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Need for Specific Sugar-Sweetened Beverage Lessons for 4th and 5th Graders

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Abstract

Objective—Consumption of sugar-sweetened beverages (SSB) is linked to obesity. We hypothesized that school-based nutrition education would decrease SSB consumption.

Design—Self-selected interventional cohort with random selection for pre and post measurements

Setting—Arizona SNAP-Ed eligible schools

Participants—Randomly selected (9%) 4th and 5th grade classroom students

Intervention—The University of Arizona Nutrition Network (UANN) provided general nutrition education training and materials to teachers, to be delivered to their students. The UANN administered behavioral questionnaires to students in both Fall and Spring.

Main Outcome Measure(s)—Change in SSB consumption

Analyses—Descriptive statistics were computed for student demographics and beverage consumption on the day prior to testing. Paired t-tests evaluated change in classroom averages. Linear regression assessed potential correlates of SSB consumption.

Results—Fall mean SSB consumption was 1.1 (± 0.2) times; mean milk and water intake were 1.6 (± 0.2) and 5.2 (± 0.7) times, respectively. Beverage consumption increased (3.2%) in springtime, with increased SSBs (14.4%) accounting for the majority ($p=0.006$). Change in SSB consumption was negatively associated with baseline SSB and water consumption, but positively associated with baseline milk fat ($p=0.05$).

Conclusions and Implications—The results suggest the need for beverage specific education to encourage children to consume more healthful beverages in warmer weather.

Keywords

Supplemental Nutrition Assistance Program; SNAP-Ed; nutrition education; SSB; school

INTRODUCTION

Childhood obesity remains a pressing public health concern in the United States. Fifteen percent of U.S. children aged 6–11 years are obese.¹ An additional 30% of children are at risk of becoming overweight or obese.² Obesity is associated with early onset of type 2 diabetes in youth³ and comorbidities throughout the lifespan,⁴ which have serious health implications for individuals, the medical and public health systems, and society.

There have been dramatic shifts in beverage consumption patterns in the United States in the last 30–50 years. Sugar-sweetened beverages (SSB) have gained prominence in various forms including soft drinks, both carbonated and noncarbonated, fruit drinks (not 100% juice), vitamin and other sugared waters, energy drinks, and more. Although SSB consumption has declined slightly since its peak in 2000, consumption among youth is approximately two times what it was in the 1970s and SSB consumption triples between the ages of 2–6 and 13–18 years of age.⁵ Limited data also suggest that unflavored milk intake among young children has declined while flavored (sugar-sweetened) milk and fruit juice have increased.⁶ These trends are clinically relevant due to SSB consumption links to obesity through the excess caloric intake,^{7,8} as well its displacement of more nutritive foods in an individual's diet.⁹ Emerging evidence also demonstrates associations between SSBs and adverse cardiometabolic profiles in children.^{10,11} These types of outcomes imply that an individual's beverage consumption patterns early in life may have lasting effects throughout the life span.⁶

Emerging research in the U.S. and other nations suggests that reducing SSB intake at school and at home may diminish excess weight gain among youth.¹² The largest percentage (36%) of added sugars in the American diet derives from soda, energy drinks, and sports drinks;

thus, the U.S. Dietary Guidelines for Americans recommend limiting one's intake of SSBs.¹³ Multiple calls to action, particularly targeting low income individuals, have been issued in the U.S. and other nations to attempt to address the problem of excess SSB intake in youth (Child Nutrition and WIC Reauthorization Act of 2004;¹⁴ WHO 2010 resolution WHA63.14¹⁵), including reducing the availability of SSBs in schools with the intent to decrease obesity.¹⁶ However, little is known about the impact of nutrition education on overall fluid intake in youth.

The aim of the present study was to evaluate change in beverage consumption patterns in 4th and 5th grade classrooms that qualified for the Supplemental Nutrition Assistance Program-Education Program (SNAP-Ed). It was hypothesized that general nutrition education would result in decreased SSB consumption in favor of milk and water consumption. Correlates of SSB consumption were explored.

