

The Association between Access to Water and Sugary-Sweetened
Beverage Consumption in 37 Schools in King County

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Abstract

The association between access to good quality water and Sugar-Sweetened Beverage consumption in 37 schools in King County

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Background: Water is the ideal source of hydration with several health benefits. Water can be substituted for sugar-sweetened beverages (SSB) to decrease energy intake and other negative health consequences of SSBs. Increasing access to water is considered a successful strategy to decrease SSB consumption, but there has been little research to show the association. The purpose of this study is to explore access to water, SSB consumption and the relationships between them.

Methods: This cross-sectional study, combined data from an inventory of water and SSB access in 37 low-income secondary schools with data from the Washington State Healthy Youth Survey 2010, to examine the associations between school beverage environments and youth SSB consumption. Descriptive analyses were used to characterize access to SSBs using the number of slots of SSB in vending machines and other sources per 1000 students and access to water using the number of functional water stations per 1000 students. The quality of each water station was also used in the analysis by assigning each station a score of zero to four, based on the number of positive attributes of each station (water temperature less than 15 C°, odor-free, well-maintained,

fast flowing water). Simple linear regression and multiple linear regression models were used to examine the associations between access to water, quality of water stations and SSB consumption. Regression models also examined the influence of socioeconomic status, using the percent of students eligible for Free and Reduced-Price Lunch (% FRPL), on these relationships.

Results:

- Access to high quality water stations was limited.
 - The average quality scores for water stations in twenty-nine schools were less than two, and eight other schools' scores were between 2 and 2.6.
- High schools had higher access to SSBs compared to middle schools. Eleven out of 20 middle schools had zero access to SSBs, while this was only the case for one high school.
- Access to water was negatively associated with SSB consumption during the past day in high schools ($p < 0.05$), but not in middle schools.
- The %FRPL at the school and access to water were negatively related in high schools ($P < 0.05$) but not middle schools. Also, % FRPL at the school and SSB consumption during the past day were positively related both in middle and high schools ($p < 0.05$, $p < 0.01$).
- Adjusting the association between water access and SSB consumption for % FRPL, made the result no longer significant.

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Introduction

Water is the ideal beverage for all children and adults. It should be easily accessible as a basic human right [1]. Water keeps children hydrated, which has positive effects on their daily performance at school, as well as on their short- and long-term health. Even mild dehydration can negatively impact a number of important aspects of cognitive function such as concentration, alertness and short-term memory in children [2]. Providing water to school children can improve attentiveness and cognitive function [3, 4]. Fluorinated water consumption also prevents dental caries, the most chronic disease among children and adolescents [5]. Also, drinking water can substitute for sugar-sweetened beverages (SSBs), thus decreasing energy intake [6-8].

The Dietary Guidelines for Americans 2010 encourages people to drink water as a healthful means of hydration [9]. Free water is limited in many public places such as schools, and often does not meet the needs of the population [10]. The California Project LEAN's survey of more than 200 school districts determined the availability of drinking water in California schools. It found that schools do not have enough water fountains for the number of students, and that nearly 40% of responding districts reported not offering free drinking water in food service areas [11]. Unfortunately, caloric beverages become the default choice when access to water during school and after school hours is limited, and sugary beverages are easily accessible [12].

SSBs are beverages that contain added caloric sweeteners, such as sports drinks, energy drinks, juice flavored drinks, flavored waters, and sweetened tea and coffee drinks [13]. Excessive SSB consumption is associated with negative consequences such as excessive energy intake, weight gain, and obesity [13-23]. SSBs are the major source of

added sugar in the American diet [22]. These drinks account for approximately 22% of the “empty calories” consumed by children and teens [14, 15]. More than 23 million children and adolescents are overweight or obese in the US [24-26]. SSB consumption also reduces nutrient intake when SSBs are substituted for nutrient-dense beverages like milk. SSBs frequently contain caffeine, and their consumption can cause anxiety, withdrawal effects, and poor sleep; all of these can affect school performance [27].

The consumption of SSBs doubled in the US between 1977 and 2001 [28]. Adolescents aged 12-19 are the predominant consumers of SSBs and get 13% of their total calories from these beverages [24, 29]. Boys aged 12–19 years consume an average of 22.0 ounces of full-calorie sodas per day, and girls in the same age group consume an average of 14.3 ounces of full-calorie sodas [30]. During their time at school, students are now consuming less soda concurrent with the implementation of policies that restrict soda sales in schools [26, 31]. However, access to other SSBs such as sport drinks is not restricted as often by school policies, and consumption of non-soda SSBs has increased substantially [26]. High school students have greater access to SSBs compared to middle school students. In the 2010-11 school year, 63% of middle and 88% of high school students could buy some type of sugary drink at school [32].

