Published in final edited form as:
J Sch Health. 2014 March ; 84(3): 177–184. doi:10.1111/josh.12134.

Piloting "sodabriety" – a school-based intervention to impact sugar-sweetened beverage consumption in rural Appalachian high schools

Laureen H. Smith, PhD, RN [Associate Professor] and
The Ohio State University, 342 Newton Hall, 1585 Neil Avenue, Columbus, Ohio 43210, Phone: 614-292-4578, Fax: 614-292-4948

Christopher Holloman, PhD [Associate Professor]
The Ohio State University, 212 Cockins Hall, 1958 Neil Avenue, Columbus, Ohio 43210, Phone: 614-292-0738

Laureen H. Smith: smith.5764@osu.edu; Christopher Holloman: holloman.5@osu.edu

Abstract

BACKGROUND—Sugar-sweetened beverages (SSBs) are the largest source of added sugar in the US diet. In adolescents aged 12–19, these drinks account for 13% to 28% of total daily calories. Compared to other adolescents, those residing in Appalachia have the highest consumption rates of SSBs.

METHODS—Using a Teen Advisory Council, a student-designed and student-led intervention was conducted at 2 high schools in a rural Appalachian county. Using repeated-measures models design with Bonferroni correction, data were collected on daily and weekly consumption of SSBs and of water at baseline, immediately post intervention, and 30 days post intervention. Vending machine surveys were completed.

RESULTS—The 186 participants reported purchasing SSBs from school vending machines (41.4%), cafeteria (36.5%), and school stores (7.7%). Daily SSB servings decreased from an average of 2.32 (SD = 2.14) to 1.32 (SD = 1.29) ($p < .001$). Weekly consumption decreased from an average of 4.30 (SD = 2.40) days per week to 2.64 (SD = 1.91) ($p < .001$). Water consumption increased 19% from baseline to immediately post intervention.

CONCLUSIONS—Student-directed efforts to support behavioral change are feasible and effective at affecting individual lifestyle behaviors. Small and manageable changes may lead to net improvements in lifestyle behaviors.

Keywords

sugar-sweetened beverages; adolescent health; peer intervention; obesity

The consumption of sugar-sweetened beverages (SSBs) has increased worldwide in the past 4 decades.[1] In the US, there has been a 2-fold increase.[1] SSBs are the largest source of added sugar in the US diet.[2] The consumption of SSBs is estimated to add 224 kcal/day (11%–15% of total daily calories) to the typical American diet.[3] Most American children and adolescents are regular consumers of SSBs. On average, 80% of youth consume SSBs daily,[4] with adolescents aged 12–19 years old consuming the most; SSBs contribute from 13% to 28% of their total daily caloric intake.[4,5]

Correspondence to: Laureen H. Smith, smith.5764@osu.edu.

Although not all studies support the association between SSB consumption and obesity,[6,7] the Centers for Disease Control and Prevention recognizes these beverages as one factor contributing to the prevalence of adolescent obesity in the US.[8] High consumption of SSBs has been associated with obesity's comorbid conditions, including insulin resistance,[9] diabetes,[10] elevated triglycerides,[11] cardiovascular disease,[12] and dental caries.[13] Furthermore, SSB intake has consistently been associated with increased body weight and increased fat mass;[14-,16] the odds of children becoming obese increases 1.6 times for each additional daily SSB serving.[14] Consequently, health experts recognize SSBs as a public health concern and are calling for a reduction in SSB consumption.[1]

Despite the recent leveling off of childhood obesity rates nationwide, the prevalence of childhood overweight and obesity is increasing in rural areas of the US, such as Appalachia.[17,18] Children and adolescents residing in Appalachia have higher consumption rates of SSBs compared to others their same age. Nearly one-half of 3rd-grade children residing in Appalachia have been found to consume at least one SSB daily, exceeding the rates of SSB consumption among 3rd-graders found in other rural, urban, and suburban locales in Ohio.[18] Consumption of SSBs has gained attention from researchers and health professionals working to impact the childhood obesity epidemic in the Appalachian region of the US. The school environment and policy-level changes have been the focus of much effort to date.

