## APPLICATIONS

■ A listserv offers a practical and innovative way to teach, learn, and communicate for dietetic interns who are participating in supervised practice rotations at remote sites. A listserv may provide the same advantages regardless of location.
■ Future research should compare responses between interns in the Coordinated Program and the Dietetic Internship Program, evaluate student-led discussions in a classroom setting vs those on the listserv, and compare intern reactions to increased faculty time on the listserv vs increased faculty time visiting sites.


**References**

**1**. Sutherland LA. Nutrition professionals in cyberspace: getting wired for the new millennium. *J Am Diet Assoc.* 1999;99:1365-1366.
**2.** Palumbo C. Using new technology for nutrition counseling. *J Am Diet Assoc.* 1999;99:1363-1364.
**3.** Cotugna N, Vickery CE. Use of computer-based patient records in dietetics supervised practice programs. *J Am Diet Assoc.* 2000;100:95-97.
**4.** Litchfield RE, Oakland MJ, Anderson JA. Improving dietetics education with interactive communication technology. *J Am Diet Assoc.* 2000;100:1191-1194.
**5.** Barker AM, Arensberg MF, Schiller MR. *Leadership in Dietetics: Achieving a Vision for the Future.* Chicago, Ill: American Dietetic Association; 1994.
**6.** Fast Company Website. Available at: http://www.fastcompany.com. Accessed: January 14,1999.
**7.** Davis MJ, Wythe J, Rozum JS, Gore RW. Use of world wide web server and browser software to support a first-year medical physiology course. *Am J Physiol.* 1997;17(suppl):S1-S14.
**8.** Roper FW. Surveying knowledge and skills in the health sciences: results and implications. *Bull Med Libr Assoc.* 1993;81:396-407.
**9.** Barber K, Wyatt K, Gerbasi F. On-line interactive evaluation in course and clinical instruction. *Nurs Educ.* 1999;24:37-40.
**10.** Delcourt MAB, Kinzie MB. Computer technologies in teacher education: the measurement of attitudes and self-efficacy. *J Res Dev Educ.* 1993;27:35-40.
**11.** Cravener PA. Faculty experiences with providing online courses: thorns among the roses. *Comp Nurs.* 1999;17:42-47.
**12.** Ellenchild Pinch WJ, Graves JK. Using web-based discussion as a teaching strategy: bioethics as an exemplar. *J Adv Nurs.* 2000;32:704-712.


# The nutritional consequences of flavored-milk consumption by school-aged children and adolescents in the United States

*RACHEL K. JOHNSON, PhD, MPH, RD; CAROL FRARY, MS, RD; MIN QI WANG, PhD*

Children in the United States are drinking less milk because they are drinking more of other beverages such as soft drinks and fruit drinks (1-3). This decline in milk consumption may have serious, long-term, detrimental effects on the bone health of today's youth (4,5). Milk and dairy products provide the most important source of calcium in children's diets and account for 75% of the calcium in the US food supply (6). According to the US Department of Agriculture (USDA), 90% of teenage girls and 70% of teenage boys do not meet current calcium recommendations of 1,300 mg per day (7). The changes in children's milk consumption patterns have been attributed to a number of phenomena. Massive marketing of soft drinks as "fun" food (8) and increased competition for milk in schools from beverages that can generate greater profit (9) have undoubtedly contributed to the changes.

Flavored milk has the potential to increase children's milk consumption in school and at home. In a large school district in Georgia, a 15% gain in milk consumption resulted from the introduction of nonfat strawberry and vanilla milk (personal communication, G. Schulz, MEd, RD, Gwinett County School Nutrition Program, June 2, 2000). Some school nutrition personnel and parents are reluctant to offer children flavored milk, however, based on the perception that it will have a negative impact on the overall quality of children's diets. Specifically, concern is expressed that flavored milk increases added sugar consumption and could lead to lower total milk consumption resulting from children developing a taste preference or dependence for the flavored milk. Previous research conducted among Pennsylvania elementary school children demonstrated that including chocolate milk in school meals was well justified from the standpoint of nutrient intake (10). This research is now more than 20 years old, however, and was conducted using a relatively small sample of children in a limited geographic area. There is a need for contemporary research using a large, nationally representative sample of children in the United States to determine the nutritional consequences of flavored-milk consumption.

