selection rate of 83.5%, which was not significantly different than the nonintervention rate of 86.2% (F[1, 20,179]=1.31; P=0.26). For grades 5 through 8, this intervention led to a selection rate of 66.7%, which was significantly lower than the nonintervention rate of 78.2% (F[1, 1,269]=13.15; P<0.001). In sum, none of the behavioral economic interventions were associated with improvements in the percentage of students selecting milk.

DISCUSSION

This study measured plain milk selection and consumption the first year after flavored milk was removed from a school district, and again 2 years later. The results indicate that when examining the population as a whole, student selection of plain milk increases over time, ultimately resulting in higher per-capita milk consumption. Future research that tracks individual children over time and includes interviews with children about their milk consumption would be helpful to better understand the reasons why their behavior does, or does not, change over time.

The rationale behind removing flavored milk from school cafeterias is that students will simply switch to plain milk and thereby retain the nutrients without the added sugars. Conversely, the rationale behind keeping flavored milk is that students will refuse to switch to plain milk and will therefore miss out on important nutrients. Researchers and policymakers must recognize, however, that student behavior is more complicated than either of these scenarios. In order to understand whether or not a milk policy change was successful, it may be useful for future research to conceptualize students as potentially belonging to four different groups: group A are those that readily switch from flavored milk to plain milk (or that drank plain milk all along); group B are those that switch from flavored milk to plain milk eventually or to a lesser degree; group C are those that never accept plain milk as a substitute for flavored milk and stop drinking milk at school; and group D are those who never drank flavored or plain milk at school and continue to not drink milk at school. Based on the current study's data, it is possible to theorize about how the students would fit into these hypothetical groups. In the first year post-implementation, approximately 50% of the students seemed to readily accept plain milk, placing them in group A. The other half did not accept plain milk initially, but after 2 years, almost half of them (22% of the total group) joined group B by accepting the plain milk, raising the overall acceptance rate to 72%. This left 28% of all students either refusing to switch to plain (group C) or refusing to drink milk regardless of type (group D). The theory that there are four possible groups may also be useful in predicting and understanding consumption. Those in group A, who choose plain milk the first year, may have been the students who liked milk the most and therefore drank more of it per carton. After 2 years, the group B students who were now choosing it were less enthusiastic milk drinkers with lower intake, thus pulling down the per-carton consumption rate. Despite this, however, the overall amount of milk that was consumed by the student body as a whole increased significantly.

Unfortunately, it is not possible to speculate about the relative sizes of groups C and D in the present study due to the absence of baseline data. However, other studies can provide some comparison rates of milk refusal when flavored milk is a choice (ie, group D). The School Nutrition Dietary Assessment III data indicate that in schools with flavored milk, 17% of elementary school–aged students and 35% of middle school students who participate in the school lunch program do not drink any milk at all.[24] A study by Cohen and colleagues of students in kindergarten through grade 8 in a low-income district also provides a useful comparison.[17] In 2011, when students were able to choose flavored or plain, 79.8% of the students selected milk, representing a 20% refusal rate. In 2012, when flavored milk was removed, selection dropped to 55.1%, resulting in a 45% refusal rate. Interestingly, the magnitude of these numbers is similar to the current study. Based on these studies, it is reasonable to assume that at least half of the 28% of students in this study refusing plain milk after 2 years would have refused flavored milk at baseline as well. Future research should investigate the prevalence of lactose intolerance in study samples in order to assess whether this is why a proportion of the students refuse to drink any type of milk in school.

If the goal is to reduce consumption of added sugars while maintaining calcium intake, one proposed alternative to removing flavored milk entirely is substituting flavored milk that has been reformulated to have lower levels of added sugars. Yon and colleagues conducted studies before the regulation changes in the NSLP documenting that lower-sugar flavored milk is well accepted by students.[22,25] Yon and Johnson also studied 10 elementary schools before and after the NSLP regulation requiring all flavored milk to be nonfat and found that there was not a drop in milk consumption, further making the case that flavored milk reformulated to be lower in fat and added sugars is acceptable to students.[26] It is noteworthy that the amount of low-sugar, fat-free milk consumed in these studies averaged 5.4 oz[26] and 5.5 oz,[22,25] which is substantially higher than the amount of milk consumed in the current study. At the same time, the reformulated milks still contain at least 10 g added sugars, which are arguably unnecessary if plain milk became the social norm and was increasingly accepted over time. Future experimental research would be useful to compare how substituting lower-sugar milk vs removing all flavored milk from school effects student diets.

These findings also highlight the relationship between milk consumption and the presence or absence of juice. On days when juice is available, acceptance of plain milk decreases significantly. This finding suggests that students may be more likely to select plain milk as a beverage if 100% fruit juice is not provided as part of the school lunch.

Finally, the finding that the behavioral economic strategies did not have a significant impact on either selection or consumption was surprising. This may be because they were tested 2 years after flavored milk had been removed, and overall acceptance of plain milk had already increased, leaving limited room for improvement. Alternatively, each strategy was implemented only once or twice, which may not have been enough to shift behavior in the desired direction. More formative research is needed to design strategies to promote milk consumption. The research should be designed to solicit input from children across age groups, as well as from boys and girls. As noted here, one issue that may be relevant is lactose intolerance, which can influence children's decisions about drinking milk.

Limitations

As stated previously, baseline data were not collected in this study, precluding the ability to study changes in milk selection and consumption pre- and post-policy implementation. Unfortunately, the decision to remove flavored milk in this district was made over the summer—after the school year—and the opportunity to collect baseline data had ended. The sample of only two schools is small, and the generalizability of this study's findings may be limited to districts with a similar demographic profile and nutrition environment. Finally, although the students were measured on multiple occasions, it was not possible to link individual student observations over time. This is because a passive consent procedure was used in order to capture milk acceptance data from as many students as possible. However, sandwich estimators were used to obtain robust standard errors.

CONCLUSIONS

A school policy to remove flavored milk has potential public health benefits and costs—it is likely to decrease consumption of added sugars at lunch for all children, but it is also likely to decrease consumption of milk for some children and increase their risk of missing key nutrients. Before a school district makes this policy change, a comprehensive evaluation plan should be put in place. Further research is needed to better understand the short and long-term consequences of this policy on children's overall dietary patterns, and to assist school districts in making the best decisions to support student health and wellness.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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