METHODS

Study Design

This study utilized a self-selected intervention cohort, with random selection for pre and post measurements. Change in beverage consumption patterns following periodic general nutrition education among 4th and 5th graders was assessed. The cohort was defined as SNAP-Ed eligible elementary schools that partnered with the University of Arizona Nutrition Network (UANN) to provide nutrition education at the schools. The UANN utilizes the train-the-trainer model (TTT) model to provide age appropriate general nutrition education to teachers, administrators, and staff,¹³ as well as direct nutrition education to students by a professional nutrition educator. The study was limited to the partner schools in 5 of 7 counties served by the UANN that used the same delivery model, TTT, and logged nutrition education hours with the UANN according to the national SNAP-Ed reporting requirements for the Education and Administrative Reporting System (EARS). The 2 excluded counties either a) employed direct nutrition education only or b) had not yet obtained relevant tribal human subjects protection program approval. Other counties in the state, not served by the UANN either did not receive SNAP-Ed services or received them from local health departments that used diverse delivery models.

The TTT model provided teachers, administrators, and staff with state health department approved training, lessons, and materials. It guided them to integrate nutrition education into multiple school settings such as: math, reading, art, music, science, and other lessons; classroom, cafeteria, and school-wide activities; signage, menus, and handouts; and classroom or public address (PA) system school-wide announcements. The TTT model was tailored according to the readiness of the school, teachers, and staff to maximize trainer implementation. Educational materials were derived from state health department approved evidence-based curricula, individual lessons, presentations, handouts, and other supportive educational tools in alignment with the USDA guidelines. The USDA guidelines and tip sheets, as well as the state approved materials included the recommendation that one should limit intake of SSBs,¹³ but at the time of the study, there was not an approved SSB specific curricula or beverage specific set of activities.

The frequency, intensity, and duration of programming varied from classroom to classroom and school to school based on the tailored approach. On average, new materials and lessons were provided to the schools on a monthly basis after a minimum of 1–2 hours of initial training. The types of resources provided were gauged locally based on site readiness and the need for technical support following the initial training and included any or all of the resources or contact types listed in Table 1. Monthly attempts to increase engagement and advance services in schools that were in the initial stages of program implementation were made via email or phone. In an end of year sub-study of 2 of the counties, 89% percent of educators confirmed that they had received resources from their UANN program representative at least once per month during the school year (unpublished data). Participating schools submitted hours dedicated to nutrition and nutrition-integrated physical activity monthly, in alignment EARS topics. Topics tracked by EARS included: A-Fat Free and Low Fat Milk or Equivalent (and alternative calcium sources); B-Fats and Oils; C-Fiber-Rich Foods; D-Food Shopping/Preparation; E-Fruits and Vegetables; F-Lean Meat and Beans; G-Limit Added Sugars or Caloric Sweeteners; H-MyPyramid/MyPlate - Healthy Eating Plan; I-Physical Activity Lesson/Demonstration; J-Promote Healthy Weight; K-Sodium and Potassium; L-Whole Grains; M-Food Safety; N-Other - Breast Feeding; O-Other - Folic Acid; P-Other - All content areas; Q-Other – Hydration.

Once all participating classrooms were identified in the 5 counties from historical time logs, the UANN randomly selected 8% of 4th and 5th grade classrooms, with a minimum output of 2 classrooms per UANN county level team forced into the randomization model. The final yield was 9% of UANN classrooms (N=46 classrooms) (Figure 1). Teachers in selected classrooms were invited to participate in the administration of a brief survey to the children in their classroom.

Survey Instrument and Proctoring

The Youth Nutrition and Physical Activity Survey combined validated questions from 2 age appropriate surveys with good validity and reliability. Nutrition questions were adapted from the School Physical Activity and Nutrition survey and physical activity questions from the Day in the Life Questionnaire.^{17–21} The combined survey (N=21 questions) was reviewed by nutrition experts at the University of Arizona for content face validity, feasibility, and survey layout. It was tested for clarity and interpretation using a convenience sample of 3 recreation groups participating in the UANN summer programs. The protocol, instructions, and scripts were assessed with these pilot groups. Based on feedback from teachers, staff and participants, modifications were made to the protocol and questions. Surveys were then administered across Arizona by the UANN staff or classroom teachers in the Fall and Spring (October–December 2011 and April– May 2012 respectively).

A protocol and script were provided and used by all proctors to ensure consistent survey administration across all classrooms. Children were informed that the survey was anonymous, voluntary, could be filled out in part, in full, or not at all, and that it would not affect their grades in school or ability to participate in school or the UANN program activities. When students stated that they had finished their surveys or stopped working on them, they were collected, with no attempt to review surveys for completeness during the

proctoring period. Total administration time was approximately 20 minutes. The usual nutrition education supported by the UANN was delivered during the interceding months via the TTT model. The UANN support of nutrition education in all schools remained stable regardless of study participation status.