## METHODS

### Research Sample

The research sample was selected from all children aged 5 to 17 years participating in the 1994-96 and 1998 USDA Continuing Survey of Food Intakes of Individuals (CSFII) and for whom 2 complete days of dietary intake data were available (11). The surveys used a multistage, area probability sample designed to reflect the racial, geographic, and sociodemographic diversity of the US population. Sample weights developed by the USDA to compensate for variable probabilities of selection, differential nonresponse rates, and sampling frame considerations were used. This allowed for the generalization of the

*R. K. Johnson is a professor of nutrition and dean in the College of Agriculture and Life Sciences and C. Frary is a research assistant in the Department of Nutrition and Food Science at The University of Vermont, Burlington. M. Q. Wang is a professor in the Department of Public and Community Health, The University of Maryland, College Park.*

*Address correspondence to: Rachel K. Johnson, College of Agriculture and Life Sciences, The University of Vermont, Burlington, VT 05405. E-mail: rachel.johnson@uvm.edu.*

**Table 1**
Mean total milk[a], soft drink[b], fruit drink[c], and fruit juice[d] consumption in grams by level of flavored-milk[e] consumption by school-aged children (aged 5 to 11 years, n=2,763) and adolescents (aged 12 to 17 years, n=1,125), adjusted for total energy intake, age, sex, and race

| | Flavored-milk consumption of childred aged 5 to 11 years | | | Flavored-milk consumption of adolescents aged 12 to 17 years | | |
|---|---|---|---|---|---|---|
| | Nonconsumer (n=2,001) | >0 and ≤240 g (n=562) | >240 g (n=200) | Nonconsumer (n=883) | >0 and ≤240 g (n=155) | >240 g (n=87) |
| Total milk (g) | 325[x] | 404[y] | 517[z] | 262[x] | 382[y] | 539[z] |
| Soft drink (g) | 174[x] | 139[y] | 147[y] | 470[x] | 346[y] | 343[y] |
| Fruit drink (g) | 154[x] | 116[y] | 102[y] | 165[x] | 154[x] | 107[y] |
| Fruit juice (g) | 49[x] | 37[x] | 47[x] | 33[x] | 24[x] | 40[x] |

[a]Total milk includes all beverages with fluid cows' milk as the primary ingredient. Items such as evaporated milk and dry, reconstituted milk were included. Items such as canned meal replacements and infant formulas were excluded, as well as nonbeverage forms of milk such as yogurt, pudding, and ice cream.
[b]Soft drink includes all regular-calorie carbonated beverages, such as cola, fruit-flavored soft drink, and cream sodas.
[c]Fruit drink includes punch, ade, and drinks that include <10% fruit juice.
[d]Juice includes fruit juice, nectar, citrus fruit, and mixture of citrus juice with noncitrus juice.
[e]Flavored milk includes milk with powder or syrup flavoring, milkshake, malted milk, milk drink, eggnog, and *Carnation instant breakfast* (not specific to flavor or milk type) (Nestlés, North Brunswick, NJ).
[x,y,z]Means in a row with different superscripts are significantly different ($P \leq .05$).

**Table 2**
Mean nutrient intakes by level of flavored-milk consumption for school-aged children (aged 5 to 11 years, n=2,763) and adolescents (aged 12 to 17 years, n=1,125), adjusted for total energy intake, age, sex, and race

| | Flavored-milk consumption by school-aged children | | | Flavored-milk consumption by adolescents | | |
|---|---|---|---|---|---|---|
| | Nonconsumer (n=2,001) | >0 and ≤240 g (n=562) | >240 g (n=200) | Nonconsumer (n=883) | >0 and ≤240 g (n=155) | >240 g (n=87) |
| Vitamin A (RE[a]) | 910.9[x] | 886.7[x] | 871.3[x] | 898.4[x] | 892.5[x] | 735.4[y] |
| Vitamin C (mg) | 99.3[x] | 85.7[y] | 89.1[y] | 103.0[x] | 104.2[x] | 93.2[x] |
| Folate (mg) | 270.0[x] | 264.0[x] | 239.2[y] | 260.6[x] | 275.9[x] | 261.4[x] |
| Calcium (mg) | 877.1[x] | 932.0[y] | 997.1[z] | 924.7[x] | 1,000.1[y] | 1,067.1[z] |
| Phosphorus (mg) | 1,157.2[x] | 1,190.2[y] | 1,244.6[z] | 1,331.5[x] | 1,380.0[x] | 1,446.9[y] |
| Cholesterol (mg) | 204.8[x] | 213.6[x] | 206.3[x] | 262.0[x] | 238.6[x] | 212.6[y] |
| Figer (g) | 12.6[x] | 12.5[x] | 13.1[x] | 14.2[x] | 14.9[x] | 17.4[y] |
| Added sugars (g) | 84.8[x] | 86.2[x] | 90.2[x] | 117.6[x] | 115.1[x] | 109.9[x] |
| % kcal total fat | 32.3[x] | 33.1[x] | 32.1[x] | 32.7[x] | 33.3[x] | 31.7[x] |
| % kcal saturated fat | 11.8[x] | 12.2[y] | 12.2[y] | 11.5[x] | 11.8[x] | 11.6[x] |

[a]RE=retinol equivalents.
[x,y,z]Means in a row with different superscripts are significantly different ($P \leq .05$).

study results to all children in the United States aged 5 to 17 years.