The federally regulated School Lunch Program is a major source of food at school. However, from elementary to high school, Aran et al[19] found that participation in the National School Lunch Program declined by approximately 27% due to competitive foods defined as foods sold in competition with a federally reimbursable school meal program in food service areas. Competitive foods are purchased from services such as *a la carte* offerings, snack bars, vending machines, and school stores.[19] It has been reported that in a typical school day, 40% of children consume competitive foods and beverages.[20] Students with opportunities to purchase competitive foods at school have reported higher consumption of SSBs from soda, sports drinks, and other offerings.[19,20] Consequently, many schools have implemented policies that limit access to high-calorie, low-nutrition foods (including SSBs) during the school day.[19,21] These policies have had mixed results in changing the school environment and dietary practices of children and adolescents, especially for schools in lower-income areas such as Appalachia.[20–22,] An approach that promotes more active engagement and participation of the school community may lead to improved evaluations of health initiatives and student behavioral outcomes.[23]

To engage rural Appalachia in health initiatives, a community-based participatory research project was undertaken in Pike County, Ohio. Essential input from the community was obtained through coalition meetings; a community health survey was conducted at the county fair; and focus group sessions were held with community residents, high school staff members, and teens. This input was used to identify health concerns and develop a pilot intervention study. The health of youth and their consumption of "sugary drinks" emerged as a common theme. As a result, this school-based pilot study was developed aimed at impacting SSB consumption among teenagers. The purpose of the project was to examine school-based purchasing patterns of SSB and explore the impact of a school-based and student-led intervention aimed at limiting short-term and longer-term SSB consumption. To understand SSB consumption patterns, both daily servings and the numbers of days per week that SSB were consumed were examined. Our research questions were: (1) Are there differences in the school-based purchasing patterns of SSB from baseline compared to immediately post intervention and 30 days post intervention? (2) Are there differences in the number of daily SSB servings consumed from baseline compared to immediately post intervention and 30 days post intervention? (3) Are there differences in the frequency of

SSBs consumed per week from baseline compared to immediately post intervention and 30 days post intervention? (4) Are there differences in daily water servings from baseline compared to immediately post intervention and 30 days post- intervention?

METHODS

The piloted intervention consisted of the creation of a Teen Advisory Council (TAC) at each of 2 high schools to design specific components of the intervention: a "Sodabriety" 30-Day Challenge. Each TAC consisted of 12 members overall: 2 teachers and at least 2 students from each grade in school (grades 9–12). Each TAC: (1) designed a tailored promotional campaign including a "commercial," flyers, T-shirts, and posters to promote the 30-Day Challenge; (2) prepared daily facts about the benefits of limiting sweetened beverage consumption which were read during announcements; and (3) promoted the 30-Day Challenge to consume only unsweetened beverages such as water, unsweetened tea, or diet soda. Each TAC met 9 times to plan and implement the intervention: 5 planning meetings and 4 more (one weekly) meetings during the 30-Day Challenge; each TAC also met once post-intervention. To gather baseline data, pre-intervention an assessment of school vending machine beverage choices was completed. For the intervention, data were collected at 3 time-points: pre-intervention, immediately post intervention, and at 30 days post intervention. SSBs were defined as regular pop or soda, sweetened tea, sweetened coffee drinks, fruit drinks (excluding 100% juice), sports drinks, and energy drinks. One beverage serving was defined as 8 ounces or one cup.

Participants

Each of the 2 participating high schools was located in the same rural Appalachian county. Nearly 40% of students attending these schools are economically disadvantaged, defined as those who qualify for free or reduced lunch prices. Student TAC members were recruited by personally contacting students recommended by health teachers at each participating school. Teachers serving on the TAC were either health or physical education teachers who volunteered to serve. Twenty-four students and 4 teachers served as TAC members. As part of the work of each TAC, a media campaign using flyers, daily announcements, and video messages was developed and implemented to recruit intervention participants. Intervention participants numbered 186 students, comprising nearly 50% of all students attending each school. TAC members said that the participation rates of older students and males were limited due to those students attending off-site district vocational training instead of attending the participating schools during the time of the study. Excluding students attending vocational training, the participation rate approached 70% of eligible students.

Instruments

Demographic survey—Descriptive variables were collected by self-report during the pre-intervention data collection. Variables of interest included: sex, age, grade in school, and race. The grades participating in the study ranged from grades 9 to 12. The ages of participants were reported in years. Racial categories included: White/Caucasian, Black/ African American, Native American, Asian American, or more than one race.

School vending machine survey—Based on input from school personnel and teens, a Vending Machine Survey was designed and completed by study personnel prior to implementation of the intervention. The survey consisted of: the number vending machines, the location of each vending machine, accessibility to vending machines during school day, and beverage options for each vending machine located in the participating schools.