There have been some policy changes regarding access to free water in schools. The “Act Relative to School Nutrition,” signed in 2010, requires Massachusetts schools to make free water available to all students during the day [33]. In 2011, California passed a similar reform, mandating school districts to provide free access to fresh drinking water during meal times in school food service areas [34]. On a national level, the Healthy, Hunger-Free Kids Act requires that schools participating in the National

School Lunch Program provide free, potable water at lunchtime and in places where lunch meals are served [35]. Through the Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) requires that municipal water systems test their water regularly for contaminants, although taste and odor of drinking water, and the condition of water access points are not included in federal and state requirements [36].

There is a small, but growing body of research about water access and water drinking behaviors in secondary schools. Before federal and state water access policies were implemented in California, one study showed that only 1 in 25 students drank free drinking water in food service areas [37]. Factors influencing water consumption include the number of stations, as well as students' perceptions regarding water station appearance and the smell and taste of the water. [37-39]. A 5-week intervention trial to study the effects of increasing access to good quality water in a Los Angeles middle school, found that students from the intervention group had higher adjusted odds of drinking water compared to the control group [40]. Currently, a three-year federally funded study is trying to increase the intake of tap water through different intervention strategies such as improving access to and quality of water in lieu of SSBs among Latino children and adolescents. So far no results have been published on this project [41].

The Institute of Medicine recommends that all SSBs be banned in schools [42]. Many states and districts have implemented less stringent policies that simply limit access to SSBs in schools [43]. Based on the Child Nutrition and WIC Reauthorization Act of 2004 [44], all the school districts that participate in United States Department of Agriculture (USDA) school meal programs have developed wellness policies that address

all foods and beverages in schools. In addition to school meals, which are required to meet the federal nutrition standards, students have access to other foods and beverages in school cafeterias, vending machines, stores, and other venues. These foods and beverages are called competitive foods, and they are usually high in added sugars, fat, and sodium [45, 46]. The Hunger-Free Kids Act of 2010 required the USDA to develop competitive food and beverage standards and wellness policy regulations [35], which limit access to SSBs and other competitive foods, but these have yet to be finalized [47], and policies regarding access to SSBs currently have considerable variation throughout the US [31].

Many studies find a strong association between access to SSBs and SSB consumption. A review found that policies that limit access to SSB decrease purchases and consumption of SSBs; these impacts are almost immediate [48, 49]. For adolescents, frequency of soft drink consumption is positively associated with the use of vending machines and access to soft drinks at school [49, 50]. Adolescents are 2.4 times more likely to consume soft drinks more than five times a week when they are available at school [49].

Advocates believe that increasing access to water in schools will decrease SSB consumption [51-53], but there has been little research demonstrating this relationship.

This study takes advantage of existing secondary data to describe access to water and SSBs in 37 schools in King County. The study also explores the association between access to water and SSB consumption in these schools. Previous studies show that access to water and SSB consumption differ based on socioeconomic status (SES) [54, 55]; this study explores whether access to water and SSB consumption are related to the percent of students eligible for Free and Reduced-Price Lunch (% FRPL) as a proxy for SES.

The aims of this study are to:

(1) Describe the characteristics of water access, SSB access, and SSB consumption in 20 middle and 11 high schools located in South King County.

(a) Describe the characteristics of the study sample and the distribution of the proportion of students eligible for %FRPL across the schools;

(b) Determine the distribution of total water access points per 1000 students and the quality of those water access points in regards to temperature, odor, color, speed of flow, and appearance/maintenance of water stations;

(c) Describe the distribution of SSB access per 1000 students across the schools;

(d) Describe the distribution of SSB consumption across the schools;

(e) Determine if there are differences in water access, water quality, SSB access or SSB consumption in middle compared to high schools;

(f) Determine the associations of % FRPL with water access, water quality, SSB access or SSB consumption in middle compared to high schools;

(g) Examine the overall associations between SSB access (access to any SSB at school) and SSB consumption (times consumed SSB during the past day and past seven days).

(2) Examine the associations between water access and SSB consumption.

(a) Determine the overall unadjusted associations between (i) water access points and (ii) quality of the water access points per 1000 students and SSB consumption;

- (b) Determine the unadjusted associations between water access points, quality of the water access points per 1000 students, and SSB consumption stratified by middle and high schools;
 - (c) Determine the unadjusted associations between water access points, quality of the water access points per 1000 students, and SSB consumption stratified by the lowest and highest %FRPL;
 - (d) Determine the unadjusted associations between water access points, quality of the water access points per 1000 students, and SSB consumption stratified by access to SSB at school and no access to SSB at school.
- (3) Examine the associations between water access and SSB consumption in multivariate models adjusting for SES (or %FRPL). The hypothesis is that higher access to good quality water in schools is associated with lower SSB consumption.