The dietary intake data were collected as 2 in-person, 24-hour multiple-pass recalls. This dietary intake method has been demonstrated to provide valid measures of dietary intake for groups of children (12). For purposes of analysis, the sample was divided into 2 groups: school-children 5 to 11 years of age and adolescents aged 12 to 17 years.

## Study Variables

The independent variable was 2-day mean flavored-milk intake. All food codes in the CSFII database where the primary ingredient was flavored fluid cows' milk in beverage form were included. Nonbeverage forms of flavored milk (eg, strawberry yogurt, vanilla pudding, and chocolate ice cream) were excluded. The total intake in grams per sample child was calculated, and from this a 2-day mean intake was determined. For each age group, 3 categories of flavored-milk intakes were established: nonconsumers, >0 and ≤240 g, and >240 g.

The dependent variables in the study were 2-day mean intakes of total milk, soft drinks, sugar-sweetened fruit drinks and ades (<10% fruit juice), and fruit juices. Table 1 provides definitions of the beverage categories. Intakes of vitamins A and C, folate, iron, calcium, and phosphorus were examined. Cholesterol, fiber, and added sugars intakes, as well as percent energy from total and saturated fat, were examined.

## Statistical Analysis

The Statistical Export and Tabulation System (SETS) software was used to convert the CSFII data contained in a CD-ROM to a usable format. The Statistical Analysis System was used to recode and format the data for statistical analysis. The Survey Data Analysis System (SUDAAN, release 6.40, 1995, Research Triangle Institute, Research Triangle Park, NC) was used to weight the sample, compute variances, and perform the statistical procedures. Analysis of covariance was used to determine the net effect of flavored-milk consumption on the dependant variables. Child age, sex, race, and total energy intake were entered as control variables to account for variations in the dependent variables that might otherwise be attributable to the control variables. Statistical significance for all analyses was set at $P<.05$.

## RESULTS AND DISCUSSION

### Description of the Sample

The total sample size was 3,888 (n=2,763 school-aged children and n=1,125 adolescents), and it was distributed approximately evenly between boys and girls (51.6% boys). By design, the sample was representative of the US population of children and adolescents aged 5 to 17 years.

### Total Intakes of Milk, Soft Drink, Fruit Drink, and Fruit Juice

On average, the school-aged children consumed 358 g total milk per day, and the adolescents consumed 301 g per day. These averages included 174 school-aged children and 269 adolescents who did not consume any milk (total milk intake=0) over the 2-day survey period. In contrast, on average, the school-aged children consumed 53 g flavored milk per day, and the adolescents consumed 47 g per day. These averages included 935 school-aged children and 508 adolescents who did not consume any flavored milk (flavored-milk intake=0), which skewed the mean toward zero.

Flavored-milk intake was significantly ($P<.05$) and positively associated with total milk intake in both age groups (Table 1). On average, those children who consumed more than 1 cup of flavored milk per day had a total milk intake that was 192 g higher for children 5 to 11 years of age and 277 g higher for adolescents 12 to 17 years of age than the children in the respective age groups who were nonconsumers of flavored milk. Among the school-aged children and adolescents, flavored-milk intake was not associated with fruit juice intake and was significantly ($P<.05$) and negatively associated with soft drink and fruit drink consumption (Table 1).

### Nutrient Intakes

Flavored-milk intake was positively associated with energy-adjusted calcium, phosphorus, and percent energy from saturated fat intakes and negatively associated with energy-adjusted vitamin C and folate intakes in the children aged 5 to 11 years (Table 2). Flavored-milk intake was positively associated with energy-adjusted calcium, phosphorus, and fiber intakes and negatively associated with energy-adjusted vitamin A intakes in the adolescents aged 12 to 17 years. There was no association between flavored milk intake and percent kilocalories from saturated fat among adolescents. There was no association between flavored-milk consumption and percent energy from total fat and energy-adjusted added sugars intakes in either age group (Table 2).

This study was the first to our knowledge that examined the nutritional consequences of flavored milk in a representative sample of school-aged children and adolescents in the United States. The major findings were:

- Children who consumed flavored milk had higher total milk intake and lower soft drink and fruit drink intake but similar fruit juice intake compared with children who were nonconsumers of flavored milk; and
- Children who consumed flavored milk had higher calcium intakes but similar percent energy from total fat and added sugars intake compared with children who were nonconsumers of flavored milk.