Beverage survey—A 10-item beverage survey was completed by each participant at 3 times: pre-intervention, immediately post-intervention, and 30-days post-intervention. Content and predictive validity for use with adolescents has been demonstrated.[2] Four items focused on SSB consumption. The first item asked about where they and their families purchased SSBs. Participants checked all that applied from: vending machines at school, local or corner stores, larger grocery stores, school cafeteria, school snack rooms, bring them from home to school, or other sources. The second item asked about the frequency of SSBs consumed during a week (How many days a week do you drink sugared-sweetened beverages?), ranging from every day to at least 5 days a week, 3–4 times a week, 1–2 times a week, less than once a week, or never (I do not drink sweetened beverages). The third item asked participants to estimate the number of sweetened drinks they consumed per day. The fourth item asked participants to report the sweetened beverage that they drank most often.

Two items asked about water consumption. The first item asked participants to report the number of water servings they consumed every day. The second item asked participants to report where they usually drank water from, including the "tap" or sink, drinking fountains, and/or bottled water. One item asked participants to rank their favorite drinks among: water, low-fat or skim milk, diet or sugar-free soda/pop, fruit juices, iced tea or sweet tea, sports drinks, regular soda, energy drinks, or other. Respondents were asked to rank their most highly favored drink as "1," next favorite as "2," etc., with the least favorite drink being ranked as the final number of however many were listed. However, after the top 3, many respondents had difficulty deciding and assigned more than one choice to an individual number ranking. The final 2 items asked whether drinking healthy beverages was important to them and whether their school had healthy drink options available. Each of these 2 items was dichotomized, with "yes" coded as one and "no" coded as zero.

Daily beverage log—Each participant was provided a beverage log to complete during the 30-day intervention. They were asked to record how many servings they drank of SSBs and other beverages. Other beverage options included water, unsweetened tea, diet soda/diet pop, 1% or skim milk, 100% fruit juice, and coffee with no sugar. SSBs included regular soda/pop, sweet tea, fruit drink (not labeled as 100% juice), sports drink, energy drink, flavored or sweetened milk, coffee with sugar, other coffee drink, and other. The total number of servings from these choices was recorded for each day.

Procedure

Recruitment for the "Sodabriety" project occurred in 2 phases. The first phase focused on recruitment of members to serve on each TAC; the second phase focused on recruitment of students attending each school to participate in the "Sodabriety" project. A packet containing an information sheet, application to serve on the TAC, parent permission form, and written assent form was distributed via homeroom teachers to all students in each grade at participating schools. An information sheet was given to all students, and posters were displayed at the school that invited all school students to participate in the Challenge. The project investigators and TAC members attended home room periods to explain the Challenge. During homeroom periods, an "advertisement" video produced by the TAC was played. Recruitment lasted one week. All student participants signed a written assent and obtained written parent permission to participate. Subjects were paid $5 at each data collection point, for a total of $15.

Each TAC was led by 2 student leaders. Each student TAC member was paid $15 per meeting session. Each session ended with TAC members responsible for planning activities and follow-up. Each TAC was divided into 4 subgroups: recruitment and survey

administration; social marketing/media and messaging; weekly support, activities, and supplies; and end-of-intervention assembly.

Each TAC designed a "kickoff" kit provided to each student participant. Each kit contained a nylon tie bag, water bottle, and other supplies such as rubberized wrist bands, magnets, book marks, or T-shirts. Each school designed a different kit with a budget of $10–$12 per kit. In addition, each TAC designed a "tag line" and logo for the intervention. Tag lines included: "What's in your Cup?" "Drop Pop and Stop It." and "Less Sweet, Better Treat." The messaging during the intervention was an important choice for each TAC. For example, deciding whether to promote complete abstinence from SSBs or merely reduction of SSB consumption was discussed. Also, whether to simultaneously promote water consumption was considered. Each TAC decided to focus messaging on reducing SSB consumption rather than abstinence and not to focus messaging on water consumption.

During the intervention, each TAC met weekly to discuss intervention challenges, needs, and support or messaging needed. For example, during morning announcements, TAC student members delivered daily reminders to complete the beverage logs and "daily facts" about SSBs. Media coverage occurred during recruitment and throughout the intervention period. Media included the school newsletters, local county newspapers, and signage outside of the schools. At the end of the intervention, each TAC planned a school-wide assembly. The assemblies included presentations about type 2 diabetes, facts about SSBs, challenges and benefits of completing the intervention, and other wellness activities such as Zumba or dancing. Completely planned and delivered by TAC members, these assemblies were attended by local media, district personnel, parents, and community stakeholders.

