



Short communication

The association between sugar-sweetened beverage availability in school vending machines and school staff sugar-sweetened beverage consumption

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ABSTRACT

Reducing sugar-sweetened beverage (SSB) consumption is a leading strategy to help combat high rates of adult obesity and overweight. Regulating SSB sales in schools has reduced access among youth. However, current federal school nutrition standards are focused on student rather than staff environments (i.e. school staff lounges). This study examines the association between the availability of SSBs in school vending machines and school staff SSB consumption.

The study sample included 51 public schools in California, Oregon, Washington, Maryland, and Washington DC participating in an evaluation of Kaiser Permanente's Thriving Schools initiative in school year 2017–18. Data collection included: 1) observations of school cafeterias, staff lounges, stores and outdoor snack areas for the presence of, and content in, vending machines, and 2) an online survey of school staff about their SSB consumption.

Fifty-nine percent ($n = 1586$) of staff responded to the survey; 1229 (77% of respondents) reported on SSB consumption. Thirty percent of schools had staff lounges with SSB vending machines and 34% of staff reported drinking ≥ 1 SSBs/day. On average, the probability of consuming ≥ 1 SSBs/day was 6.6% greater in staff in schools with SSBs available in staff lounge vending machines (95% CI: 0.11%, 13.12%).

Staff in schools with SSB vending machines in staff lounges were more likely to report consuming ≥ 1 SSBs per day compared to staff without SSB vending in staff lounges. Examining the impact of extending SSB regulations to the entire school environment on school staff SSB consumption is an important next step.

1. Introduction

Forty percent of U.S. adults experience obesity (Hales et al., 2018). Sugar-sweetened beverage (SSB) consumption has been causally linked with obesity, cardiovascular disease, and diabetes (Hu and Malik, 2010; Xi et al., 2015). Thirty percent of U.S. adults drink one or more SSBs per day (Park et al., 2016), underscoring the need for reducing SSB consumption.

Removing SSBs from schools has successfully reduced youth SSB consumption (Avery et al., 2015). However, school-based obesity prevention policies rarely target adults in schools. For example, while the federal Healthy, Hunger-Free Kids Act of 2010 (111th Congress, 2010) created nutrition standards to regulate the foods and beverages sold to

students outside of school meals, these regulations do not extend to the nutrition environment for staff. Extensive research has examined the impact of the school food environment on student health (Bramante et al., 2019), but not school staff.

In a nationally representative survey of working adults, nearly 25% obtained beverages at work (Onufrak et al., 2019). Improved understanding of the relationship between school staffs' access to SSBs and consumption could help support extending school food and beverage policies to the entire school setting, potentially improving the health of the 8.5 million adults (U.S. Department of Labor. Statistics, B. L., 2018) working in U.S. schools.

This study examined the association between the availability of SSBs in school vending machines and school staff SSB consumption.

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2. Methods

2.1. Study sample

This cross-sectional study included 51 schools participating in follow-up onsite observations and online staff surveys in school year 2017–18. Study schools were part of an evaluation of Kaiser Permanente's (KP) Thriving Schools program implemented in school years 2014–15 and 2017–18. The Thriving Schools program focused on healthy eating and physical activity opportunities to improve student and staff health. The present study is limited to follow-up data because schools did not report making substantial changes to SSBs available to school staff as part of the Thriving Schools program and follow-up data was more complete.

Schools were in 5 KP service areas: California (n = 34); Oregon (n = 7); Washington (n = 2); Maryland (n = 4); and Washington DC (n = 4) were selected from 329 Thriving Schools to ensure representation across KP regions and grade levels. All staff in study schools were invited to participate in an anonymous, online survey. School administrators sent an invite to participate via email all staff. Each survey generated a unique record within a web-based platform accessible only to research staff. Surveys and observations were conducted with the approval of all participating schools, and the University of California Davis Institutional Review Board deemed this evaluation non-human subjects research.

2.2. Presence of SSB vending

Vending data were collected by trained staff using a standardized observation form adapted from an instrument designed to assess and monitor adherence to nutrition standards for competitive foods sold on school campuses (Bullock et al., 2010). During a single site visit, researchers recorded and photographed the school vending machine location (i.e., cafeteria, school store, snack bars, staff lounge), number of vending slots, and the name/brand of all beverages in all the vending machines slots. The Healthy, Hunger-Free Kids Act of 2010 established Smart Snack standards (U.S. Department of Agriculture Food and Nutrition Service. U.S. Department of Agriculture., 2019) for sales of competitive foods and beverages to students in school. These standards allow school-day sales of certain types of milk, juice, and low/no calorie beverages with additional ingredient and portion size standards by student grade levels. Two researchers reviewed all vending location, content, and photographed data. Vending machines were first categorized by location – 1) anywhere on campus or 2) in the staff lounge. Next, they were coded for content – 0 “SSBs not available” if there were no beverages for sale in that location or if all beverages in that location met the Healthy, Hunger-Free Kids Act Smart Snack standards for beverage type (contained only water, unflavored low-/non-fat milk, flavored non-fat milk, 100% fruit/vegetable juice), and 1 “SSBs available” if any beverages in vending machines in that location did not meet Smart Snack standards. Portion size limits and calorie Smart Snack standards meant for student age/grade were not applied to this study.

