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Limited school drinking water access for youth

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Abstract

PURPOSE—Providing children and youth with safe, adequate drinking water access during school is essential for health. This study utilized objectively measured data to investigate the extent to which schools provide drinking water access that meets state and federal policies.

METHODS—We visited 59 middle and high schools in Massachusetts during spring 2012. Trained research assistants documented the type, location, and working condition of all water access points throughout each school building using a standard protocol. School food service directors (FSDs) completed surveys reporting water access in cafeterias. We evaluated school compliance with state plumbing codes and federal regulations and compared FSD self-reports of water access with direct observation; data were analyzed in 2014.

RESULTS—On average, each school had 1.5 (SD: 0.6) water sources per 75 students; 82% (SD: 20) were functioning, and fewer (70%) were both clean and functioning. Less than half of the schools met the federal Healthy Hunger Free Kids Act requirement for free water access during lunch; 18 schools (31%) provided bottled water for purchase but no free water. Slightly over half (59%) met the Massachusetts state plumbing code. FSDs overestimated free drinking water access compared to direct observation (96% FSD-reported versus 48% observed, kappa=0.07, p=0.17).

CONCLUSIONS—School drinking water access may be limited. In this study, many schools did not meet state or federal policies for minimum student drinking water access. School

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administrative staff may not accurately report water access. Public health action is needed to increase school drinking water access.

IMPLICATIONS AND CONTRIBUTIONS—Adolescents' water consumption is lower than recommended. In a sample of Massachusetts middle and high schools, about half did not meet federal and state minimum drinking water access policies. Direct observation may improve assessments of drinking water access and could be integrated into routine school food service monitoring protocols.

INTRODUCTION

Access to safe, clean drinking water is essential for health.[1–2] Adequate water intake helps to maintain proper body hydration. In turn, hydration status is associated with proper circulatory and metabolic function;[1–2] emerging evidence suggests that poor hydration is associated with poorer cognitive function,[3–7] mood,[6–7] and wellbeing.[8] Increasing water consumption may be an effective strategy for reducing intake of sugar-sweetened beverages and subsequently reducing risk of obesity and dental caries.[2, 9–12] However, national studies suggest that children and adolescents, in particular, do not drink adequate amounts of water as defined by the Institutes of Medicine[13–14] and that over half of children and adolescents are not adequately hydrated at any given time, with significant disparities in hydration status by gender and race/ethnicity.[15]

Most American children and youth spend much of their time – on average 6.6 hours per day for about 180 days per year[16] – in public school settings. It is crucial, therefore, that schools provide students with access to safe, free, clean drinking water during the day. School water access is determined by policies at several levels of influence. Individual states set plumbing codes that specify the minimum number of water sources per a given number of students and can also specify the types of water sources allowed;[17] codes requiring a higher minimum of sources have been associated with higher levels of student-reported water access in schools.[18] Although district- or school-level wellness policies could set requirements for water access, few of such policies have been found to do so.[19] At the federal level, the Healthy, Hunger-Free Kids Act of 2010 requires schools participating in the National School Lunch Program to provide drinking water at no cost to students during lunch, in the places where they are served lunch.[20] This requirement went into effect during the 2011–2012 school year.[21]

Despite these policies, water access in schools is by no means universal. Access varies by region and by the sociodemographic makeup of the student body,[18] and providing adequate access to safe water can be challenging for schools with older infrastructure or limited access to safe tap water sources.[19, 22–23] Although a recent, nationally representative survey of U.S. public schools found that most public school students (over 86%) attend schools that meet the HHFKA requirement for providing free water during lunch,[24] this survey relied on reports from school principals, the validity of which are unclear. In order to assess whether public health action is needed to improve water access in schools and thus reduce the potential negative health impacts of inadequate water intake and hydration, there is a need for objectively measured data about the adequacy of water access in schools.

Our aim was to describe the state of drinking water access for youth using a direct observation protocol in a sample of public middle and high schools throughout Massachusetts. From these direct observations, we evaluated whether schools met the Massachusetts state plumbing codes as of spring 2012, as well as whether the schools met the HHFKA requirement for free water access during lunch. These two policies were the relevant drinking water access policies in place at the time for Massachusetts schools; although Massachusetts now has a state regulation specifying that free drinking water must be made available to students throughout the day (implemented in the 2012–2013 school year), this was not in place at the time of the study[19] Similarly, although it is possible for local education agencies to issue district wellness policies that specify the provision of drinking water to students, very few Massachusetts districts (6%) had such policies in place.[19] Lastly, to assess the validity of administrator-reported data about school water access, we compared our direct observations of water access in lunchroom areas to reports about water access in lunchroom areas from school food service directors.

