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ARTICLE

# Impact of the removal of chocolate milk from school milk programs for children in Saskatoon, Canada

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**Abstract:** Studies in the United States report inclusion of flavoured milk in the diets of children and youth improves nutrient intakes. No research has investigated the contribution of flavoured milk to overall milk intake or the milk preferences of Canadian children. The objective of the study was to measure milk consumption (plain milk and flavoured milk) by children in an elementary school environment and investigate factors contributing to milk choice. A mixed-method research design was applied across 6 schools for 12 weeks. Milk waste was measured in grades 1–8 for 12 weeks. Weeks 1–4 (phase 1) and 9–12 (phase 3) provided both plain milk and flavoured milk as chocolate milk while weeks 5–8 (phase 2) provided plain milk only. Beverage Frequency Questionnaires were used in each phase (in grades 5–8 only) to assess usual beverage consumption. Statistical nutrient modelling was conducted to determine the effects of removing chocolate milk during phase 2 as a milk choice. Later, focus groups were conducted with students in grades 5–8 to determine what influences them to choose/not choose to drink milk. Total milk intake decreased by 12.3% when chocolate milk was removed from the schools (26.6% ± 5.2% to 14.31% ± 1.6%, $p < 0.001$). Milk choice was influenced by environmental factors as well as taste, cost, convenience, and variety. Total milk intake was associated with location ($p = 0.035$) and cost ($p < 0.001$), with rural students and/or those students receiving free milk drinking the greatest amount of milk. Nutrient modelling revealed chocolate milk is more cost-efficient and convenient at providing nutrients than alternative food/drink combinations.

*Key words:* flavoured milk, students, milk replacement, focus groups, nutrient modelling, plate waste.

**Résumé :** Des études aux États-Unis rapportent que l'introduction de lait aromatisé dans le régime alimentaire des enfants et des adolescents améliore l'apport en nutriments. Il n'y a pas d'études sur la place du lait aromatisé dans la consommation totale de lait ou sur les préférences en matière de lait chez les enfants au Canada. Cette étude se propose de mesurer la consommation de lait (lait nature et lait aromatisé) chez les enfants en milieu scolaire élémentaire et d'examiner les facteurs contribuant au choix du type de lait. On utilise un devis mixte de recherche dans 6 écoles sur une période de 12 semaines. On mesure aussi les déchets de lait durant 12 semaines dans les classes de 1re à la 8e année. Durant les semaines 1 à 4 (phase 1) et 9 à 12 (phase 3), on fournit du lait nature et du lait aromatisé au chocolat; durant les semaines 5 à 8 (phase 2), on ne fournit que du lait nature. On utilise un questionnaire sur la fréquence de consommation de boissons à chaque phase (classes 5 à 8 seulement), et ce, pour évaluer la préférence habituelle de consommation. On applique une modélisation statistique des nutriments pour évaluer les effets lorsqu'on retire l'option du lait au chocolat durant la phase 2. Plus tard, on anime des groupes de discussion avec des élèves des classes 5 à 8 pour déterminer ce qui les a amenés à boire ou ne pas boire du lait. La consommation totale de lait diminue de 12,3 % quand on retire le lait au chocolat des écoles (de 26,6 ± 5,2 à 14,31 ± 1,6 %, $p < 0{,}001$). Le choix du type de lait est influencé par des facteurs environnementaux; il est aussi fait en fonction du goût, du coût, de la commodité et de la variété. La consommation totale de lait est associée à l'emplacement géographique ($p = 0{,}035$) et au coût ($p < 0{,}001$) : les élèves des campagnes et/ou ceux qui reçoivent gratuitement le lait sont ceux qui en boivent le plus. D'après la modélisation des nutriments, le lait au chocolat est plus économique et plus commode pour procurer des nutriments qu'une combinaison alternative d'aliment/boisson. [Traduit par la Rédaction]

*Mots-clés :* lait aromatisé, élèves, substitution du lait, groupes de discussion, modélisation des nutriments, déchets alimentaires.