Methods

Setting and Participants:

This cross-sectional study was a secondary analysis of data from a convenience sample of 37 schools in South King County. In 2011, the University of Washington Center for Public Health Nutrition conducted a comprehensive School Beverage Inventory (SBI) to gather information about the availability, type of free water access, and SSB availability in 40 secondary schools in six low-income districts that were participating in a large Communities Putting Prevention to Work initiative. The SBI was based on the Beverage Audit Protocol developed by the Harvard School of Public Health Prevention Research Center. Details on sampling methods and data collection strategies are described elsewhere [56]. To assess the availability of free water, the number of water fountains, water coolers, hydration stations and other sources of free water in each school were counted. Each of these sources of free water was assessed for water quality (flow, temperature, clarity, smell, color) and appearance. SSB availability in vending machines, school stores and à la carte in the cafeteria was inventoried. To calculate the number of slots in vending machines serving SSBs, the number of slots filled by a particular beverage or the number of buttons devoted to a particular beverage where the actual slots were not observable was used. In schools stores and à la carte where no actual slots exist to count, any type of beverage available for sale was counted as a slot. In each school, the number of slots of SSBs – non-diet sodas, juice drinks, tea and water sweetened with caloric sugar – was counted.

Mirroring the primary study [56], appropriate access to water is defined as the following in the current study: having a water temperature lower than 15 degrees

centigrade, water free of odor, well-maintained water stations of good appearance, and fast flow of water. Flow of water was measured by the time (seconds) it took to fill a 3-ounce vial.

Data on SSB consumption were obtained from the Healthy Youth Survey (HYS) 2010. The Washington State Department of Health's HYS is completed biannually in middle and high schools. This survey measures health risk behaviors that contribute to morbidity, mortality, and social problems among youth. Within participating schools, all students in grades 8, 10, and 12 were asked to participate [57]. This study used the data for grades 8 and 10. An exempt status request for HYS 2010 data was submitted in summer 2012 to the Washington State Institutional Review Board for HYS data from the schools that were inventoried for the SBI; HYS data were available for 37 of the 40 schools. The HYS survey included two questions regarding SSB consumption as follows:

- “How many sodas or pops did you drink yesterday? (Do not count diet soda)”
- “During the past 7 days, how many times did you drink regular soda, sports drinks (such as Gatorade) and other flavored sweetened drinks (such as Snapple or SoBe) at school (including any after-school and weekend activities)? Do not include diet drinks.”

Measures

Assessment of access to quality water

All the variables were aggregated at the school level. The aggregated metric of access to water in each school was the total number of functional water stations in each school divided by the school enrollment and multiplied by 1000. The number of water

access points that provided water with a temperature less than or equal to 15 degrees centigrade in each school was divided by the number of students enrolled in that school and multiplied by 1000 to calculate the mean access to water with ideal temperature. The same method was used to calculate the mean access to water with no smell, good flow, and good appearance.

Another variable was the average score of water stations per school. A score from zero to four was calculated for each access point. Four was the perfect score meaning the access point had 1) fast flow of water, 2) good appearance, 3) water with a temperature less than 15°C, and 4) water with no smell. The scores for all access points were summed for each school and were divided by the number of access points to get each school's average access point score. The SBI also provided data to measure the access to SSB in each school. The aggregate metric for the SSB access was the total number of the exposure slots divided by the school's enrollment and multiplied by 1000.

Assessment of SSB consumption at the school level

The SSB consumption data for individual students were used to extrapolate the SSB consumption at the school level. To get the average times students drank SSBs during the past seven days in each school, the responses to this question on the questionnaire were summed and were divided by the number of respondents. The same method was used to get the mean number of times students consumed SSBs during the past day in each school.

Potential Confounders

Based on previous research examining SSB consumption, control variables were considered to be % FRPL and type of school [32, 49]. Percent of students eligible for

FRPL was obtained from the Washington State Office of Superintendent of Public Instruction (OSPI). To be eligible for free or reduced lunch under the National School Lunch Act, students must live in households earning at or below 130% of the Federal poverty level. Higher percentage of FRPL shows lower socioeconomic status of the population served by the school.

Data Analysis

All the analyses were done at the school level. For the first aim, to describe the sample characteristics, the mean, median, standard deviation, and range were provided for school enrollment, % FRPL and race. Further descriptive analyses were used to describe access to water, good quality water and SSBs. Simple linear regression models were applied to explore the associations of % FRPL, water access, water quality, SSB access and SSB consumption in middle schools compared to high schools. Using the same method, the association between SSB access and SSB consumption was examined. Since access to SSBs was highly skewed in the 37 schools, log scale data were used. For the second aim, simple linear regression models were used to explore the overall and stratified associations between (i) water access and (ii) quality of water access per 1000 students and SSB consumption. These associations were explored in stratified data. Finally for the third aim, multiple linear regression models were used to assess the association between water access and SSB consumption adjusting for % FRPL.

