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ABSTRACT

During January 2011, the US Department of Agriculture issued proposed regulations with substantial changes to nutrition standards for school foods and beverages to improve the healthfulness of school meals. Milk availability is limited to fat-free or 1% white milk and fat-free flavored milk. Most elementary school students choose flavored milk. Milk processors are lowering the calories provided by flavored milks by reducing the fat and/or added sugars content. Milk is an important source of shortfall nutrients; thus, it is important to know how children accept these new milks. Four schools in the northeast and south serving lower-calorie flavored milk (>150 kcal/8 oz) were selected for a quasi-experimental plate waste study. Five control schools serving standard flavored milk (>150 kcal/8 oz) were enrolled from the same regions. During May and June 2010, flavored milk cartons were collected from 793 third- to fifth-grade students after lunch and individually weighed to determine consumption. Overall, students consumed an average of 5.52±0.10 oz flavored milk. Students consumed an average of 5.88±0.12 oz standard flavored milk (n=497) compared with an average of 4.92±0.17 oz lower-calorie flavored milk (n=296). Using linear mixed models, we found that children drinking standard milk were more likely to consume >7 oz, although the difference was not significant (P=0.09). After adjusting for group differences in socioeconomic status, region, and sex, no differences in consumption were detected (P=0.29). Because none of these milks were in full compliance with proposed regulations, milk consumption should be further monitored. J Acad Nutr Diet. 2012;112:132-136.

Milk is an important source of nine essential nutrients, including several shortfall nutrients in children’s diets (eg, vitamin D, calcium, and potassium) (1). Patterns of beverage consumption in children and adults have changed during the past 40 years with a decrease in milk consumption and increase in sugar-sweetened beverages (2). Only children who consume milk at the noontime meal come close to meeting their calcium requirements (3). Although flavored milk is criticized as a source of added sugars, children consuming flavored milk meet their calcium requirements without consuming significantly more added sugars compared with children who are not milk drinkers (4,5).

It is estimated that almost 32 million children participated in the National School Lunch Program during the 2010-2011 school year (6). School meal programs are important sources of nutrition for children. The Institute of Medicine published two reports (7,8) recommending updated nutrition standards for all foods sold in schools to bring them into alignment with contemporary dietary recommendations. During January 2011, the US Department of Agriculture (USDA) published proposed regulations recommending the Institute of Medicine’s standards for school meals (9). The new meal standards consist of sweeping changes setting both lower and upper limits on the amount of calories served as well as nutrient targets for fat and sodium. To meet the proposed fat and calorie guidelines, milk would be limited to unflavored fat-free or low-fat (1%), and, if flavored, only fat-free.

Data from the Third School Nutrition Dietary Assessment Study show that most elementary school students (71%) choose flavored milk (10). Before the release of the USDA-proposed regulation, the Alliance for a Healthier Generation—a partnership between the American Heart Association and the William J. Clinton Foundation to combat childhood obesity—established nutrition and calorie guidelines for school beverages (11). In anticipation of the USDA proposed regulations, many dairy processors reformulated flavored milk to meet the Alliance for a Healthier Generation guidelines (≤150 kcal/8 oz). Just more than half of flavored milk available in schools during the 2009-2010 school year contained ≤150 kcal; however, only 37% of school flavored milk was fat-free (12). Children often reject new foods, as was illustrated in New York City schools—where it took almost 5 years for milk use to recover after whole milk was eliminated (13,14).

As flavored milk formulations continue to change to meet the pending new school meal regulations, it is important to know whether or not schoolchildren drink the lower-calorie milks currently available. The purpose of this study was to compare elementary school students’ consumption of standard and reformulated lower-calorie milk.
flavored milk. It was hypothesized that elementary school students’ consumption of lower-calorie flavored milk (≤150 kcal) would be the same as consumption of higher-calorie standard flavored milk (>150 kcal).