## Introduction

Milk is a key source of protein, calcium, vitamin D, and several other micronutrients for children and youth (Vatanparast and Whiting 2007). These nutrients are crucial in childhood to ensure optimal bone development and prevent osteoporosis later in life (Caroli et al. 2011). Milk drinkers are more likely than nonmilk drinkers to meet the estimated average requirement for calcium, phosphorus, magnesium, vitamin A, and riboflavin (Rangan et al. 2012). By contrast, other beverages do not provide the various nutrients that milk provides, although they do contribute to energy. Fluid milk is the main source of dietary calcium as well as other bone-beneficial nutrients for children in Canada and the United States (Iuliano-Burns et al. 1999; Vatanparast and Whiting 2006, 2007; Drewnowski 2011). *Canada's Food Guide to Healthy Eating* recommends 2 servings of milk and alternatives (e.g., 1 cup milk or fortified soy beverage, 1.5 oz (42.5 g) cheese or 0.75 cup (177 mL) yogurt) for children aged 4 to 8 years and 3 to 4 servings of milk and alternatives for children ages 9 to 13 years (Health Canada 2007). As children move to adolescence, the contribution of fluid

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milk to dietary calcium intake declines, but milk remains the main source of calcium and vitamin D. (Iuliano-Burns et al. 1999; Vatanparast and Whiting 2006, 2007). White milk intake contributes 21% of dietary calcium intake and 54% of vitamin D intake in children (Nicklas et al. 2013).

Between 35% and 40% of children's daily nutritional needs are met at school and therefore, a healthy school food environment is crucial to encourage the development of healthy eating habits (Larson et al. 2006). Flavoured milk (FM) provides an option for meeting the recommended intake of milk and alternatives. When offered in school, FM has the potential to increase children's milk consumption (Condon et al. 2009). Research in American schools showed that students purchased more milk when the milk offered was enhanced and included FM in addition to plain milk (Quann and Adams 2013). In 1 study, children preferred the taste of chocolate milk (CM) but perceived plain milk to be a more nutritious choice (De Pelsmaeker et al. 2013). Canadian studies have found that the daily milk recommendations of Canada's Food Guide were not being met by children (Minaker et al. 2006; Moffat and Galloway 2008). Data from the NHANES 1999–2002 reported that children who drank both types of milk, plain and FM, had significantly higher intakes of vitamin A, calcium, phosphorus, magnesium, potassium, and saturated fat than nonmilk drinkers who drank plain milk ($p < 0.05$) (Murphy et al. 2008). Despite children's preference for FM and its documented nutritional benefits, some schools have limited access to FM out of concern that FM milk is an unhealthy choice because of added sugar (Petterson and Saidel 2009).

The purpose of this study was to measure milk consumption (both plain milk and CM) by children in an elementary school environment, determine the effects on nutritional status from removing CM as a milk choice through nutrient modelling, and investigate factors contributing to milk choice. We also aimed to determine how FM restriction would impact milk intake, and, using focus groups, determine how children themselves viewed their milk drinking habits.

## Materials and methods

### Experimental design

A mixed-method, cross-over research design was employed. Milk waste was measured in grades 1 through 8 for 12 weeks. Weeks 1 through 4 (phase 1) and 9 through 12 (phase 3) provided both plain milk and CM while weeks 5 through 8 (phase 2) provided plain milk only. Beverage Frequency Questionnaires (BFQs) were conducted (grades 5–8 only) at each phase to assess usual beverage consumption. Statistical nutrient modelling, where foods that could hypothetically replace the nutrient deficit from the hypothesized reduced milk consumption when chocolate milk was removed, was conducted. This allowed determining the effects of removing CM during phase 2 as a milk choice. Focus groups were conducted with students in grades 5–8 to determine what influenced them to choose/not choose to drink milk.

### Subjects

The target population was comprised of students who attended 6 elementary schools (grades 1 to 8) within the Greater Saskatoon Catholic School Division in Saskatoon, Saskatchewan, Canada. Four schools were located in urban areas and 2 schools in rural areas. The overall sample was 1205 students (Table 1). For the purposes of anonymity, the schools were numbered as indicated in Table 1. Schools who agreed to participate were those providing plain milk and CM as part of their school meal program, either for purchase ($n$ = 4) or for free ($n$ = 2). Ethical approval was obtained from the University of Saskatchewan's Behavioural Ethics Board. Permission was obtained from the Greater Saskatoon Catholic Board, participating schools, children, and caregivers. A letter of information was sent home with each student within the school

**Table 1.** School demographics.

| School | Location | Cost of milk | No. students in school | No. students; grades 1–4 | No. students; grades 5–8 |
|---|---|---|---|---|---|
| 1 | Urban | Free | 179 | 99 | 80 |
| 2 | Urban | Paid | 238 | 90 | 148 |
| 3 | Rural | Paid | 222 | 112 | 110 |
| 4 | Rural | Paid | 192 | 90 | 102 |
| 5 | Urban | Paid | 225 | 116 | 109 |
| 6 | Urban | Free | 149 | 53 | 96 |
| Total | — | — | 1205 | 560 | 645 |

informing families about the changes that were made to the milk program. Written consent was not required for the milk waste measurement.