Data Analysis

The IBM SPSS version 19 statistical software was used to conduct all analyses.[25] Data were analyzed using both descriptive and inferential methods. Descriptive data were analyzed by calculating frequency, means, standard deviations, and ranges of values. To examine the accuracy and criterion-related validity of the beverage survey, self-reported recall of daily beverage consumption (beverage survey) was compared to the weekly beverage logs; paired t tests were conducted between the immediately post intervention results (Time 2) and the reported means of water consumption and daily SSB consumption at Week 4. To compare the differences over 3 time-points, repeated-measures models with post-hoc Bonferroni correction were constructed for each of the three outcomes measured via the beverage survey: (1) daily servings of SSBs; (2) weekly consumption or frequency of SSBs; and (3) mean daily servings of water. These models included time as a within-subjects effect. Between subjects effects included school, grade in school, and sex. To construct a repeated-measures model for weekly consumption of SSBs, the ordinal scale was converted to an analogous interval scale as follows: I do not drink SSBs = 0; less than once a week = 1; 1–2 times per week = 2; 3–4 times per week = 3; at least 5 days per week = 5; every day = 7. Model diagnostics for the outcomes of interest found no problems with assumptions of normality or homogeneity of variance. Consumption patterns from baseline (Time 1) and immediately post intervention (Time 2) were compared to patterns at 30 days post intervention (one month after the intervention ended [Time 3]). Mean difference was deemed significant at $p = .05$ level.

RESULTS

This study was conducted during the 2011–12 school year. A total of 186 students participated in the intervention at 2 high schools. Consistent with the demographics of the surrounding community, most students were White/Caucasian (95%), as shown in Table 1. Participants were predominantly female (N = 113) and in the 9th grade (N = 86) or 10th

grade (N = 47). Participation by 11th and 12th grade students was limited due to approximately half of those students attending off-site vocational or technical training during the school day during the time of the study. The students' age ranged from 14–20 years; mean age was 15.85 years (SD = 1.78).

At baseline, both schools offered beverage options to both students and faculty via vending machines. However, posted policies indicated that vending machines accessible to students and faculty differed. Vending machines labeled for student use were found in the hallways just outside of the cafeteria areas and gymnasiums. Each school had 2–3 vending machines at each of these school locations; 4–6 vending machines in each school were for student use. Vending machines labeled for faculty use were found in school offices and faculty lounges. Each school had 2 vending machines labeled for faculty use. Vending machines marked for student use contained water, milk, and 100% juices; vending machines marked for faculty use contained regular soda and diet soda. However, at baseline, many students reported purchasing SSBs from school-based sources within the past week including vending machines (41%), school cafeteria (36%), and school stores or snack rooms (7.7%) [See Table 2]. The purchase of SSBs from vending machines decreased from baseline to immediately post intervention ($p = .017$) and from baseline to 30 days post intervention ($p = .03$). Purchasing from vending machines did not differ from immediately post intervention to 30 days post intervention ($p = .86$). Purchasing patterns from the school cafeteria or snack rooms did not differ from baseline compared to immediately post intervention or at 30 days post intervention. At baseline, most students (63%) reported consuming SSBs at least 3 days per week, with more than one-third of students (33.9%) reporting daily consumption of SSBs. Immediately post intervention, the majority of students (65%) consumed SSBs fewer than three days per week. Only 7.2% of students consumed SSBs daily immediately post intervention. One month after the intervention ended, nearly 60% of students still consumed SSBs fewer than three days per week. These results did not differ by school ($p = .99$), grade in school ($p = .95$), or by sex ($p = .07$). Regular soda or "pop" was the preferred SSB for 92% of participants who consumed SSB at baseline. Preference patterns did not change at immediately post intervention or at 30 days post intervention.

Beverage consumption reported on the Daily Beverage Logs did not differ from reported beverage consumption on the Beverage Surveys. Over 90% of participants completed both measures. Although the reported daily SSB consumption mean of 1.17 beverages per day (SD = 2.11) was lower at Week 4 on the daily log, the difference was not significant from the mean of 1.43 (SD = 1.63) reported on the Beverage Survey at immediately post intervention ($t = 1.23$, $p = .22$). The daily reported water consumption mean of 4.63 (SD = 1.28) servings per day was lower at Week 4 of the daily log compared to the mean of 5.02 (SD = 3.44) servings per day reported on the Beverage Survey at immediately post intervention; however, the difference was not significant ($t = 1.28$, $p = .28$).