2.3. School staff characteristics and SSB consumption

School staff demographics and beverage consumption were collected using an online survey administered using the SurveyMonkey platform. Researchers provided each school administrator with a unique survey link that they forwarded to staff with an invitation to participate in the survey. Demographic data included: sex, age, race/ethnicity, job type, and years worked at that school. Beverage consumption was assessed with two questions from the 2013 Behavioral Risk Factor Surveillance Survey (BRFSS): “During the past month, how often do you drink soda or pop that contains sugar” and “During the past month, how often do you drink sweetened drinks, such as Kool-Aid, fruit drinks, sweet teas or coffees, energy drinks, etc.” For

each question, staff reported the number of times per day, week, or month they consumed these beverages. Per BRFSS protocol (Park and Pan), monthly and weekly consumption were converted to daily consumption by dividing by 30 and 7, respectively, and summed to equal SSBs/day. For example, a teacher reporting 15 sodas/month and 7 sweetened drinks/week, consumed $0.5 + 1 = 1.5$ SSBs/day. Daily SSB consumption was categorized < 1 SSB/day or ≥ 1 SSBs/day (Park et al., 2014).

2.4. School characteristics

School-level demographic data for school year 2016–17 were downloaded from the National Center for Education Statistics (U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics, 2018), including total student enrollment; student enrollment by race/ethnicity (African American, Asian, Latinx or White); and proportion of enrolled students eligible for free/reduced-price meals (FRPM). Washington DC FRPM data were from 2014 to 15 (the most recent available).

2.5. Statistical analysis

To determine the associations between 1) SSB vending machines anywhere in the school and 2) SSB vending machines in staff lounges and staff SSB consumption, we used multilevel logistic regression models adjusted for school-level (total enrollment, enrollment by race/ethnicity and enrollment by FRPM status) and staff-level (age, sex and race/ethnicity) characteristics, a random intercept for school. Postestimation commands (margins) were used to determine the difference in the average predicted probability of each outcome between groups. Analyses were conducted using Stata/SE v15.1.

3. Results

Observational data were collected from all 51 schools. Fifty-nine percent (n = 1586) of the approximately 2700 school staff invited to take the survey responded and 1229 answered all demographic and SSB-related questions (46% of those surveyed). There were no significant differences in demographic characteristics between schools with a low ($< 50\%$) or high ($\geq 50\%$) school staff survey response rate (Table 1). Staff with incomplete survey data were more likely to work at schools with higher enrollment (987 vs. 850 students, $p = 0.003$); no other school-level characteristics were associated with survey completeness.

Forty-three percent of schools (n = 22) had vending machines on campus selling SSBs and 39% (n = 20) had SSB vending in the staff lounge. Thirty-four percent of staff reported consuming ≥ 1 SSBs/day. Among staff who drank ≥ 1 SSBs/day, mean consumption was 2.2 SSBs/day.

While holding other variables in the model fixed, staff in schools with SSBs in vending machines available anywhere on campus had a 1.3 greater odds of consuming ≥ 1 SSBs/day (95% CI 0.98, 1.74) as compared to staff in schools without SSB vending on campus, which equates to a 5.8% greater average probability of consuming ≥ 1 SSBs/day (95% CI: -0.48% , 12.00%). However, this did not quite reach statistical significance. While holding other variables in the model fixed, staff in school with SSBs in staff lounge vending machines had a statistically significant greater odds of consuming ≥ 1 SSBs/day (OR = 1.4; 95% CI: 0.98, 1.74), which translates to a 6.6% greater average probability of consuming ≥ 1 SSBs/day (95% CI: 0.11%, 13.12%) compared to staff in schools without SSB vending on campus (Table 2).

4. Discussion

In this first known examination of the association between the

Table 1
Descriptive characteristics of participating schools and school staff who reported sugar-sweetened beverage (SSB)^a consumption.

School Characteristics ^b	(n = 51)
School Type, n (%)	
Elementary	40 (78%)
Middle	6 (12%)
High	5 (10%)
Total enrollment, mean ± SD	712 (51.8)
Student enrollment by race/ethnicity, % ± SD	
African American	18% ± 28%
Asian	8% ± 7%
Latinx	54% ± 30%
White	16% ± 19%
Students who qualify for free or reduced-price meals, % ± SD	76% ± 21%
SSBs in vending machines in school, n (%)	22 (43%)
SSBs in vending machines in school staff lounge, n (%)	20 (39%)
School Staff Characteristics	(n = 1229)
Female, n (%)	993 (81%)
Age, n (%)	
< 30 years old	152 (13%)
30–39 years old	290 (24%)
40–49 years old	385 (31%)
≥ 50 years old	402 (33%)
Race/ethnicity, n (%)	
African American	101 (8%)
Asian	169 (14%)
Latinx	195 (16%)
White	718 (58%)
Other/Multiracial	46 (4%)
Position at school, n (%)	
Classroom teacher	820 (70%)
Educational staff (i.e. librarian, PE teacher)	22 (19%)
Administrative staff (i.e. principal, secretary)	79 (7%)
Food and facility service staff (i.e. cafeteria worker)	13 (1%)
Student health service staff (i.e. school nurse)	39 (3%)
Number of years worked at the school, n (%)	
0 to < 3 years	362 (30%)
3 to 10 years	495 (40%)
> 10 years	369 (30%)
Daily SSB consumption, n (%)	
< 1 SSB/day	816 (66%)
≥ 1 SSBs/day	413 (34%)

^a Sugar sweetened beverages (SSBs) defined as drinks with added sugar such as soda, pop, Kool-Aid, fruit drinks, sweet teas or coffees, energy drinks, etc.