### Milk consumption using milk waste measurement

A cross-over study design was conducted to measure milk consumption by children using measured milk waste, a technique similar to "plate waste", between 3 October 2011 and 22 December 2011. Milk was sold or provided for free (Table 1) in 250-mL individual cartons. Of note, school 1 provided free milk (175 mL) poured into glasses rather than using cartons.

During weeks 1–4 (phase 1), both CM and plain milk were offered or sold (depending on the school). Milk consumed was determined as milk sold minus milk waste during weeks 2 to 4, as week 1 was considered an adjustment period. During weeks 5–8 (phase 2), only plain milk was offered or sold. Again, milk waste was measured in weeks 6–8. During weeks 9–12, both plain milk and CM were offered or sold, and milk waste was measured in the last 3 weeks. During the milk waste measurement, milk coordinators in each school recorded the number of milk servings provided to students in grades 1 to 8 during lunch hour (1200 to 1300 h). Trained data collectors with standardized measuring equipment measured milk wasted on a daily basis. Large containers were provided to each classroom and all students were instructed to discard all containers with leftover milk (if any) into the container. The data collectors counted the number of cartons and poured the waste into standardized measuring containers to record the waste of CM and plain milk separately for each class. If a classroom had less than 100 mL total waste, the waste data were combined into the total school milk waste. In urban schools, data collectors were senior undergraduate students; in rural areas, for schools selling milk, the grade 7 and 8 students were trained as data collectors, and in schools where free milk was provided, the food coordinators tracked milk provided.

### Nutrient modelling

The nutrient modelling was conducted by Prime Consulting Group (USA) (Quann and Adams 2013). The nutrient modelling work translated the change in milk consumption into the change in nutrient intake and then evaluated potential foods to replace the nutrient gaps. Foods such as salmon, cheese, spinach, and yogurt were considered for inclusion in the diet as replacements for milk. Nutrient levels for individual foods were obtained from the Canadian Nutrient Database (Health Canada 2010). The nutrient modelling analysis focused on the decrease in milk consumption that occurred within the schools when CM was removed from the schools (Quann and Adams 2013). Drawing upon Health Canada research (Health Canada 2010), potential nutritional losses should children choose not to drink plain milk when CM was removed were determined.

### BFQ

Beverage intake was assessed at the end of each 4-week phase using a semiquantitative self-administered BFQ previously created and used by the researchers (Lo et al. 2008). The BFQ was completed by consenting students in grades 5 to 8 within the 6 schools. The BFQ asked students about their age, sex, grade, and consumption frequency of 16 different drinks and 3 calcium-rich foods over the past week. BFQ responses included "more than once a day", "once per day", "about once or twice a week", or "hardly ever/never". Written consent was obtained prior to initiating the BFQ and all students who provided written consent received a BFQ during class time while other students within the classroom received an alternate assignment to work on. Children placed their initials, sex, and age on the top of the BFQ to remain anonymous yet allowing matching between phases. Weekly dairy consumption was found as the sum of milk, yogurt and yogurt drinks, and cheese and converted to daily intake by dividing by 7 days per week for analysis.

### Statistical analyses

Data were analyzed using IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, N.Y., USA). We assumed that each student received only 1 milk carton equivalent to serving of 250 mL per day. Further, the percentage of students who chose milk (total, plain, or chocolate) was calculated as number of milk cartons sold per number of students in each grade. Data analysis by grade groupings was performed after combining grades 1–4 and grades 5–8. The Shapiro–Wilk's *W* test indicated data distribution was not normally distributed; thus, nonparametric tests were used. The Friedman test was used to compare means across test phases; and the Wilcoxon test was used for multiple comparisons. The Kruskal–Wallis was used to compare intake across age and grade and the Mann–Whitney *U* test was used for comparison of location and cost. Multiple linear regression modelling was used to evaluate the association between independent variables (sex, phase, and grade) and total milk intake determined from the BFQ. In all statistical analyses, $\alpha$ was set at 0.05.