Results

Descriptive Statistics

The characteristics of the schools in this study are shown in Table 1. There were 20 middle schools and 17 high schools. The mean school enrollment was 1097 with a range of 477-2289. Across the schools, 4,300 students answered questions related to SSB consumption on the HYS. On average, more than 50% of the students in these schools were eligible for FRPL. The distribution of % FRPL across the 37 schools was fairly normal. In 17 schools, the percentage of FRPL was less than 50% and in 20 schools it was more.

Table 2 provides detailed information on access to water and SSBs at the school level for the study sample. The number of functional water stations in these 37 schools ranged from 3 to 33 per 1000 students, while the distribution was close to normal (Figure 1). On average, the number of water access points that provided water with a temperature less than 15 degrees centigrade was less than five stations per 1000 students. This was also observed for the number of stations that have good appearance and flow. On average, almost 14 fountains per 1000 students in these schools provided water with no odor, which was close to the average number of functional stations. Figure 2 shows that the distribution of the water access points that had a desirable appearance across the 37 schools is highly skewed. Most of the schools had few stations with good appearance. This was the same for the distribution of access points with other characteristics (no smell, desirable water flow, and desirable water temperature). There were 29 schools with average water access point scores less than 2, and eight other schools with access points between 2 and 2.6.

There was a mean of 15 SSB slots per 1000 students across the schools. The distribution of SSB access was not normal across the 37 schools and ranged from zero to 102 SSB slots per 1000 students. Mean SSB consumption in these schools ranged from 1.5 to 3.5 ($0.6 \pm .15$) times during the past day. The average of the mean SSB consumption during the past seven days was $2 \pm .41$, with the range of 1.5 to 3.5 times during the past seven days. The distribution of SSB consumption during the past day was almost normal, while the distribution of SSB consumption during the past 7 days was slightly skewed toward less frequent consumption.

Access to SSBs and water were different in middle schools versus high schools, but quality of water and SSB consumption were not. SSB access had a range of zero to 24 slots per 1000 students in middle schools, while this range was zero to 102 slots per 1000 students in high schools. Eleven out of 20 middle schools had zero access to SSBs while this was the case for one high school. Water access was also higher in high schools versus middle schools. On average, access to water was 12 ± 6 access points per 1000 students in middle schools and 17 ± 6 access points per 1000 students in high schools. Detailed information on water access and water quality in middle schools versus high schools is provided in Table 3.

Percent FRPL at the school and access to water were negatively related in high schools ($P < 0.05$) but not middle schools. Also, % FRPL at the school and SSB consumption during the past day were positively related both in middle and high schools ($p < 0.05$, $p < 0.01$). There were no associations between SSB access and % FRPL, water quality, or SSB consumption during the past seven days; and school level SSB access was not related to SSB consumption during the past day or the past 7 days.

Unadjusted Correlation between Access to Water and SSB Consumption

In unadjusted models, access to water and SSB consumption during the past day were negatively related ($p < 0.05$). Figure 3 displays a scatter plot of the number of access points and SSB consumption during the previous day at the school level. There was no association between water access per 1000 students and SSB consumption during the past seven days.

The quality of water access stations was not significantly related to either of the two measurements of SSB consumption (SSB consumption during the past day and SSB consumption during the past 7 days), either by comparison with the overall quality score or with each component of water quality.

When answers to the HYS question about SSB consumption in the previous day were used as the indicator of SSB consumption, access to water was significantly associated with lower SSB consumption in high schools ($p < 0.05$), but not in middle schools. Water access was associated with lower SSB consumption when SSBs were available in the school ($p < 0.01$), but not associated when SSBs were not available in the school. Water access and SSB consumption were not significantly related in a stratified analysis conducted on both the lowest and highest % FRPL schools. When using the HYS question about SSB consumption during the past 7 days, none of the associations between consumption and access variables were significant.

Adjusted Correlation between Access to Water and SSB Consumption

For the last aim, multivariate models were used to adjust for % FRPL. Adjusting for this covariate did not change the insignificant results of the bivariate regressions.

However, adjustments did change the results for access to water and SSB consumption over the last day. For this multivariate model, % FRPL was significantly related to SSB consumption over the last day and access to water was no longer significant. More specific information on regression models is provided in Tables 4 and 5.

Discussion

The purpose of this study is to explore water and SSB access and the relationships between them in order to inform public health actions to improve the healthfulness of beverage consumption in secondary schools.

In these 37 low-income schools, neither the quantity nor the quality of the water access points appears to meet students' water needs at school, especially in the lowest income schools, and SSB access is highly variable. In the study sample, access to SSB and water is higher in high schools versus middle schools. Low student socioeconomic status is associated with both lower water access in high schools and higher SSB consumption both in high schools and middle schools. In high schools access to water does seem to be associated with SSB consumption in some way, but other factors may make a bigger difference in SSB consumption.