Surveys were scheduled Tuesdays through Fridays, and none followed a school holiday, to target remembrance of a “normal” weekday. All behavior questions were phrased similarly, referring to “yesterday”, and had mutually exclusive multiple-choice (MC) answer options. For example, “Yesterday, did you drink any regular (non-diet) soda, punch, Kool-Aid®, sports drinks, or other fruit-flavored drinks? Do not count 100% fruit juice.” Answer options included 0, 1, 2, and 3 or more times “yesterday”. Beverage consumption frequency questions included milk, water, and SSBs on the prior day. The survey also evaluated type of milk consumed, classified as whole, 2%, 1% or fat free, or non-dairy milk. Non-drinkers and those that did not know the type of milk they consumed were also captured. Students were queried regarding fruit, vegetable, and whole grain consumption. After-school activity and physical education (PE) answer options were presented in 30-minute increments in an MC format. Break times and transportation to and from school had categorical answer options of sit, stand, walk, or run for break and by walking, bicycle, bus, or car for transportation. They were classified by active versus passive for analysis. Recognition of US vegetable, fruit, whole grain, and physical activity recommendations was measured.¹³ The study protocol and instrument were reviewed by the University of Arizona Institutional Review Board and designated as exempt prior to the initiation of the study.

Data Analysis

Descriptive statistics were computed for student demographics and beverage consumption on the prior day. Due to the anonymous nature of the questionnaires, paired t-tests were used to evaluate change in classroom averages between Fall (pre) and Spring (post), rather than change in individual behaviors. Models were weighted by the pre-survey class size. Regression models, to assess correlates of change in SSB consumption, were constructed by individual behavior and knowledge variables. Individual variables associated with change in SSB consumption, at the $p=0.2$ level, were placed in a backward step-wise regression model together. The model with the greatest adjusted R^2 value and significance is presented. Only surveys that were 90% complete were included in the analyses. No data were imputed for skipped questions and questions with unintended multiple answers were excluded from analyses. To normalize data distribution, milk consumption frequency was transformed using the Square Root and water was log transformed. Significance was set at $p<0.05$. Stata version 10.1 (2008; College Station, TX) and SAS version 9.3 (2011; Cary, NC) were used for all statistical analyses.

RESULTS

Nearly 3/4 of the 4th and 5th grade classrooms selected for participation completed the survey process for both Fall and Spring (Figure 1). Ninety-eight percent of the pre- and post-nutrition education surveys were included in the analyses. At baseline, 51% of the children were female (49% female at follow-up) and 71% were 4th graders. The mean age at baseline was 9.7 years (± 0.7), which increased at follow-up (10.1 yrs ± 0.7 ; $p<0.0001$).

Mean frequency of SSB consumption on the previous day was 1.1 times (± 0.2) in the Fall. Milk was consumed 1.6 (± 0.2) times and water was consumed 5.2 (± 0.7) times. The Fall sum of mean SSB, milk, and water was 7.8 times (± 0.9). In the Spring, SSB and milk consumption frequency increased ($p < 0.05$), without significant changes in water or total beverages (Figure 2). Table 2 demonstrates these changes relative to baseline value of the respective beverage (%). The significant increase in SSB consumption accounted for the greatest relative proportion of the overall change in beverage consumption. Differences between counties were observed for total beverage intake, but not for other categories ($p < 0.05$). Overall, the prevalence of any amount of SSB consumption increased between Fall and Spring (66.6% to 71.1%). This reflects a decrease in those not consuming any SSBs and those consuming SSBs 1 time the prior day in the Spring compared to the Fall (No SSBs: 33.4% to 29.0%; 1 SSB: 39.9% to 37.2%). SSB consumption of 2 times (15.2% to 19.7%) and 3 times or more increased (11.5% to 14.1%). As a percent of total beverage intake, milk was 20.2% at baseline and 20.6% at follow-up. Water was 66.5% at baseline and 64.5% at follow-up. The SSB intake was 13.4% at baseline and 14.8% at follow-up.