### Focus groups

Eleven focus group interviews took place in January 2012 with 72 children in grades 5–8 with an average of 6–7 children per group. Two focus groups were conducted at each school to group in grades 5/6 and in grades 7/8, except at 1 urban school where grades 5–8 had to be combined because of the small number of participants. Participants had previously provided written parental consent. Each focus group session was conducted and audiotaped by the project manager (T.P.) and a research assistant. The discussions were 30 to 40 min in length. Audiotaped records were transcribed for analysis. The focus group guide included semistructured questions that were developed by the research team and pre-tested within the target demographic. Thematic analysis of focus group questions took place by reading the transcriptions of the audio tapes and highlighting themes or patterns by hand within each of the 11 focus group responses. Analysis was directed at the following factors influencing milk intake in children: benefits/barriers to milk consumption at home or at school; attitudes or perceptions when CM was removed from schools; and suggestions for improving the school's milk program.

## Results

### Milk waste measurement after excluding CM

The measured waste procedure found that average milk consumption was highest in phase 3 (227 ± 4 mL) (both plain and CM was available) across the 3 phases (Table 2). Average milk consumption was lowest during phase 2 (213 ± 4 mL) when only plain milk was offered. Milk consumption across all 3 phases was significantly different ($p < 0.001$). All schools were included in the analysis of the percent of students who chose to consume milk. Overall, phases 1 and 3 had significantly more students choose to drink milk when CM milk was available; further, more chose to drink CM than plain milk ($p < 0.001$). When plain milk was the only option in phase 2 the percentage of students drinking plain milk increased from 3% in phase 1 to 14% in phase 2 ($p < 0.05$). Data

**Table 2.** Mean milk servings (mL) consumed per student per day, and as percentage of students who chose milk.

| | Phase 1: plain and flavoured | Phase 2: plain only | Phase 3: plain and flavoured | *p* |
|---|---|---|---|---|
| Total milk | | | | |
| mL* | 225±2a | 213±4b | 227±4c | <0.001 |
| %† | 26.6±5.2a | 14.31±1.6b | 24.1±3.1a | <0.001 |
| Plain milk | | | | |
| mL | 223±5 | 213±4 | 223±6 | 0.06 |
| % | 2.7±0.3a | 14.3±1.6b | 1.9±0.3a | <0.001 |
| Chocolate milk | | | | |
| mL | 226±5a | — | 237±2b | 0.011 |
| % | 24.0±2.2 | — | 22.2±2.7 | 0.182 |

**Note:** Data are means ± SE. When the main effect of phase was significant ($p < 0.05$) post hoc testing was performed. Means for variables without a common letter differ, $p < 0.05$. Data represented does not include school 1 as they offered a different serving size of milk compared with the other schools.
*Millilitres consumed per student.
†Percentage of students who chose milk.

for milk consumption were analyzed with and without school 1 as they provided a smaller serving size then the other schools. Results for the difference between groups for millilitres consumed were similar; data shown are those analyzed excluding school 1.

### Factors affecting milk consumption

Rural and urban schools differed in milk consumed, indicating greater waste in urban schools (Table 3). Both rural and urban students chose CM more frequently than white milk. Overall a greater percentage of urban children chose CM in phases 1 and 3 than in rural schools (Table 3). However, once the urban schools offering milk for free were removed from analysis students in rural schools consumed significantly more milk across all 3 phases ($p < 0.05$). In both analyses urban students wasted more of the milk they purchased.

In schools where milk was offered for free, a greater percentage of students chose to consume milk (both plain and chocolate) across all 3 phases than students in schools where they purchased milk (Table 3). Students who paid for milk wasted less milk, independent of the type of milk (Table 3).

In phase 1 and 2, both grade groups (1–4 and 5–8) chose milk (both flavours) in equal percentages. When CM was removed in phase 2, the older students chose to consume milk less often than the younger group. In phase 3 the age groups consumed similar amounts of plain milk; however, the younger students chose greater amounts of CM. Younger students consumed a smaller portion of the milk that was provided to them with the exception of plain milk in phases 1 and 2 where they consumed similar amount of plain milk as the older students.

### Nutrient modelling

Modelling was conducted by focusing exclusively on students who chose to drink only CM. It showed the loss of essential nutrients and potential replacements for CM to meet the nutrient losses on a daily basis when CM is removed. The essential nutrients (and their quantities) that would need to be replaced if 100 mL of CM was eliminated from a child's diet were 119 mg calcium, 38 IU vitamin D, 63 RAE vitamin A, 116 mg phosphorous, 196.3 g protein, and 15 mg magnesium. When 5 alternative food/beverage scenarios were modelled to replace most of the essential nutrients that CM provides (data not shown), in every case they exceeded CM in either calories, sugar, or both.