Based on the Washington State plumbing code, one drinking fountain is required for the first 150 occupants, then one per each additional 500 occupants in a school building. This means that two fountains would be required for every 1000 students. According to this code, all the schools in this study are meeting the requirements [56, 58]. However, the ideal number of water stations per student is probably higher than the Washington state code. California requires one water fountain per 150 people on a school campus (six access points per 1000 students). Even then, a 1999 memo from the Superintendent of Public Instruction in California found that the requirement was inadequate for the needs of schools [59].

It is important to note that the quantity of access points is not the only factor determining the adequacy of the access to water. Maintenance of the fountains also

determines the sufficiency [37]. In this sample of 37 schools, the majority of the schools have an average water access point score less than 2.0, which indicates that not many access points in the schools meet quality requirements (appearance, good flow, water with no smell, and good temperature). Not meeting these quality requirements has been found to be a major barrier to water consumption [37]. In addition to improving access, there is a need to improve the quality of free water with better quality in schools.

A significant negative association between access to water and SSB consumption during the past day in high schools suggests that increasing water access may be worth pursuing as a strategy to decrease SSB consumption. The directions of association between some indicators of good quality water and SSB consumption, although not significant, suggest that increasing water quality might also decrease SSB consumption. Inadequate water access in schools, specifically when SSBs are easily accessible, may contribute to students' choices to drink SSBs when they are thirsty. Though the evidence on this association is not extensively investigated, CDC considers increasing access to water and improving its quality as a strategy to decrease SSB consumption [40, 52].

In the study sample, access to water is significantly associated with SSB consumption in schools where SSBs are available, but that is not the case when SSBs are not available. This is while access to SSBs is higher in high schools compared to middle schools. National surveys have also found higher levels of access to SSBs in high schools compared to middle schools [32]. By the time children move to higher grade levels, and transition to increasingly greater independence and start forming their own dietary habits, the school food environment offers significantly more à la carte and vending choices promoting calorically-dense and nutrient-poor options such as SSBs [32, 60]. When

there are more competitive food and beverage choices, higher exposure to SSBs contributes to higher SSB consumption [48, 49]. Although in-school SSB consumption has been estimated to account for 7-15% of total weekly SSB calories consumed by students, adolescents are 2.4 times more likely to consume soft drinks more than five times a week when they are available at school [49]. Johnson et al. showed that SSB exposure is a significant predictor of SSB consumption [61]. These findings emphasize the importance of limiting access to all types of SSBs in schools.

Previous studies have found that improving access to water alone without decreasing access to SSBs does not decrease SSB consumption significantly [6, 62]. However, the Zuni High School Diabetes Prevention Program found that reducing access to and providing education about SSBs, while simultaneously improving access to water, increases water consumption and decreases SSB consumption [63].

In this study, the significant association between access to water and SSB consumption diminish after adjusting for % FRPL and school type. In multiple linear regression, it was observed that % FRPL was significantly associated with SSB consumption. This suggests that other than water access, SES plays a major role in SSB consumption. As in other studies, the current study found that low SES is positively associated with SSB consumption [54]. In the National Health and Nutrition Examination Survey (NHANES) data from 1999 to 2008, low-income children had higher odds of SSB consumption and also higher energy intake from total SSBs and fruit drinks than high-income children [64]. At the same time, in this study and others, schools in low-income communities have lower access to free water [55]. All of the above points indicate that socioeconomic status may confound the association between

access to water and SSB consumption

Access to water and SSBs are not the only factors at play in adolescent beverage consumption behaviors. Determinants of SSB consumption are complex and interrelated. There are many factors at the individual, interpersonal, and environmental levels that affect water and SSB consumption. Cultural and economic factors, health behaviors, health education and awareness, schools' policies and even students' daily schedule play important roles in student dietary behaviors [39, 65-67]. For instance, adolescents may prefer to focus their time and energy on fun activities rather than standing in line for drinking water from water fountains, or they may wish to behave like their peers and drink sport drinks instead of water.

Conclusion

There is a need to improve both access to water and the quality of water in schools to meet student's basic needs for hydration during the school day. Improving water access can be aligned with comprehensive approaches to decrease SSB consumption, specifically in high schools. High schools with higher % FRPL might benefit from additional attention regarding ways to improve water access and decrease SSB access [61]. The reasons for SSB consumption and inadequate water intake are poorly understood, and more research is needed to determine the most important components of a comprehensive approach to improve the healthfulness of adolescent beverage intake at school.