Correlates of change in SSB consumption over the survey period are represented in Table 3. The final regression model explained 57% of the variance. Several variables emerged as independently predictive of change in SSB consumption. Change in SSB intake was negatively associated with baseline SSB consumption ($p < 0.001$) and water consumption ($p = 0.01$), but positively associated with milk fat consumption (i.e. type of milk selected; $p = 0.05$). Change in SSB consumption between Fall and Spring was positively associated with accurate knowledge of required vegetable intake for the age group and negatively associated with underestimation of required fruit intake ($p = 0.05$).

DISCUSSION

It was hypothesized that general nutrition education would result in decreased SSB consumption in favor of milk and water consumption. In contrast, nutrition education encompassing the breadth of the USDA recommendations did not positively affect SSB consumption in this sample. A non-significant increase in overall beverage consumption between Fall and Spring was driven by a significant increase in SSB consumption. Increased beverage consumption in warmer months is expected, however, increased water intake is preferable.

These results are not unique. Regular, unsweetened milk intake declined and sugar-sweetened milk and fruit juice consumption have increased among young children over the past few decades.⁶ Other studies have shown over 50% of total beverages consumed by 4th-6th graders were sugar sweetened²² and an approximate tripling of soda and fruit drink consumption between pre-school and high school years. These data reinforce the window of opportunity for nutrition education in elementary school aged children. Although more recent data demonstrates a corrective trend in SSB intake from the peak earlier in the century, children aged 6–12 years still drink daily sodas (45%), fruit drinks (35%), and sports drinks (7%).²³ If these data represented different individuals, then consumption of combined SSBs in 70% of the 4th and 5th grade children in the present study is consistent with the NHANES report. In the present study, milk consumption was aligned with the

recent US estimates among children 6–12 years of age (13 ounces) if it is assumed that each “time” milk was consumed represented an 8oz serving size.^{23, 24}

This study explored correlates of SSB consumption to aid in hypothesis generation for future studies targeting SSB consumption and found that several baseline knowledge and behavior variables were associated with change in SSB consumption over the school year. These results differ from other published studies in that there were observed associations related to change in SSB consumption rather than cross-sectional associations, but the data were in alignment with cross-sectional findings. For example, baseline selection of higher fat milk, an energy dense food, associated with increased SSB consumption over the year, which is consistent with prior research showing that energy dense food consumption tracks with higher SSB consumption.⁸ Cullen et al²² found similar positive correlations between of 4th – 6th grade SSB consumption and high fat vegetable consumption, as well as negative SSB associations with fruit consumption. In the present study, change in SSB consumption was not associated with fruit consumption itself, but it was associated with knowledge of the guidelines for fruit and vegetable consumption.

In addition to comparisons with other studies, the strengths and limitations of this study should be considered when interpreting the results. Multisite, random selection of the UANN participating classrooms in diverse regions was a strength of the study, which supports generalizability across Arizona 4th and 5th graders. Another strength of the study was the reading and comprehension level appropriate survey instrument. Limitations included: modest sample size (n=33 classrooms) and age range; combined beverage consumption categories on the survey instrument; difficulty in identifying 100% juice drinks among youth; insufficient detail in the educational logging system; and lack of control groups. The study did not include control groups to eliminate delay or withholding of entitlement services in qualified schools and to avoid introducing gross demographic differences in non-qualifying schools. The delay of services in some schools or use of non-qualifying schools as controls are relevant options, but funding such a study can be difficult. The following study limitations may be viewed as strengths: lack of serving size information is a limitation, yet, elementary school children have difficulty identifying serving sizes without parental assistance; flexible programming may be considered a limitation, but it allows programming to be tailored to school and trainer readiness, which has previously improved adoption and adherence to approved curriculum in the state.

IMPLICATIONS FOR RESEARCH AND PRACTICE

A significant proportion of youth surveyed in this study demonstrated inadequate milk and water intake and SSB consumption 2 times on a typical day. These results suggest a need for beverage specific education to shift beverage consumption patterns among children and diminish the contribution of SSBs to daily calories and added sugar,^{8,9,23,24} with attention to potential racial/ethnic and socioeconomic disparities.^{8,22,25–27} Although SSB associations with weight status and other health outcomes have varied across studies,²⁸ addressing SSB consumption in youth has limited potential harm and great potential to impact long-term consumption patterns,²⁹ increase diet quality,³⁰ manage weight and body composition,^{7,9,12,29,31–36} and impact lifelong health.^{6,37}