METHODS

Sample and design

This cross-sectional study utilizes information gathered from the baseline data collection of the Nutrition Opportunities to Understand Reforms Involving Student Health (NOURISH) study, conducted May–June 2012. School districts with both middle and high schools in Massachusetts were eligible to participate in the study; 113 districts were invited to participate, with a middle and high school randomly sampled within each district.[25] Of these, 31 districts (31%) agreed to participate in the water access assessment, with the primary reason for nonparticipation given being a lack of time on the part of the district food service directors, resulting in a final sample size of 59 school buildings for water access analysis (in two districts, the middle and high school shared the same building, while in a third district only a high school was visited). Each participating school was visited by research assistants on one day to complete a direct observation of drinking water availability at the school. Study procedures were approved by the Office of Human Research Administration at the Harvard T.H. Chan School of Public Health.

Measures

For the on-site observations of water access, trained research assistants visited each participating school and used a standardized protocol to document school drinking water access. Research assistants walked through the entire school building to assess the presence of drinking water access points. Each time a drinking water access point was identified, the research assistant recorded the type (e.g. fountain, cooler, pitcher), functional status (able to draw water versus not able to draw water from the source), and their perception of the cleanliness of the water source (coded as clean or dirty). Bathroom, classroom, and kitchen sinks were excluded unless cupholders or signage specifying the sink should be used for drinking were observed. Research assistants recorded the location of the water source, including the specific floor and closest room number (if applicable) and categorized the location type (i.e., hallway, cafeteria, gym, classroom, office, play space, outdoors, or other). Flow rate, operationalized as the time to the nearest second needed to draw nine fluid ounces from the water source, was measured using a stopwatch and cup. Water temperature was measured using a digital thermometer (Taylor; Model # 9847N) to the nearest tenth of a degree Fahrenheit. Research assistants were trained to take detailed qualitative notes about their perceptions of the water sources' appearance (e.g. whether the water source was rusty, had trash in the basin, etc.). Additionally, research assistants documented each vending machine, school store, or other beverage sale access point where bottled water was sold, including in cafeterias. In a separate study utilizing a similar protocol, inter-rater reliability for coding of water source type was excellent, with κ=0.91; interrater reliability was also high for coding of water source location, with κ=0.83.

Food service directors (FSDs) for each school district were asked to complete a survey online asking about water access at the selected middle and high schools. The survey was developed with input from expert fellow researchers and stakeholders, and was meant to align with similar questions asked about water in the USDA's Special Nutrition Program Operations Study.[26] The survey asked FSDs to report on the school building's source of tap water (response options: public or municipal, site-operated well, no tap water available, or don't know) and the frequency of water quality testing at the school (response options: more than annually, annually, less than annually, or not tested). FSDs were also asked for both the participating middle and the high school, "Is free drinking water available to students where school meals are served?" and asked to either choose "No water is available" or to indicate which specific water source was available in that school's cafeteria (water fountain, water cooler, large insulated container, hydration station, pitcher/jug, or free individual bottled water). FSDs were also given a response option of "don't know." Pictures representing each water source type were provided to assist FSDs with choosing their answer. We coded the FSDs as reporting lunchtime cafeteria water access if they answered yes to any of the listed types of lunchtime water access. FSDs completed surveys about water access for 48 sampled schools (81%). Schools with FSD reports were not significantly different from schools without FSD reports with regards to school-level demographics or water availability.

School-level demographic information for school year 2011–2012, including total enrollment, the racial/ethnic makeup of the student body, and the proportion of the student body qualifying for free or reduced price lunch was obtained from the Massachusetts Department of Elementary and Secondary Education website.[27]

Statistical Analysis

We calculated the total number of drinking water sources for each school and the average number of free water sources per school cafeteria, as well as the proportion of those sources that were fountains and the proportion that were marked as clean and functioning by data collectors. We also calculated the number of water sources per 75 students (as per Massachusetts state plumbing code[28]) by dividing the total sources by the total enrollment for the school. We created indicator variables to evaluate each school building's compliance with the HHFKA meal service requirement, coding "compliant" if at least 1 functioning free water source was found per cafeteria[20] and the MA state plumbing code (at least 1 functioning plumbed water tap per 75 students).[28]

Among the schools for which we had corresponding data from FSDs and from direct observation (48 schools, 81% of sample), we evaluated the validity of FSD reports on the availability of free drinking water in cafeterias by calculating kappa coefficients comparing FSD's responses (yes/no) to whether or not research assistants identified any free drinking water source in the cafeteria. Data were analyzed in 2014.