### BFQ

The mean intake of the total milk (servings/day) according to 3 BFQs across the 3 phases is presented in Table 4. There were no significant differences in the distribution of the usual fluid milk

**Table 3.** Mean milk servings (mL) consumed at school per student, per day, in each of the three phases, by location, cost, and grade.

| | Phase 1 | | | Phase 2 | | | Phase 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plain | Chocolate | Total | Plain | Chocolate | Total | Plain | Chocolate | Total |
| Rural | | | | | | | | | |
| mL | 240±6 | 236±2 | 236±2 | 229±5 | — | 229±5 | 244±31 | 245±1 | 245±1 |
| % | 1.1±0.1 | 15.4±2.2 | 16.2±2.3 | 7.3±0.8 | — | 7.3±0.8 | 1.3±0.2 | 13.4±1.3 | 14.7±1.1 |
| Urban | | | | | | | | | |
| mL | 211±6 | 219±4 | 218±2 | 192±5 | — | 192±5 | 219±8 | 232±2 | 229±2 |
| %* | 3.6±0.5 | 26.4±3.1 | 30.0±3.5 | 18.1±2.2 | — | 18.1±2.2 | 2.2±0.4 | 27.2±3.0 | 29.9±0.8 |
| Free | | | | | | | | | |
| mL | 189±7 | 223±1 | 219±2 | 173±6 | — | 173±6 | 187±9 | 224±2 | 220±2 |
| %† | 6.0±0.7 | 48.8±2.1 | 54.7±2.6 | 33.3±1.0 | — | 33.3±1.0 | 3.9±0.5 | 44.1±1.3 | 48.0±1.7 |
| Paid | | | | | | | | | |
| mL | 232±5 | 223±5 | 229±2 | 218±4 | — | 218±4 | 240±5 | 242±6 | 241±1 |
| % | 1.1±0.12 | 12.0±1.3 | 13.1±1.3 | 6.4±0.5 | — | 6.4±0.5 | 0.9±0.1 | 11.5±0.9 | 12.4±0.9 |
| Grades 1–4 | | | | | | | | | |
| mL | 215±7 | 202±4 | 200±4 | 190±6 | — | 190±6 | 217±6 | 219±5 | 218±5 |
| %‡ | 4.2±0.8 | 29.8±3.9 | 34.0±3.9 | 19.6±2.5 | — | 19.6±2.5 | 3.7±0.75 | 25.9±3.6 | 29.6±3.6 |
| Grades 5–8 | | | | | | | | | |
| mL | 235±5 | 242±3 | 241±1 | 227±4 | — | 227±4 | 223±9 | 241±2 | 241±2 |
| % | 2.6±0.4 | 27.4±3.1 | 30.0±3.4 | 14.5±2.1 | — | 14.5±2.1 | 1.4±0.2 | 23.1±3 | 24.6±3.4 |

**Note:** Values shown are means ± SE. Data represented does not include school 1 as they offered a different serving size of milk compared with the other schools.

*There was significantly higher percentage of urban students for total milk and both milk choices (both plain and chocolate) in phase 1. In phase 3 the percentage of urban students choosing milk for total and chocolate milk was significantly higher than students in rural schools. Analysis was conducted using Krusakal–Walis, $p < 0.05$.

†Schools receiving milk for free had a significantly greater percentage of students choosing milk in all phases and categories than schools where students must pay for milk. Analysis was conducted using Krusakal–Walis, $p < 0.05$.

‡The percentage of younger students who chose milk more often in phase 2 was significantly greater; they also chose chocolate milk significantly more often in phase 3. Analysis was conducted using Mann–Whitney, $p < 0.05$.

**Table 4.** Milk consumption (servings/week) across the 3 phases from self-reported intakes in the BFQ.

| | Phase 1: plain and flavoured | Phase 2: plain only | Phase 3: plain and flavoured | *p* |
|---|---|---|---|---|
| **All students who completed the BFQ (*n* = 280)** | | | | |
| Total dairy consumption | 3.6±0.1 | 3.3±0.1 | 3.4±0.1 | 0.083 |
| Total milk consumption | 2.1±0.1 | 1.9±0.1 | 2.0±0.1 | 0.257 |
| Milk consumed at school | 0.5±0.1 | 0.4±0.1 | 0.5±0.1 | 0.331 |
| Flavoured milk consumed | 0.6±0.1 | 0.5±0.1 | 0.5±0.1 | 0.082 |
| **Students who chose milk in Phase 1 (*n* = 146)** | | | | |
| Total dairy consumption | 4.1±0.2a | 3.5±0.2b | 3.8±0.2a | 0.029 |
| Total milk consumption | 2.3±0.1a | 1.9±0.1b | 2.2±0.1a | 0.006 |
| Milk consumed at school | 0.8±0.1a | 0.6±0.1b | 0.8±0.1a | 0.001 |
| Flavoured milk consumed | 0.6±0.1 | 0.5±0.1 | 0.6±0.1 | 0.057 |

**Note:** Values shown are means ± SE. BFQ, Beverage Frequency Questionnaire. Means for variables without a common letter differ, $p < 0.05$.

as well as dairy (including cheese and yogurt) consumption across the 3 phases ($p = 0.147$).