Flavored milks offer a well-accepted, nutritious alternative in the wide array of beverages available to children in the United States

The observations that flavored milk did not increase added sugars intake was in all likelihood the result of lower intakes of soft drinks and fruit drinks by the children who consumed flavored milk. Guthrie and Morton (2) found that soft drinks were the major source of added sweeteners in the diets of children in the United States. Fruit-ades and drinks also accounted for a substantial portion of the total added sugars in children's diets. Together these beverages accounted for 34% of total added sugars intake for children aged 6 to 11 years, 48% of adolescent girls' intake, and 53% of adolescent boys' intake (2). Hence, it is not surprising when consumption of flavored milks reduces the intake of these nutrient-poor, sugar-sweetened beverages, there is no overall impact on total added sugars intake.

There are a number of studies demonstrating the important role that beverage choices play in the adequacy of children's diets. We previously demonstrated that only those children who include milk at the noontime meal achieve their recommended calcium intake (3). Harnack and colleagues (1) studied the nutritional consequences of soft drinks consumption and found that children and adolescents who were high consumers of soft drinks had lower intakes of riboflavin, folate, vitamins A and C, calcium, and phosphorus. Lastly, researchers who examined changes in children's eating patterns and food choices in a longitudinal, cohort study of Minnesota children found that as children moved from elementary school to junior high, the proportion of beverage coming from soft drinks more than tripled with concomitant reductions in milk and fruit juice consumption (13).

Tests of school vending machines conducted in 2001 demonstrate that low-fat and nonfat, flavored milks are a popular and feasible alternative to soft drinks and fruit drinks (7). Initial trials where milk vending machines were installed in middle and high schools have shown promising results with machines selling out on a daily basis (14). Chocolate was the preferred flavor, and although unflavored milk was available, it was typically the least popular.

## APPLICATIONS

Flavored milks can play a role in changing recent trends in children's sugar-sweetened beverage consumption patterns that have a negative impact on their diet quality. Flavored milks offer a well-accepted, nutritious alternative in the wide array of beverages available to children in the United States.

### References

**1.** Harnack L, Stang J, Story M. Soft drink consumption among US children and adolescents; nutritional consequences. *J Am Diet Assoc.* 1999;99:436-441.

**2.** Guthrie JF, Morton JF. Food sources of added sweeteners in the diets of Americans. *J Am Diet Assoc.* 2000;100:43-51.

**3.** Johnson RK, Panely C, Wang MQ. The associa-

tion between noon-time beverage consumption and the diet quality of school-aged children. *J Child Nutr Mgmt.* 1998;2:95-100.

**4.** Wyshak G, Frisch RE. Carbonated beverages, dietary calcium, the dietary calcium/phosphorus ratio, and bone fractures in girls and boys. *J Adolesc Health.* 1994;15:210-215.

**5.** Wyshak G. Teenaged girls, carbonated beverage consumption, and bone fractures. *Arch Pediatr Adolesc Med.* 2000;154:610-613.

**6.** Kennedy E, Goldberg J. What are American children eating? Implications for public policy. *Nutr Rev.* 1995;53:111-126.

**7.** CD-ROM: CSFII 1994-96, 1998 DATA SET. Web site:http://www.barc.usda.gov/bhnrc/foodsurvey/pdf/scc_all.pdf. Accessed: April 24, 2002.

**8.** Jacobson MF. Liquid Candy; how soft drinks are harming Americans' health. Washington, DC: Center for Science in the Public Interest; 1998.

**9.** Foods sold in competition with USDA school meal programs: Report to Congress. http://www.fns.usda.gov/cnd/Lunch/CompetitiveFoods/competitive.foods.reprt.to. congress.htm. Accessed February 9, 2001. Washington, DC: US Dept of Agriculture; 2001.

**10.** Guthrie HA. Effect of a flavored milk option in a school lunch program. *J Am Diet Assoc.* 1977;71:35-40.

**11.** Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96. USDA Web site: http://www.barc.usda.gov/bhnrc/foodsurvey/cd98.html. Accessed: April 24, 2002.

**12.** Johnson RK, Driscoll P, Goran MI. Comparison of the multiple-pass 24-hour recall method with total energy expenditure by doubly labeled water in young children. *J Am Diet Assoc.* 1996;96:1140-1144.

**13.** Lytle LA, Seifert S, Greenstein J, McGovern P. How do children's eating patterns and food choices change over time? Results from a cohort study. *Am J Health Promot.* 2000;14:22-228.

**14.** Drinking it up: milk doing well in school vending machines. *Health News*. http://www.intelihealth.com/IH/ihtIH/WSIHW000/333/8015/315711. Accessed April 5, 2001.

*This research was funded by the National Dairy Council.*