Only 7.2% of student participants did not consume SSBs at baseline. At immediately post-intervention, 11.8% of student participants reported that they did not drink SSBs, a 64% increase in abstainers. For those who continued to consume, the intervention reduced daily servings of SSBs from an average of 2.32 (SD = 2.14) to 1.32 (SD = 1.29) ($p = .000$). The reduction was nearly one serving per day (.994 servings). At 30 days post-intervention, daily servings of SSBs increased slightly to 1.70 (SD 1.52); however, this change was not significant ($p = .08$). Participants were able to maintain a reduction in the number of servings consumed compared to baseline. Furthermore, at one month after the intervention ended, 11.8% of student participants abstained from consuming SSBs (Table 3). These results did not differ by school ($p = .27$), grade in school ($p = .53$), or by sex ($p = 15$).

Likewise, weekly consumption of SSBs was reduced. At baseline, participants reported consuming SSBs on average on 4.31 (SD = 2.40) days of the week. Weekly consumption decreased to an average of 2.64 (SD = 1.91) days per week (p = .000) at immediately post-intervention — a reduction of 1.66 days per week (39%). At 30 days post-intervention, consumption increased to 3.14 (SD = 2.26) days per week, an increase of .50 days from immediately post-intervention. Although this was a significant increase (p = .03) from immediately post-intervention, it still represented a significant reduction of weekly consumption when compared to baseline (p = .000). Respondents were able to maintain nearly a 30% reduction in days per week (1.17 days) that SSBs were consumed from baseline to one month after the intervention ended. Boys consumed more SSBs compared to girls at all 3 time-points.

Water consumption increased 19% from baseline to immediately post-intervention. Participants reported consuming 4.28 (SD = 4.09) servings of water per day at baseline and 5.08 (SD = 3.60) servings per day at immediately post-intervention; however, this increase was not statistically significant (p = .11). Water consumption did significantly increase from baseline to 30 days post-intervention (p = .014), when students reported consuming an average of 5.56 (SD = 4.73) water servings per day, an increase of 30% from baseline and 9% from immediately post-intervention. These results did not differ by school (p = .58), grade in school (p = 77), or by sex (p = .74). These findings indicate that students continued to increase their water consumption.

DISCUSSION

To our knowledge, this is the first study to test a school-based and student-led intervention resulting from a community-identified health need to impact SSB consumption among teenagers. Our nearly 70% participation rate and greater than 90% retention rate from baseline to 30 days post-intervention indicates that, although the health concern was first identified by community elders, stakeholders, school personnel, and parents, teenagers themselves also understood the importance of limiting consumption of SSBs. In addition to the excellent response rate, the applicability of the findings to other schools of similar demographic profiles is supported by the relative socio-demographic homogeneity among our schools. Students attending both schools were similar including racial/ethnic composition, household income, family employment, academic achievement on state mandated measures, student/teacher ratios, and extra-curricular activities offered at school. Three important findings emerged from this study.

First, although the participating schools developed policies and procedures limiting the purchase of SSBs during the school day, the implementation of these policies may be inconsistent. For example, at each school, vending machines found in hallways were most accessible to students. These vending machines contained different beverage options than those machines found in faculty lunchrooms or staff lounges. In addition, 2 participating schools “turned off” vending machines during lunch periods and labeled some vending machines as “faculty use only.” However, despite these policies and procedures, many students still purchased SSBs at school during the school day, implying that they sought out vending machines or other sources offering SSBs. Vending machines remained a source of purchase for over 44% of students. School cafeterias were a source of SSB purchase for 40% of students. Although difficult, more stringent implementation of policies regarding the purchase of beverages during the school day and limiting all vending machine options to healthier choices could have a significant impact on the school environment and beverage choices made by students. Our findings show, that by raising awareness and offering student-led support, students made choices to purchase fewer SSBs from vending machines and cafeterias. What is not known is if the school policies and procedures were more closely

followed during the time of the "Sodabriety" intervention or if the changes in purchasing found were the result of participant choices alone.