METHODS
School districts (n=7) around the United States offering flavored milk reformulated to ≤150 kcal/8 oz during the 2009-2010 school year were identified for study recruitment as part of a larger study evaluating the acceptance of lower-calorie flavored milk. A convenience sample of four ethnically diverse public school districts from urban, suburban, and rural regions in the northeast and south were enrolled in this quasi-experimental plate waste study. The flavored milks offered in the reformulated schools contained 150 kcal/8 oz and were either fat free or 1% milk fat, with total sugar contents of 22 to 27 g. Before reformulation, these schools served standard flavored milk with 170 kcal/8 oz, 1% milk fat, and up to 28 g total sugar. Public school districts (n=4) with comparable demographics in the northeast and south, using standard flavored milk (160 to 170 kcal/8 oz, 1% milk fat, 25 to 27 g total sugar), were identified and enrolled as controls. Written informed consent was obtained from each school nutrition director, at which time one or more elementary schools serving third- through fifth-grade students were randomly selected from within each of the eight districts.

School nutrition directors completed a survey to collect school district and school-specific demographic information. Milk collections were scheduled at lunch in each elementary school during May and June 2010 on a Tuesday, Wednesday, or Thursday. Upon completion of the survey and plate waste visit, each school district was eligible for a mini-grant of $500. The University of Vermont Institutional Review Board reviewed and approved the study.

A protocol guide describing the methods to be used in each school, as well as a code of conduct on how to interact with school personnel and students, were developed and tested at two nonstudy elementary schools during April 2010. On the day of each school visit, the research team arrived 30 minutes before lunch, at which time school nutrition environment data were collected with a focus on cafeteria factors that have been shown to influence milk consumption. The research team reviewed lunch procedures with school personnel, sharing that the team was collecting milk data as part of a larger study evaluating the acceptance of lower-calorie flavored milk. It was hypothesized that elementary school students’ consumption of lower-calorie flavored milk (≤150 kcal) would be the same as consumption of higher-calorie standard flavored milk (>150 kcal).

RESULTS AND DISCUSSION
Sample Descriptives
A total of 798 containers of flavored milk (99% chocolate) were collected from third- through fifth-grade students across all nine schools in the northeast (n=6) and south (n=3), of which 793 were usable for analysis (Tables 1 and 2). Of these containers, 67 were unopened, representing 8% of the full sample. A somewhat larger percentage of cartons were unopened from within the reformulated group (12.5%) in comparison to the control group (6%). Within the control group, two schools did not use offer vs serve, meaning that students were required to take all meal components, including milk, at lunch. Although it might be speculated that more cartons of milk would be wasted in this environment, only 7% of cartons were unopened in these schools. In comparison, the largest proportions of unopened cartons (12% and 26%) were found in the two schools operating under Provision 2 rules, offering free meals to all children. Earlier plate waste

Statistical Analyses
Descriptive analyses (means and standard errors for continuous variables and cross tabulation tables for ordinal and nominal variables) were used to describe the characteristics of each group. Differences between groups were examined using independent samples t tests for continuous variables, and χ² analyses and Fisher’s exact tests for categorical variables. School environment factors were examined for correlations with consumption (Spearman rank correlations). The outcome variable (milk consumption) was highly positively skewed and not responsive to transformation. Thus, it was reclassified into a binary variable (0 to 7 oz or >7 oz) for analyses.

Generalized linear mixed models (PROC GLIMMIX) were used to test for differences in milk consumption between groups, which accounted for the study’s nested design of students within schools. Using individual milk measures to detect a 15% difference (slightly >1 oz) in milk consumption, power calculations confirmed that 176 milk containers were needed from each group. Data were analyzed using IBM SPSS (version 18.0, 2009, IBM Corporation, Somers, NY) and Statistical Analysis Software (version 9.2, 2008, SAS Institute Inc, Cary, NC) with P<0.05 (two-tailed) required for statistical significance.
work in schools found that students receiving free lunch wasted more than students paying full price (16). Because the study qualified as exempt research, the research team was not allowed to interact with students other than to collect milk; thus, it is difficult to discern why children took milk at lunch but then did not open the container. There are a number of possible explanations: students may take the milk with no intention of drinking it, especially in the Provision 2 schools where there was no cost for lunch; although students had 20 to 30 minutes for lunch, they may not have had time for milk, or decided not to drink it once the meal was underway; and even though the reformulated milks were available to these students for 5 to 10 months, giving them ample exposure and time to adjust to either fat-free or low-sugar flavored milk, they may not like the milk (17).