Limitations

As a secondary analysis of data that were collected for another purpose, this study has limitations. This cross-sectional study can only show associations between factors,

not a causal relationship. The convenience samples used in this study are not representative of all secondary schools. Water consumption is the potential mediating factor in assessing the associations between access to water (exposure) and consumption of SSBs (outcome), but data on the students' actual water consumption from the water stations at school are not available. The HYS survey was conducted in 2010, while the water inventory completed in 2011; thus, it is possible that there were some changes in access to free water stations throughout the schools from 2010 to 2011.

Implication for Schools' Health

Considering the sizable amount of time that children spend in school, the school environment influences children's healthy eating behaviors. Studies have reported that when school-aged children drink beverages high in sugar, this can displace their consumption of healthier beverages [68, 69]. Improving access to appealing water has been shown to increase water consumption [6, 40, 62, 63]. Water intake will improve children's school performance and overall health. It can substitute for SSBs and decrease energy intake. Increasing access to water specifically in schools with lower SES would be a good strategy to increase water consumption. Simultaneous efforts should focus on decreasing SSB consumption through different strategies, such as decreasing access to SSBs. Access to soda in schools has decreased significantly over time, and its consumption has decreased in schools. However, non-soda SSB access has not shown the same trend, and as a result their consumption has tripled among adolescents [31, 64]. Targeting other popular SSBs, such as sport drinks and fruit drinks, in all accessible places would be helpful to decrease SSB consumption.

Human Subjects Approval Statement

The Washington State Department of Health Institutional Review Board approved the study protocol of this research.

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Figure 1. Distribution of the Number of Water Access Points at the School Level in 37 Secondary Schools in King County

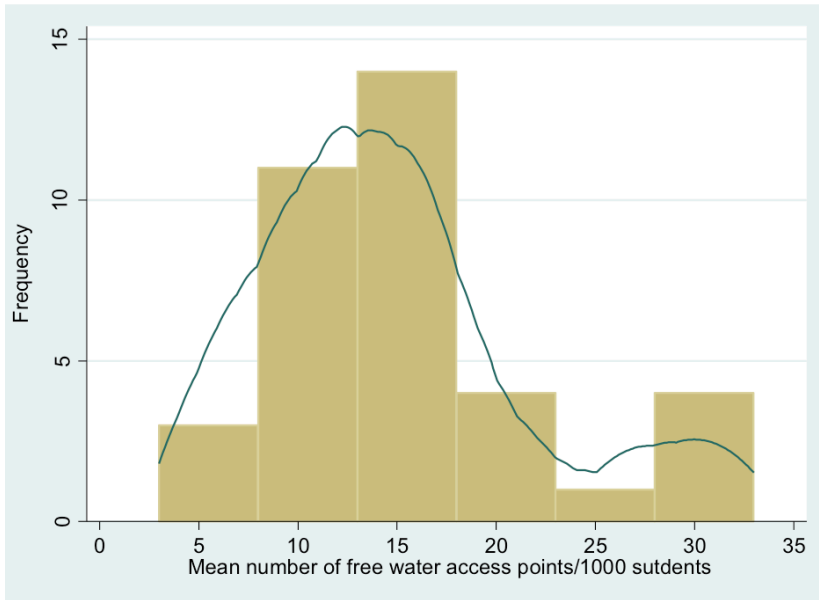


Figure 2. Distribution of the Number of Water Access Points With Desirable Appearance at the School Level in 37 Secondary Schools in King County

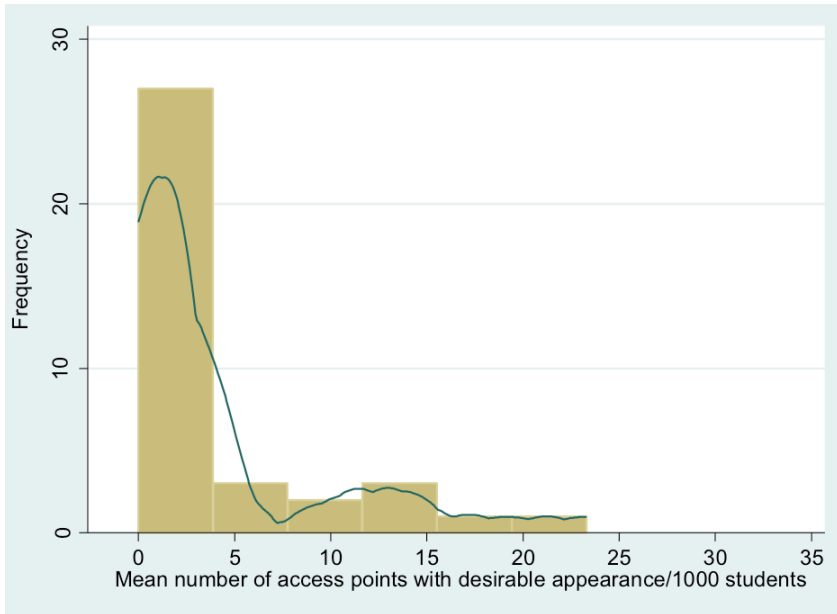


Figure 3. Scatterplot of School-Level SSB Consumption During the Past Day and the Number of Water Access Points per 1000 Students in 37 Schools in King County, $r=-0.4$, $p=0.02$