Second, the results indicated that student-led interventions coupled with peer support are effective both for short-term behavioral change. At the conclusion of the intervention, student participants reduced both their daily consumption of SSBs and the number of days per week these beverages were consumed. The short-term behavioral change would equal a substantial reduction in daily caloric intake from SSBs. With a reduction of in SSB consumption of nearly one serving per day (as found in this study), a net reduction of 150 kcal per day could be achieved if other dietary factors remained constant. If sustained over a long period of time, an estimated 12–15 pounds per year could be lost, substantially impacting the prevalence of adolescent overweight and obesity in this student population.[6,7,14,26,27] Further, results indicate that participants abstained from consuming SSBs most days of the week, indicating steps toward a lifestyle behavior change. Although not all changes found immediately post-intervention were maintained at a month later, the positive changes in reducing SSB consumption persisted, as participants at 30 days post-intervention still consumed SSBs with less daily frequency and on fewer days per week when compared to baseline.

Third, although not a focus of the TAC messaging, water consumption was increased after the intervention. The messaging at all schools focused only on reducing SSB consumption, not increasing water consumption. To our knowledge, no other school-based campaign or community effort occurred during the time of "Sodabriety." At the start of "Sodabriety," daily water consumption was nearly identical to SSB consumption: about 4 servings a day. Immediately post-intervention, water consumption increased to more than 5 servings a day, and it continued to increase at 30 days post-intervention. This indicates a change in consumption at the end of data collection. This finding indicates that making a choice to change a lifestyle behavior can result in changing other behaviors concurrently. These behavioral changes being sustained for at least one month post intervention suggest that the school environment supported the efforts of students to change their lifestyle behaviors.

This study emerged from a larger community-based participatory research project (CBPR).[2] Consequently, through health surveys, focus groups and personal interviews, the health topic of SSB consumption among teens was identified by community and school stakeholders, residents, and students. The use of students to design a tailored campaign to promote "Sodabriety" within their schools closely followed the spirit of CBPR. Because the intervention was student designed and student-driven, the use of school-based TACs to impact health behaviors or provide health coaching is promising. TACs may be maintained to impact health issues or topics of importance to our target schools and the surrounding community. Further, advisory councils may be formed within other schools or communities; thus, the approach used in this study becomes useful to other communities and schools.

Limitations

This study focused on short-term measurement of behavioral change. Although student participants shared perceived health benefits of participating in "Sodabriety," health outcomes were not measured but should be included in future studies. Further, although behavioral outcomes were measured at one month post-intervention, longer-term evaluation of the intervention's effect is warranted. Although our attrition rate was low, it seems likely that those students who did not complete the surveys at immediately post-intervention and 30 days post-intervention may have been more likely to consume SSBs or not change SSB patterns. To sustain the gained effects, some booster messaging is indicated, specifically regarding limiting the weekly frequency of consumption. Also, because this was a feasibility study, a control or comparison group was not utilized. Consequently, whereas there were

significant effects from baseline to 30 days post-intervention, without a control group, there is no way to know whether these same effects may have occurred in a high school with no intervention. Potential sources of bias include social desirability to under report SSB consumption and testing bias because of the repetition of data collection over a short period of time. Finally, although the participating schools were located in the same geographic county and did not differ demographically, we did not separate the schools however our results did not indicate any differences in outcomes between the schools.

Conclusions

Our results show that student-directed efforts to support behavioral change are effective and efficient at affecting individual lifestyle behaviors. Small and manageable changes may lead to other behavioral changes that result in net gains in lifestyle behaviors. For example, although increasing water consumption was not the focus of the targeted intervention, participants consistently increased water consumption as they decreased SSB consumption. Interventions aimed at individual behaviors that are conducted in school settings also may support broader changes in the school environment.

IMPLICATIONS FOR SCHOOL HEALTH

Student-designed and student-driven approaches to support the adoption of healthy lifestyle behaviors may be important tools as schools work to adapt the learning environment to promote the health and well-being of students. This study's findings suggested that students can serve as effective leaders and role models to promote individual behavioral change and environmental change within a school setting. This study's findings further suggested that school policies regarding beverage purchases at school may be inconsistently enforced by administration or adhered to by students. At our participating schools, although vending machines designated for student use contained only healthy beverage options, students routinely purchased SSBs from vending machines labeled for faculty use only. To increase the likelihood that school environments support the adoption of healthy behaviors, evaluation of policies impacting beverage choices should include appraisals of implementation of such policies.

Human Subjects Approval Statement

The study was approved by The Ohio State University Social and Behavioral Sciences Institutional Review Board.