Differences in consumption between the reformulated and control groups were analyzed both with and without unopened cartons. There was no difference in the results. Thus, results presented include the unopened cartons because the study’s intent was to determine milk acceptance by measuring actual consumption once the children took milk from the cafeteria line, as opposed to school use, which could be measured using production record data.

Flavored Milk Consumption

The total sample of students consumed an average of 5.52±0.10 oz flavored milk. Students in the reformulated group (n=296) consumed an average of 4.92±0.17 oz, whereas students in the standard flavored milk group (n=497) consumed an average of 5.88±0.12 oz. As a binary variable, 45% of students in the reformulated milk schools consumed most (≥7 oz) of their milk, compared with 66% of the students consuming standard flavored milk (F (1,7)=3.86; P=0.09).

Cafeteria Environment Factors

A number of cafeteria environment factors were correlated with milk consumption, including milk temperature (r_s=−0.11; P=0.001); consumption decreased as the temperature of the flavored milk increased. Later lunch times (12:45 PM vs 11:00 AM) were positively correlated with consumption (r_s=0.12; P<0.0001). Milk consumption was higher in schools that did not use offer vs serve where children were required to take milk as part of lunch (r_s=0.18; P<0.0001). These correlations were small and these factors are well documented (15). The cafeteria environment factors (ie, milk temperature and lunch time) were not significantly different between the refor-

Table 1. Demographic characteristics of elementary schools participating in a study assessing consumption of lower-calorie flavored milk

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All schools</th>
<th>Control^a</th>
<th>Reformulated^b</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total schools (n)</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>School enrollment (n)</td>
<td>512±5</td>
<td>584±7</td>
<td>489±6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Students eligible for free or reduced-price meals (%)</td>
<td>53.1±1.1</td>
<td>48.7±1.31</td>
<td>60.5±1.74</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Race/ethnicity (%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>66.7±1.06</td>
<td>75.1±0.81</td>
<td>42.3±1.98</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Black</td>
<td>10.6±0.59</td>
<td>17.3±8.4</td>
<td>2.1±0.12</td>
<td>&lt;0.001</td>
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<tr>
<td>Hispanic</td>
<td>18.9±1.18</td>
<td>2.9±0.15</td>
<td>53.6±2.12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Asian</td>
<td>2.8±0.1</td>
<td>3.5±0.14</td>
<td>1.4±0.07</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

^aSchools offering flavored milk >150 kcal/8 oz.
^bSchools offering flavored milk ≤150 kcal/8 oz.

Table 2. Demographic characteristics of elementary school students participating in a study assessing consumption of lower-calorie flavored milk

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All schools</th>
<th>Control^a</th>
<th>Reformulated^b</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total students in sample</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
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<tr>
<td>Male</td>
<td>403</td>
<td>51</td>
<td>268</td>
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<tr>
<td>Female</td>
<td>390</td>
<td>49</td>
<td>229</td>
<td>46</td>
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<tr>
<td>Grade</td>
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<td>Third</td>
<td>276</td>
<td>35</td>
<td>173</td>
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<td>Fourth</td>
<td>282</td>
<td>35</td>
<td>166</td>
<td>33</td>
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<tr>
<td>Fifth</td>
<td>235</td>
<td>30</td>
<td>158</td>
<td>32</td>
</tr>
</tbody>
</table>

^aSchools offering flavored milk >150 kcal/8 oz.
^bSchools offering flavored milk ≤150 kcal/8 oz.
mulated and control schools. Although standard flavored milk had a shorter outdate (10 days) than the reformu-
lated flavored milk (13 days; \( P < 0.0001 \)), outdate was not correlated with milk consumption in this sample. To focus
the analyses on the primary question and preserve the limited degrees of freedom, cafeteria level variables were
not entered into the statistical models.