The mean intake of the total milk (servings/day) according to BFQ administration was 2.1 ± 0.1, 1.9 ± 0.1 and 2.0 ± 0.1 at the end of phases 1, 2, and 3, respectively. Milk consumed at school accounted for approximately 24% of total daily milk consumption. When analysis was performed using just students who reported consuming milk at school, a significant reduction was found in the average number of servings of milk consumed at school at each phase (0.8 ± 0.1 at phase 1, 0.6 ± 0.1 at phase 2, and 0.7 ± 0.1 at phase 3, $p = 0.001$). Further, total servings of milk consumed per day decreased at phase 2 compared with phases 1 and 3 (2.3 ± 0.1 at phase 1, 1.9 ± 0.1 at phase 2, and 2.2 ± 0.1 at phase 3, $p = 0.006$).

## Age and milk consumption

No significant age differences were observed in the distribution of the total milk consumption across phases as well as for plain and CM consumption. For the students who chose to drink milk in phase 1, there was a significant difference in the distribution of the total milk consumption across ages in phase 2 ($p = 0.007$): 10-year-olds consumed milk most often and 14-year-olds consumed milk least often.

Males contributed 45.7% of the sample as determined through self-report on the BFQ. No significant sex difference was observed in any phase among the students who chose to drink milk at school or in the number of servings of milk consumed at school across all 3 phases.

## Grade and milk consumption

Grade 5 had the highest total usual milk consumption, and grade 7 the lowest across all 3 phases (data not shown). No significant difference in total milk intake across grades was observed for the 3 phases ($p = 0.420$, 0.187 and 0.903, respectively) as well as in number for servings of plain or CM by grade across the 3 phases ($p > 0.05$ for all tests). For the students who reported drinking milk at school in phase 1, their phase 2 milk consumption at school was significantly different by grade ($p = 0.012$) between the following pairs: grades 5 and 8, grades 6 and 7, and grades 6 and 8.

## Focus groups

Themes emerging from focus group discussions centered on factors that influenced milk intake in children: health, taste, environment (both physical and social), convenience, cost, routine/habit, and variety/choice. For *health*, children perceived milk to be a healthy beverage, but highlighted that too much fat and sugar is not good and, therefore, they felt some milk products may or may not be as healthy because of their higher amounts of sugar and fat. The concept of *taste* was consistently mentioned as important for milk consumption. Both the physical and social *environment* impacted children's ability to access and choose milk products. School and home were the main physical environments, and children were reliant upon adults in each place for purchase or provision of milk. Schools that were located close to convenience stores allowed students to purchase milk or other beverages on their own. The social environment, parents, grandparents, siblings, and friends influenced the availability and acceptability of choosing milk as a beverage. Additionally, the impact of role models such as public figures and teachers also arose.

Children noted that in many cases, the choice of drinking or not drinking milk depended on the *convenience* of finding milk at school, work, or home. The easier it was to access milk, the easier it was to consume milk. *Cost* was an issue as children do not like to use their own money for school milk, especially when white milk was available at home for free. Milk was identified as a staple beverage in most households and perceived as a *routine* comfort food. However, children expressed the need for *variety/choice* in their beverages.

## Discussion

Similar to Patterson and Saidel (2009) and Quann and Adams (2013) in the United States, we found that the removal of FM from school milk programs reduced overall milk consumption. The total consumption of milk decreased by 48%, and within a period of 4 weeks, no adaptation, such as drinking plain milk, was observed. The reduced milk consumption and greater waste in phase 2 when only plain milk was available may indicate that students were not used to drinking white milk at lunch time. These findings agree with the focus group findings wherein children highlighted the role of taste in determining whether or not they would consume any drink. It is in agreement with a recent study by De Pelsmaeker and colleagues (2013), which found that children prefer and consume more FM than plain milk with this decision being self-made and based on taste preference.