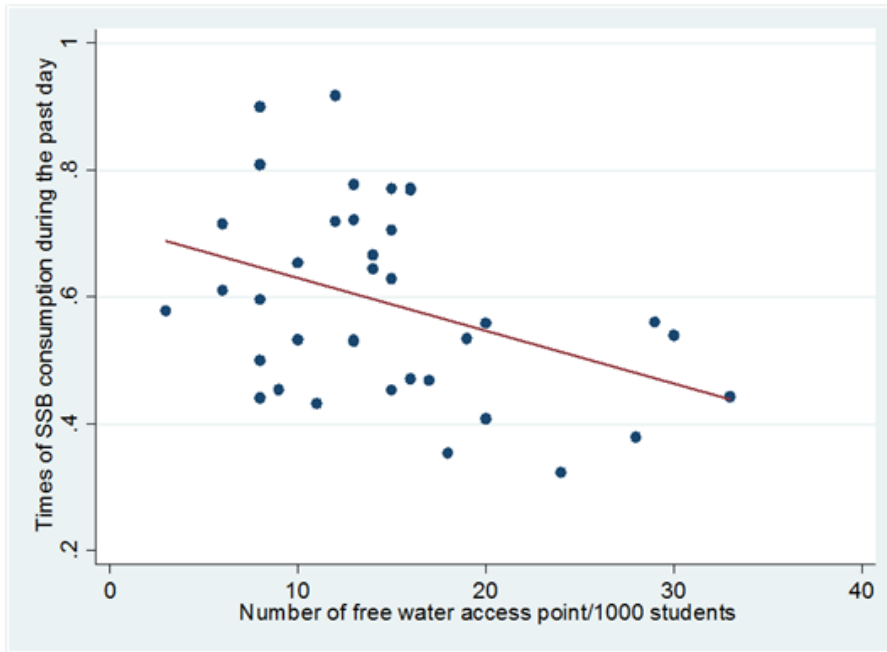


Table 1. Characteristics of Study Secondary Schools in Six School Districts in South King County (n=37)

Characteristics	Mean± SD	Median	Range
School enrolment (n)	1097±491	911	477-2289
Proportion of students eligible for free and reduced-price lunch (%)	51±16	52.4	27-82
Race/ethnicity (%)			
Asian	21.73±10.39	18.2	7.92-55.55
American Indian/ Alaskan Native	1.73±1.34	1.35	0.44-8.1
Black	17.52±12.59	12.2	4.85-57.3
Hispanic	16.14±7.74	14.7	5.94-37.32
White	40.06±20.08	39.7	4.09-70.82

Table 2. Indicators of School-Level Beverage Environments (Water and SSB) n=37

Explanatory variables	Mean± SD	Median	Range
Access to free water at school by enrollment (No of functional water stations/school enrollment x1000)	14.73±6.1	14.00	3- 33
Average water access points score*	1.65±0.44	1.63	.25-2.65
Access to water access points with water temperature<15°C at school by enrollment (No. of water stations with water <15°C +/-school enrollment) x1000	1.82±2.38	1.22	0- 9.77
Access to water access points with water flow <3sec at school by enrollment (No. of water stations with flow <3 sec/school enrollment) x1000	4.88±3.89	4.02	0- 16.74
Access to access points with odorless water at school by enrollment (Number of water stations with no smell water/school enrollment) x1000	13.85±8.76	10.81	0- 50.23
Access to water access points with appealing appearance at school by enrollment (No. of water stations with appealing appearance/school enrollment) x1000	3.90±5.87	2.01	0-23.30
Access to SSB at school by enrollment (No. of total exposure slots for SSB/school enrollment)x1000	15.3±24.6	3.6	0-102

*Each access point could get any score from 0 to 4. Four is the best score and means the access point has all the desirable characteristics which are 1) has flow of water less than 3 sec, 2) has good appearance, 3) water temperature is less than 15°C 4) and water has no. Description of the scores is as follow:

- 4 = Access point has all four desirable characteristics
- 3= Access point has three desirable characteristics
- 2= Access point has two desirable characteristics
- 1= Access point has one desirable characteristics
- 0= Access point has neither of the desirable characteristics

Table 3. Access to Sugary Sweetened Beverage (SSB) and Access to Water in 37 Middle schools and High Schools in King County

Characteristic	Mean \pm SD	Median	Range
Access to SSB at school (n slots/1000 students)			
Middle school (n=20)	4.4 \pm 7	0	0-24
High school (n=17)	28 \pm 31	20	0-102
Water access at school (n access point/1000 students)			
Middle school (n=20)	12 \pm 6	11.5	3-33
High school (n=17)	17 \pm 6	16	6-30