Acknowledgments

The project described was supported by Award Number UL1RR025755 from the National Center for Advancing Translational Sciences. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Center for Advancing Translational Sciences or of the National Institutes of Health.

References

1. Sturt J. Higher consumption of sugar-sweetened beverages is associated with increased risk of developing type 2 diabetes or metabolic syndrome. Evid Based Nurs. 2011; 14(2):35. [PubMed: 21421965]
2. Wang YC, Bleich SN, Gortmaker SL. Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among US children and adolescents: 1988–2004. Pediatrics. 2008; 121(6):1604–1614.
3. Flood JE, Roe LS, Rolls BJ. The effect of increased beverage portion size on energy intake at a meal. J Am Diet Assoc. 2006; 106(12):1984–1990. [PubMed: 17126628]

4. Centers for Disease Control and Prevention (CDC). The CDC Guide to Strategies for Reducing the Consumption of Sugar-Sweetened Beverages. Atlanta, GA: CDC; 2010.
5. Ranjit N, Evans MH, Byrd-Williams C, Evans AE, Hoelscher DM. Dietary and activity correlates of sugar-sweetened beverage consumption among adolescents. Pediatrics. 2010; 126:754–761.
6. O'Conner TM, Yang SJ, Nicklas TA. Beverage intake among preschool children and its effect on weight status. Pediatrics. 2006; 118(4):e1010–e1018. [PubMed: 17015497]
7. Forshee RA, Anderson PA, Storey ML. Sugar-sweetened beverages and body mass index in children and adolescents: a meta-analysis. Am J Clin Nutr. 2008; 87(6):16612–1671.
8. Centers for Disease Control and Prevention. Beverage consumption among high school students--United States, 2010. MMWR Morb Mortal Wkly Rep. 2011; 60(23):778–780. [PubMed: 21681174]
9. Bremer, AA.; Auinger, P.; Byrd, RS. [Accessed December 1, 2013] Sugar-sweetened beverage intake trends in the US adolescents and their association with insulin resistance-related parameters. J Nutr Metab. 2010. Available at: http://www.hindawi.com/journals/jnme/2010/196476/
10. Montonen J, Jarvinen R, Knekt P, Heliövaara M, Reunanen A. Consumption of sweetened beverages and intakes of fructose and glucose predict type 2 diabetes occurrence. J Nutr. 2007; 137(6):1447–1454. [PubMed: 17513405]
11. Dhingra R, Sullivan L, Jacques PF, et al. Soft drink consumption and risk of developing cardiometabolic risk factors and the metabolic syndrome in middle-aged adults in the community. Circulation. 2007; 116(5):480–488. [PubMed: 17646581]
12. Fung TT, Malik V, Rexrode KM, et al. Sweetened beverage consumption and risk of coronary heart disease in women. Am J Clin Nutr. 2009; 89(4):1037–1042. [PubMed: 19211821]
13. Sohn W, Burt BA, Sowers MR. Carbonated soft drinks and dental caries in the primary dentition. J Dent Res. 2006; 85(3):262–266. [PubMed: 16498075]
14. Harrington S. The role of sugar-sweetened beverage consumption in adolescent obesity: a review of the literature. J Sch Nurs. 2008; 24(1):3–12. [PubMed: 18220450]
15. Kavey RE. How sweet it is: sugar-sweetened beverage consumption, obesity, and cardiovascular risk in childhood. J Am Diet Assoc. 2010; 110:1456–1460. [PubMed: 20869483]
16. Koordeman R, Anschultz DJ, vanBaaren RB, Engels R. Exposure to soda commercials affects sugar-sweetened soda consumption in young women. An observational experimental study. Appetite. 2010; 54:619–622. [PubMed: 20236611]
17. University of Wisconsin Population Health Institute. [Accessed December 1, 2013] County Health Ratings: Mobile Action toward Community Health--Ohio 2010. 2010. Available at: http://www.countyhealthratings.org/ohio
18. Oza-Frank, R.; Norton, A.; Scarpetti, H., et al. A Report on the Body Mass Index of Ohio's Third Graders: 2009–2010. Columbus, OH: Ohio Department of Health; 2011.
19. Aran C, Kubik MY, Fulkerson JA, Davey C, Story M. Association between food opportunities during the school day and selected dietary behaviors of alternative high school students, Minneapolis/St. Paul, Minnesota, 2006. Prev Chronic Dis. 2011; 8:A08. [PubMed: 21159220]
20. Kakarala M, Keast DR, Hoerr S. Schoolchildren's consumption of competitive foods and beverages, excluding a la carte. J Sch Health. 2010; 80:429–435. 461–463. [PubMed: 20690974]
21. Mendoza JA, Watson K, Cullen KW. Change in dietary energy density after implementation of the Texas Public School Nutrition Policy. J Am Diet Assoc. 2010; 110:434–440. [PubMed: 20184994]
22. Institute of Medicine (IOM). Nutritional Standards for Foods in Schools: Leading the Way toward a HealthierYouth. Washington DC: IOM; 2007.
23. Smith LH, Valenzuela J, Ludke RL. Engaging rural and urban Appalachians in research using a community-based participatory research approach. PRISM: J Regional Engagement. 2012; 1:3–17.
24. Neuhouser ML, Lilley S, Lund A, Johnson DB. Development and validation of a beverage and snack questionnaire for use in evaluation of school nutrition policies. J Am Diet Assoc. 2009; 109(9):1587–1592. [PubMed: 19699839]
25. International Business Machines (IBM) Corporation. Statistical Package for Social Scientists Version 19. Armonk, NY: IBM; 2012.
26. Brietel RR, Wilson A, Cabili C, Hedley DA. Reducing calories and added sugars by improving children's beverage choices. J Acad Nutr Diet. 2013; 113(2):269–275. [PubMed: 23351631]