Cost was a crucial factor in how often children drank milk. In the quantitative portion of the study, in schools where milk was provided for free, 4 times as many students in schools drank milk than students from schools that required payment. The focus groups indicated that children noted that cost played a role in how much milk they would buy using their own money, and they also reported not liking to spend their own money on milk products. Sturm and Datar (2008) found that higher dairy prices lead to a decline in milk consumption. Nutrient modelling suggested that if those children who were unable to consume the FM they desire then the intake of important nutrients, such as protein, calcium, and vitamin D, would decline. Sufficient amounts of calcium and vitamin D are required during childhood and adolescence because a significant amount of adult bone mass is accrued during this time (Mughala and Khadilkarb 2011). Milk is a good source of both these nutrients. Nutrient modelling revealed that many nutrients would be reduced with CM restriction and replacement scenarios would not be efficient and convenient. Food combinations to replace the nutrients lost by removing CM from schools included scenarios such as tomato soup (250 mL, made with milk), salmon (75 g canned with bones), cheddar cheese (50 g), and spinach (125 mL cooked); or salmon (75 g canned with bones), carrots (125 mL cooked), spinach (125 mL cooked), yogurt (175 mL fortified fat-free with sugar substitute), and grapes (20–100 mg).

Results from the BFQ showed that students' total milk intake at home, or milk consumption at school, did not change across the study phases. This may be due to the majority of students not choosing milk every day. For the students who did consume milk at school, the BFQ revealed that the elimination of CM resulted in a reduction in milk consumption at school. Overall, there was a decline in total milk consumption. Total dairy consumption revealed that on average students were meeting the 3–4 servings per day recommended by Canada's Food Guide for 9- to 13-year-olds (Health Canada, 2007). Milk consumption made up approximately 57% of students' total dairy consumption, with milk consumed at school accounting for 13%–15% of total dairy consumed. Johnson et al. (1998) reported that only the children who consume milk at the noon-time meal approached the recommendation for calcium intake.

The urban/rural difference found in this research is confirmed by Minaker et al. (2006), who found that rural students consumed more milk than urban students. Age and grade had small differences but not in a consistent direction.

To our knowledge this is the first study in a Canadian elementary school population to investigate the effect of removing CM from schools. It is also the first study to examine the effects on total dairy intake and explore the reasons for milk flavour choice among elementary school students. One limitation was the assumption that each student consumed only 1 milk carton. Milk purchases might not be limited to 1 per day. Also even though data collectors received training in standardized measurement techniques there may still be inter-individual variations. Although the BFQ was developed to cover assess beverages consumed in childhood, some beverages may have been missed or misclassified by participants. Given that the BFQ was self-administered students, they may have under- or overestimated their intake. Additionally BFQs were not performed in younger students. As a higher percentage of younger students chose milk than older students, the elimination of CM may have had impacted their daily milk intake more than older students. Further, in the BFQ it was assumed that reported dairy intake represented 1 whole serving of dairy product. This may over or under represent the amount consumed per child.

In conclusion, while some schools may limit access to FM, presumably because of concerns that these beverages provide unhealthy levels of added sugars and fat, our study showed that when CM was removed the number of students choosing milk reduced by 41%. Additionally, of the students who chose plain milk there was a greater amount of milk wasted. Given children's preferential intake of CM, further studies into whether children will accept lower sugar formulations need to be investigated.

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## References

Caroli, A., Poli, A., Ricotta, D., Banfi, G., and Cocchi, D. 2011. Invited review: dairy intake and bone health: a viewpoint from the state of the art. J. Dairy Sci. **94**(11): 5249–5262. doi:10.3168/jds.2011-4578. PMID:22032348.

Condon, E.M., Crepinsek, M.K., and Fox, M.K. 2009. School meals: types of foods offered to and consumed by children at lunch and breakfast. J. Am. Diet. Assoc. **109**(2 Suppl.): S67–S78. doi:10.1016/j.jada.2008.10.062. PMID:19166674.

De Pelsmaeker, S., Schouteten, J., and Gellynck, X. 2013. The consumption of flavored milk among a children population. The influence of beliefs and the association of brands with emotions. Appetite, **71**: 279–286. doi:10.1016/j.appet.2013.08.016. PMID:24001396.

Drewnowski, A. 2011. The contribution of milk and milk products to micronutrient density and affordability of the U.S. diet. J. Am. Coll. Nutr. **5**(1): 422S–428S. doi:10.1080/07315724.2011.10719986. PMID:22081688.