Table 4. Association Between School-Level Water Access Characteristics and Mean Number of Times Students Reported Consuming SSB During the Past Seven Days in 37 Secondary Schools in King County

Explanatory variables	Times of SSB consumption during the last 7 days					
	Unadjusted			Adjusted ^b		
	Coef. (95% CI)	SE	P	Coef. (95% CI)	SE	P
Access to free water (No of functional water stations/school enrollment x1000)	.004(-.016, .025)	.01	.7	.01(-.01, .03)	.01	.3
Middle school (n=20)	-.003(-.025, .018)	.01	.8	.001(-.02, .02)	.01	.9
High school (n=17)	-.01(-.048, .021)	.02	.4	-.001(-.04, .04)	.02	.9
Schools with no access to SSB (n=12)	.01(-.008, .035)	.01	.2	.01(-.01, .03)	.01	.2
Schools with access to SSB (n=25)	-.001(-.03, .03)	.01	.9	.01(-.02, .04)	.01	.4
Access to water access points with water temperature<15°C (No. of water stations with water <15°C +/school enrollment) x1000	-.005(-.064, .055)	.03	.9	-.005(-.07, .05)	.03	.8
Access to water access points with water flow <3sec (No. of water stations with flow <3 sec/school enrollment) x1000	-.03(-.062, .009)	.02	.1	-.02(-.06, .01)	.02	.2
Access to water access with water no smell	.003(-.012, .019)	.01	.7	.003(-.01, .02)	.01	.6
Access to water access points with appealing appearance (No. of water stations with appealing appearance/school enrollment) x1000	.004(-.02, .028)	.01	.8	.001(-.02, .02)	.01	.9
Average water access points scores [†]	-.08 (-.39, .24)	.2	.6	-.07(-.4, .2)	.1	.6

* P<.05

^bAdjusted for %FRPL

[†]Each access point could get any score from 0 to 4. Four is the best score and means the access point has all the desirable characteristics which are 1) has flow of water less than 3 sec, 2) has good appearance, 3) water temperature is less than 15°C 4) and water has no. Description of the scores is as follow:

4 = Access point has all four desirable characteristics

3= Access point has three desirable characteristics

2= Access point has two desirable characteristics

1= Access point has one desirable characteristics

0= Access point has neither of the desirable characteristics

Table 5: Association Between School-Level Water Access Characteristics and Mean Number of Times Students Reported Consuming SSB During the Past Day in 37 Secondary Schools in King County (20 Middle Schools and 17 High Schools)

Explanatory variables	Unadjusted			Adjusted ^b		
	Coef. (95% CI)	SE	P	Coef. (95% CI)	SE	P
Access to free water (No of functional water stations/school enrollment x1000)	-.008(-.015, -.001)	.003	0.02*	-.003(-.01, .004)	.003	.3
Middle school	-.002(-.013, .008)	.005	0.6	.001(-.01, .01)	.005	.8
High school	-.01(-.022, -.001)	.005	0.03*	-.006(-.02, .005)	.005	.2
Schools with no access to SSB (n=12)	-.002(-.01, .007)	.004	0.6	-.001(-.01, .01)	.005	.8
Schools with access to SSB (n=25)	-.01(-.02, -.003)	.004	0.008**	-.004(-.01, .004)	.004	.3
Access to water access points with water temperature<15°C (No. of water stations with water <15°C +/school enrollment) x1000	-.001(-.023, .02)	.01	0.9	-.002(-.02, .02)	.008	.8
Access to water access points with water flow <3sec (No. of water stations with flow <3 sec/school enrollment) x1000	.0001(-.013, .013)	.006	0.9	.003(-.007, .01)	.005	.5
Access to water access with water no smell	.002(-.004, .007)	.002	0.6	.001(-.003, .006)	.002	.5
Access to water access points with appealing appearance (No. of water stations with appealing appearance/school enrollment) x1000	-.0001(-.008, .008)	.004	0.9	-.003(-.01, .004)	.003	.3
Average water access points scores¶	-.03 (-.149, .083)	.06	0.6	-.03(-.1, .07)	.05	.5

* P<.05** P<0.01

^b Adjusted for %FRPL

¶Each access point could get any score from 0 to 4. Four is the best score and means the access point has all the desirable characteristics which are 1) has flow of water less than 3 sec, 2) has good appearance, 3) water temperature is less than 15°C 4) and water has no. Description of the scores is as follow:

4 = Access point has all four desirable characteristics

3= Access point has three desirable characteristics

2= Access point has two desirable characteristics

1= Access point has one desirable characteristics

0= Access point has neither of the desirable characteristics