RESULTS

Among the 59 schools observed, the average percentage of students receiving free or reduced-price lunch in the schools was 23.5%, and the average percentage of students identifying as White was 79.8% (Table 1). The sampled schools had significantly higher percentages of White and female students and significantly lower percentages of African American and Hispanic students as well as students receiving free or reduced price lunch.

On average, each school had 15.7 (SD: 8.4) drinking water sources, or 1.5 (SD: 0.6) source per 75 students, with most (95%) of those sources being water fountains (Table 2). However, only 82% were documented as functioning, and fewer (70%) were observed to be both clean and functioning at the time of assessment. The mean water temperature from fountains was 60.5 degrees Fahrenheit (SD: 6.6), while the water in coolers was considerably colder, at 45.5 degrees Fahrenheit (SD: 5.2). Most water sources were located in school hallways. Functioning water sources were not consistently available in gyms or physical activity spaces, with only about a third of the schools having at least one functional drinking water source in or near their gym or physical activity space.

Within school cafeterias, free drinking water access was not consistently provided (Table 2). Although the mean number of free, functioning water sources per cafeteria per school was 1.2 (SD: 1.8), over half of the schools (n=32, 54%) did not have any free water in the school cafeteria. Thirty-two schools (54%) sold bottled water in the cafeteria; 14 of these schools both sold water and provided free water, while the remaining 18 sold bottled water only. Fourteen schools (24%) had *no* cafeteria water access, free or otherwise.

The majority of the schools did not meet the HHFKA requirements for free drinking water availability during lunch, with only 46 % (n=27) meeting the requirement. Many schools also did not meet state plumbing code: 59% of the schools (n=35) met the Massachusetts state plumbing code of 1 functioning plumbed water source per 75 students.

Food service directors overestimated water access in the school cafeterias when compared to directly observed access. For those schools with both reported and observed cafeteria water access (n=48), FSDs reported a free cafeteria water source of some kind in 47 of those schools (98%), while direct observations documented free water access in 23 (48%) of the schools (κ=0.07, p=0.17), demonstrating a lack of validity for FSD reports of cafeteria water access.

DISCUSSION

Drinking water access in this sample of middle and high school buildings was not sufficient to meet state or federal drinking water policies. This study used direct observation to document drinking water access in school cafeterias, gymnasiums and throughout school buildings. More than half of schools (53%) did not have free water access in the school cafeteria; 30% provided bottled water but no free water, while 24% had *no* water access in the cafeteria at all. Just over half of the sampled schools (59%) met the state plumbing code requirements for water access. While schools, on average, provided at least 1 water source per 75 students, within each school almost a third of these water sources were broken or appeared unclean. Many schools in this sample were not in compliance with state and federal drinking water policies. Improved monitoring of compliance with drinking water access policies at federal, state, and local levels may be needed in order to ensure adequate drinking water access.

Our results are consistent with other recent studies of water access in schools in other areas. Patel et al (2011) found that 14 out of 24 schools in California, or 58.3%, provided water to students in meal service areas *before* the implementation of the HHFKA requirement;[30] we found less than half provided water *after* the requirement went into effect. These differences may be due to possible school infrastructure differences between California and Massachusetts or to study sampling differences. Data from a 2012 national survey of school principals suggests that the majority of school principals report compliance with the HHFKA water requirement to provide free drinking water access in the meal service area during mealtimes.[24] However, given the significant discrepancy between observed and reported water access by food service directors at schools in this study, it may be that school principals overestimate cafeteria water access and policy compliance. Direct observation methods may be necessary in order to validly assess water access.