Health Canada. 2007. Eating Well with Canada's Food Guide. Cat. no. H164-38/1-2007E. Health Canada, Ottawa, Ont., Canada.

Health Canada. 2010. Canadian Nutrient File. Health Canada, Ottawa, Ont, Canada. Available from http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index_e.html. [Accessed 9 March 2012.]

Iuliano-Burns, S., Whiting, S.J., Faulkner, R.A., and Bailey, D.A. 1999. Levels, sources, and seasonality of dietary calcium intake in children and adolescents enrolled in the University of Saskatchewan Pediatric Bone Mineral Accrual Study. Nutr. Res. **19**(10): 1471–1483. doi:10.1016/S0271-5317(99)00104-9.

Johnson, R.K., Panley, C., and Wang, M.Q. 1998. The association between noon beverage consumption and the diet quality of school-aged children. J. Child Nutr. Manag. **22**(2): 95–100.

Larson, N.I., Story, M., Wall, M., and Neumark-Sztainer, D. 2006. Calcium and dairy intakes of adolescents are associated with their home environment, taste preferences, personal health beliefs, and meal patterns. J. Am. Diet. Assoc. **106**(11): 1816–2431. doi:10.1016/j.jada.2006.08.018. PMID:17081833.

Lo, E., Coles, R., Humbert, M.L., Polowski, J., Henry, C., and Whiting, S.J. 2008.

Beverage intake improvement by high school students in Saskatchewan, Canada. Nutr. Res. **3**(28): 144–150. doi:10.1016/j.nutres.2008.01.005. PMID: 19083401.

Minaker, L., McCrager, L., Lambraki, I., Jessup, L., Driezen, P., Calengor, K., and Hanning, R.M. 2006. School region socio-economic status and geographic locale is associated with food behaviour of Ontario and Alberta adolescents. Can. J. Public Health, **97**(5): 357–361. PMID:17120872.

Moffat, T., and Galloway, T. 2008. Food consumption patterns in elementary school children. Can. J. Diet. Pract. Res. **69**(3): 152–154. doi:10.3148/69.3.2008.152. PMID:18783641.

Mughala, M.Z., and Khadilkarb, A.V. 2011. The accrual of bone mass during childhood and puberty. Curr. Opin. Endocrinol. Diabetes Obes. **18**: 28–32. doi:10.1097/MED.0b013e3283416441. PMID:21102321.

Murphy, M.M., Douglass, J.S., Johnson, R.K., and Spence, L.A. 2008. Drinking flavored or plain milk is positively associated with nutrient intake and is not associated with adverse effects on weight status in US children and adolescents. J. Am. Diet. Assoc. **108**(4): 631–639. doi:10.1016/j.jada.2008.01.004. PMID: 18375219.

Nicklas, T.A., O'Neil, C.E. and Fulgoni, V.L., III. 2013. The nutritional role of flavored and white milk in the diets of children. J. Sch. Health, **83**(10): 728–733. doi:10.1111/josh.12087. PMID:24020687.

Patterson, J., and Saidel, M. 2009. The removal of milk in schools results in a reduction in total milk purchases in grades K-12. J. Am. Diet. Assoc. **109**(9): A97. doi:10.1016/j.jada.2009.06.330.

Quann, E.E., and Adams, D. 2013. Impact on Milk consumption and nutrient intakes from eliminating flavored milk in elementary schools. Nutr. Today, **48**(3): 127–134. doi:10.1097/NT.0b013e3182941d6a.

Rangan, A.M., Flood, V.M., Denyer, G., Webb, K., Marks, G.B., and Gill, T.P. 2012. Dairy consumption and diet quality in a sample of Australian children. J. Am. Coll. Nutr. **31**(3): 185–193. doi:10.1080/07315724.2012.10720026. PMID:23204155.

Sturm, R., and Datar, A. 2008. Food prices and weight gain during elementary school: 5 year update. Public Health, **122**(11): 1140–1143. doi:10.1016/j.puhe.2008.04.001. PMID:18539306.

Vatanparast, H., and Whiting, S.J. 2006. Changes in food sources and intake of calcium from childhood to early adulthood in the University of Saskatchewan Pediatric Bone Mineral Accrual Study. Osteoporos. Int. **17**(Suppl. 2): S162.

Vatanparast, H., and Whiting, S.J. 2007. Beverage consumption in children and the health consequences: an alarming trend. *In* Child Nutrition Research Advances. *Edited by* L.V. Carter. Nova Science Publishers. Inc., Hauppauge, N.Y., USA. pp. 89–110.