Evidence suggests that reducing SSB availability in schools, without complementary strategies, does not alter overall intake.³⁸ One tactic has been to educate children on the energy and sugar contents of all beverages,³⁹ in addition to the typical nutrition education. Additionally, the parental characteristics, environment, and dietary component influences on SSB consumption patterns noted by others^{22, 40} may be considered in future research, particularly when engaging in public health approaches. The new SNAP-Ed guidance⁴¹ explores various public health approaches that may be used to manage SSB consumption in schools, home settings, and elsewhere,^{24,37,42} in conjunction with other stakeholders at schools and school districts, including parents and community leadership. Comprehensively testing beverage specific curriculum, interventions, and public health approaches would facilitate the appropriate expansion of evidence-based practices that balance SSB consumption with more healthful practices in schools and other settings.

Future research instruments could expand beverage categories and collect climate information to garner more detailed beverage information and control for seasonality. More precise recording of SSB specific teaching time would allow for estimation of “dose” in the absence of control groups. The EARS system is slated for revision in 2017 with opportunity for public comment, which may provide the opportunity to better capture the TTT model inputs and SSB specific education time with students and parents. Finally, measurement of height and weight simultaneous with surveys would further advance research to evaluate associations between beverage consumption patterns and weight status among low-income individuals.

Overall, this study suggests the need for beverage specific education, in conjunction with general nutrition education, to encourage more healthful choices. Further research is needed to assess beverage consumption patterns longitudinally and to assess SSB specific interventions in schools and other settings.

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Figure 1.

Consort diagram describing recruitment and enrollment of 4th and 5th grade participants in a survey of nutrition and physical activity knowledge and behaviors.

Figure 2.
Mean beverage consumption by category among Arizona 4th and 5th graders during the Fall and Spring.

Table 1

Resources provided monthly to participating schools to support nutrition and physical activity education.

Resource/ Contact types	Contents
Newsletter/Email	<ul style="list-style-type: none"> • Lessons • Student worksheets • Information to build teacher nutrition and physical activity knowledge • Grant opportunities (to further their nutrition/physical activity mission) • Simple behavior change strategies– targeted at the teacher, staff, and administrators • Links to additional online activities and resources • Recommendations to promote healthy celebrations in the classroom and school
Trainings & Technical Support	<ul style="list-style-type: none"> • Integration of nutrition education into classroom curricula • Evidence-based curricula (i.e. Serving up My Plate, WE Can!, etc.) • UANN Sponsored Teacher Conferences/Workshops
Material Distribution	<ul style="list-style-type: none"> • Nutrition education reinforcement items (i.e. water bottles) • Recipe cards, newsletters, and fact sheets • Teaching toolkits for the classroom
Promotions	<ul style="list-style-type: none"> • By teacher request and program driven initiative, such as Go for the Greens, Healthy Holidays, National Nutrition Month.
Reporting	<ul style="list-style-type: none"> • Nutrition education strategies included in monthly time log reminders • Booster trainings to reinforce nutrition education concepts

Table 2Change in Mean Beverage Consumption by Category on the Prior Day (times consumed)^a

Beverage Category	% Change ^b	p ^c
Milk	5.5	0.03*
Water	0.2	0.86
Sugar-sweetened Beverages	14.4	0.01**
Total Beverage Intake	3.2	0.09

^aBase unit is Classroom, n=33^bPost-survey average minus Pre-survey average^cPaired T-Test for data weighted by Pre-survey class size (SAS, Proc TTEST)*
p<0.05;**
p<0.01

Table 3

Knowledge and Behavior Characteristics among Arizona 4th and 5th Graders Regressed on Change in Sugar-Sweetened Beverage Consumption

Independent Variables	Standardized β -Coefficient	p-value	Adjusted R ²
			0.57
Grade ^a	-0.058	0.65	
Baseline Knowledge of USDA Recommendations ^b			
Accurate vegetable intake (%)	0.307	0.04*	
Underestimated fruit intake (%)	-0.336	0.01**	
Underestimated physical activity (%)	0.266	0.10	
Behaviors			
Milk fat, baseline (%)	0.251	0.05*	
SSB consumption, baseline (times)	-0.518	<0.001**	
Change in water (times)	-0.431	0.01**	

^a) Grade was forced into the model and model was weighted by baseline class size (WLS, n=33);

^b) percent of classroom;

* significant at p 0.05;

** significant at p 0.01