Although every effort was made to identify control schools with similar demographics as the reformulated
milk schools, the groups differed on these variables \( (P < 0.001) \) (Table 1). Because the northern schools were
less racially diverse compared with the southern schools, a variable representing region was created to account for
these racial/ethnic differences. In addition, the statistical model was fit adjusting for group differences in socioeco-

nomic status and sex. After accounting for the effects of region, socioeconomic status, and sex, children drinking
lower-calorie flavored milk were as likely to consume >7 oz milk as children drinking standard milk \( F(1,5) = 1.39; \)
\( P = 0.29 \). In the full sample, boys were more likely to drink most of their milk than girls (odds ratio 1.5, 95% confidence interval 1.1 to 2.1; \( P < 0.01 \)), with 63% consuming >7 oz flavored milk, compared with 52.8% of girls.

Because there wasn’t a large calorie difference between the reformulated and standard flavored milks, children
may not have been able to detect the reductions in re-
duced fat or added sugars. Work with toddlers suggests that reductions in the added fat and sugar contents of
foods may not affect consumption \( (18) \). This suggests that dairy processors may have been successful in developing
reformulated products that represented taste changes that are referred to by consumer psychologists as the just
unnoticeable change where the product reformulation change is not perceived or detected by the tasters \( (19) \).

The school beverage environment is changing. Al-
though high-calorie beverages are still widely available to
elementary school students as competitive foods, access
to healthier beverages, including low-fat and nonfat milk
is increasing \( (20) \). Most elementary school students in the
lower-calorie flavored milk schools did not have access to
higher-calorie flavored milk options. When sugar-sweet-
ened beverages are no longer available in school, students
will purchase and drink healthier alternatives \( (21) \). Mak-
ing changes to the food and beverage choices offered to
schoolchildren can result in behavior change \( (22) \). Dietet-
ics practitioners working with school nutrition programs
can encourage schools to begin transitioning to lower-
calorie flavored milk.

There are limitations to the study. The sample is not
representative of all schoolchildren in the United States
and, thus, the results may not be generalizable to the
total country or all ages. There is a paucity of data on
actual consumption of school meals including school milk
in the literature because most studies rely on dietary
recalls. This study provides useful data regarding how
much flavored milk was actually consumed at lunch in
this sample of elementary school-aged children. In addi-
tion, it was impossible to fully empty a container of milk;
thus, what was essentially an empty carton yielded a
consumed volume of approximately 7.7 fl oz. Finally, al-
though each school cafeteria posted rules stating children
were not allowed to share food, the team was unable to
fully monitor each child’s actual consumption. However,

these methods were able to approximate how much milk
children consume more accurately than self-reports.

Although consumption of unflavored white milk was
not measured, most children choose flavored milk in school. USDA’s 2011 proposed regulations will likely lead
to greater changes in the nutritional profiles of flavored
milk in schools. This study provides important baseline
information about how well elementary school students
accept formulations of lower-calorie flavored milk that
meet the Alliance for a Healthier Generation guidelines
for school beverages.

CONCLUSIONS

The major finding of this research was that elementary
school students drinking lower-calorie flavored milk were
as likely to drink most of their milk in comparison with
peers offered higher-fat or higher-sugar flavored milks.
None of the flavored milks sampled in these schools were
in full compliance with either the proposed USDA regu-
lation \( (9) \), or the Institute of Medicine recommendations
\( (7,8) \). Further research will be needed to monitor chil-
dren’s milk consumption as schools come into compliance
with pending regulations because it is unknown how ad-
ditional changes to flavored milk will influence school
children’s consumption.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST: Rachel K. Johnson, RD, MPH, PhD, is a member of the
Milk Processor Education Program Medical Advisory
Board. No potential conflict of interest was reported by
the other authors.

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