27. Johnson RK. Children gain less weight and accumulate less fat when sugar-free, non caloric beverages are substituted for sugar-sweetened beverages. Evid Based Med. 2013 Jan 19. [e pub ahead of print].

Table 1

Descriptive Statistics (N = 186)

School		
High School A	93	(50.0%)
High School B	92	(50.0%)
Grade in School		
Grade 9	86	(46.2%)
Grade 10	47	(25.3%)
Grade 11	21	(11.3%)
Grade 12	32	(17.2%)
Sex		
Boys	73	(39.2%)
Girls	113	(60.8%)
Mean Age (SD)	15.85	(SD = 1.78)
Race		
White/Caucasian	159	(94.6%)
Black/African American	5	(3.0%)
Native American	1	(0.5%)
Asian American	1	(0.5%)
More than one Race	4	(1.0%)

Table 2

School-based Purchase of Sugar-sweetened Beverage Purchases

Percentage of Students who Purchased Beverage from School Source			
Source			
	Time 1 N = 186	**Time 2 N = 174**	**Time 3 N = 168**
Vending Machine	41.4	33.8	36.7
Cafeteria	36.5	28.3	36.7
School Store/Snack Room	7.7	6.0	10.9

Time 1 = Baseline; Time 2 =Immediately Post ; Time 3 =30 Days Post

Table 3

Results from Repeated-measures Models

	Estimated Marginal Mean	Standard Error	95% Confidence Interval		Bonferroni- adjusted p value vs. Time 1	Bonferroni- adjusted p value vs. Time 2	Bonferroni- adjusted p value vs. Time 3
			Lower Bound	Upper Bound			
How many days per week sugar sweetened beverages were consumed (p < .001)							
Time 1	4.302	.223	3.860	4.744	-	<.001	<.001
Time 2	2.638	.178	2.286	2.990	<.001	-	.029
Time 3	3.138	.210	2.722	3.554	<.001	.029	-
Average sugar sweetened beverages consumed per day (p < .001)							
Time 1	2.318	.232	1.856	2.779	-	<.001	.028
Time 2	1.324	.140	1.046	1.601	<.001	-	.08
Time 3	1.706	.166	1.376	2.035	.028	.08	-
Average servings of water consumed per day (p = .019)							
Time 1	4.279	.389	3.509	5.050	-	.11	.014
Time 2	5.086	.342	4.408	5.763	.108	-	.277
Time 3	5.563	.422	4.726	6.400	.014	.277	-

Time 1 = baseline (N = 186); Time 2 = immediately post (N = 174); T 3 = 30 days post (N = 168)

Table 4

Between Subjects Effects

	F (df)	p
How many days per week sugar sweetened beverages were consumed		
School Attending	.007 (7)	.993
Grade in School	.220 (3)	.953
Sex	3.33(1)	.071
Average sugar sweetened beverages consumed per day		
School Attending	1.34 (1)	.27
Grade in School	.834 (3)	.534
Sex	2.11 (1)	.150
Average servings of water consumed per day		
School Attending	.546 (1)	.581
Grade in School	.509 (3)	.769
Sex	.110 (1)	.740