^b Data from the National Center for Education Statistics for the 2016–17 school year.

Table 2
Adjusted^a association between availability of sugar-sweetened beverages (SSBs)^b in school vending machines and school staff daily SSB consumption (n = 51 schools and 1229 school staff).

	Odds Ratio ± SE (95% CI)	Difference in average predicted probability ± SE (95% CI)
SSBs available in vending machines anywhere in the school (n = 22 schools)		
< 1 SSBs/day	ref	ref
≥ 1 SSBs/day	1.3 ± 0.2 (0.98, 1.74)	5.8 ± 3.2 (-0.48, 12.00)
SSBs available in vending machines in school staff lounge (n = 20 schools)		
< 1 SSBs/day	ref	ref
≥ 1 SSBs/day	1.4 ± 0.2 (1.01, 1.83)	6.6 ± 3.3 (0.11, 13.12)

^a Multilevel logistic regression models adjusted for school-level (total enrollment, student enrollment by race/ethnicity, and enrollment by student free or reduced-price meal status) and school staff-level characteristics (sex, age, and race/ethnicity), with a random intercept for school.

^b Sugar sweetened beverages (SSBs) defined as drinks with added sugar such as soda, pop, Kool-Aid, fruit drinks, sweet teas or coffees, energy drinks, etc.

availability of SSB vending machines in schools and staff SSB consumption, we found that staff in schools with SSBs in staff lounge vending machines were more likely to report consuming ≥ 1 SSBs/day compared to staff in schools without SSB vending in staff lounges. While we cannot draw causal conclusions from this cross-sectional study, these findings suggest that the school beverage environment may influence staff SSB consumption. Extending existing school beverage standards to all school locations could benefit school staff health, though merits further study.

Public schools, unlike other workplaces, provide extensive onsite meal and beverage services that comply with nutrition standards and limit the sale of SSBs to students, which can have positive, although potentially limited (as observed in Canada and Europe) (Godin et al., 2019; Capacci et al., 2018), impacts on student SSB consumption (Johnson et al., 2009). However, existing school nutrition regulations, including the Smart Snack standards, apply to locations on the school campus that are accessible to students and do not extend to school settings that only serve adults (i.e., staff lounges) in the school. Further research is needed to understand the impact of extending existing school food regulations to the entire school environment, including staff lounges, on adult SSB consumption.

Policies to reduce SSB consumption by changing vending machine content and availability have been successfully enacted in workplaces, public buildings, state agencies, and health care settings (Grech and Allman-Farinelli, 2015). In a survey of U.S. consumers, nearly half of employed adults supported healthy workplace options, although only 28% supported less SSB availability. Effective ways to increase acceptance and support for healthy vending selections include having healthy options available at lower prices and displaying motivational messages (Hua and Ickovics, 2016).

4.1. Limitations

First, this study is limited by the cross-sectional design, which precludes drawing causal inference. Second, staff SSB consumption was self-reported and possibly influenced by recall or social-desirability bias. Third, while statistical models adjusted for measured school- and staff-level characteristics, unobserved variables could confound our findings. Fourth, our survey response rate was 59%, which while high compared to other school staff studies (Mertler, 2003), may influence generalizability. While surveys were sent to all staff from a school email address, some staff may not have computer access or use email/ have the digital fluency to complete the online survey. Additionally, 19% of respondents did not complete the SSB or demographic questions, precluding a statistical approach (e.g., multiple imputation) to address missing data. Finally, with a relatively small school sample size, we were underpowered to detect differences and to test for potential effect modification by school type or between districts.

5. Conclusions

School staff in schools with vending machines selling SSBs in the staff lounge were more likely to report consuming more than 1 SSB/day. Additional research examining the impact of regulating school adult beverage environments and the resulting impact on school staff health is warranted.

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Conflict of interest

The authors declare no conflict of interest.

CRedit authorship contribution statement

Suzanne Rauzon: Conceptualization, Methodology, Writing - original draft, Visualization, Supervision. **Hallie Randel-Schreiber:** Software, Methodology, Writing - review & editing, Project administration. **Elena Kuo:** Software, Writing - review & editing. **Pamela Schwartz:** Conceptualization, Writing - review & editing. **Annie L. Reed:** Writing - review & editing. **Hannah R. Thompson:** Conceptualization, Methodology, Writing - original draft, Formal analysis, Visualization.

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