Poor water access in schools may have consequences for the health of youth and children. Recent evidence from California demonstrates that better school water access is associated with increased water intake among adolescents.[31] Emerging evidence has linked inadequate hydration status with worse cognitive performance and mood[3–7] as well as worsened aspects of wellbeing, such as increased headaches;[8] conversely, giving inadequately hydrated children plain water may improve cognitive performance.[4–5, 7] Improving water access in schools could be an important strategy for reducing inadequate hydration and improving wellbeing among children and youth; promoting water and replacing sugary drinks with water could also be a promising strategy for reducing obesity risk among children.[10–11] Providing free, safe tap water for students to drink at school also has the potential to promote healthy hydration and obviates the need for purchasing bottled water; this could especially impact families with Black or Hispanic students, who are more likely to consumed bottled water.[13]

Improving drinking water access for students may not only mean increasing the number of working water fountains in a school building or a cafeteria; the appeal, functionality, placement, and ease-of-use of the water sources are also important. In this study, we defined meeting the HHFKA requirement for cafeteria water access as having at least one functioning water access point in each school cafeteria, but this may actually be overestimating “good” access: depending on how many students are in a lunchroom during a lunch period, having only one working water access point may not be enough to allow all students to get a drink of water in time, and may send a message to students that water is not a beverage of choice during meals. Additionally, even when adequate drinking water infrastructure is provided, students and school staff may avoid drinking free water due to perceptions that the water is unclean, unsafe, or tastes bad.[32–33] In some areas, these concerns are not unfounded. Several school districts have shut off tap water sources due to concerns about lead in plumbing fixtures; although national and state efforts to reduce lead in water have had some success over the past few decades, the legacy of concerns about water safety lingers in many areas.[34–35] In this study, 30% of the water sources observed were either not functioning or were coded as not clean by observers. Finding trash in water fountain basins was a common reason cited by observers for coding a water source as unclean, as was finding dirt or grime on the fixture. These common sanitary and operational issues may further degrade perceptions among students that these sources can provide good quality water.

Several school districts around the country have implemented innovative strategies to increase access through placement and promotion strategies that can shift the existing norms around drinking water in school and increase student water intake. The New York City Public Schools demonstrated that placing a chilled water dispenser on a school lunch line could significantly increase the proportion of students taking water as well as the amount of water consumed during lunch.[36] The Boston Public Schools tested a low-cost strategy placing promotional signage and cup-holders filled with recyclable cups next to cafeteria water fountains which led to increased student water consumption and potentially reduced sugar-sweetened beverage intake.[37] A study in Los Angeles middle schools that distributed water bottles to students along with placing promotional signage around water dispensers also saw increases in the proportion of students consuming water.[38]

Study strengths and limitations

The use of a direct observation protocol by trained research assistants to assess water access has considerable strengths over self-reported estimates of availability, both because of better accuracy and because functional and sanitary conditions can also be assessed. However, there are several limitations to this study. A majority of school districts that were initially approached declined to participate in the full NOURISH evaluation due to a lack of interest or time,[25] and schools that participated had a larger proportion of white and higher income students. It is unclear whether these schools might have drinking water access that is substantially different than schools that were not sampled, and thus these findings may not be generalizable to all secondary schools in Massachusetts. Future studies should address drinking water access in other locations, utilizing direct observational assessments rather than self-report. Because the study sample was limited to middle and high schools, researchers were also unable to evaluate drinking water access among elementary schools, a critical issue that should be explored in future studies. Data collectors observed drinking water access in school cafeterias at a single point in the day on only one day. It is possible that, in some schools, portable drinking water sources that may have been used during meal service may not have been present. Additionally, day to day variability in water temperature or water source cleanliness was not captured. We did not assess reliability of research assistants' assessments of source cleanliness nor did we assess access to water during meal times for locations outside of the cafeteria, although given that all schools had cafeterias as their main meal service area, we likely captured drinking water access during meals for the vast majority of students. Additionally, researchers were unable to evaluate the relationship between school water access and student water consumption in the corresponding student populations; future research should focus on establishing how observed school water access influences student intake, as well as other factors, including school policies or practices addressing whether students can drink water during class or easily be excused for bathroom breaks.[39]

Conclusion

Access to clean, functioning free drinking water sources in schools may be limited, and compliance with state and federal policies to establish free drinking water access is low in many schools. Drinking water access in other U.S. schools should be assessed using objective measures and could be integrated into routine school food service monitoring protocols. Additional training and technical assistance for school personnel may be needed to improve access to drinking water and improve compliance with federal and state policy in order to prevent inadequate hydration and promote the consumption of healthy beverages.

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Table 1

Sociodemographic characteristics of Massachusetts middle and high schools participating in baseline water access assessment for the NOURISH study compared to non-sampled Massachusetts schools, spring 2012 (n=59 sampled schools, n=593 non-sampled middle and high schools).

	Schools in sample (n=59)	*Massachusetts middle and high school not in sample (n=593)*	p-value[1]
Total enrollment per school (mean (SD))	705.9 (452.8)	811.1 (441.9)	0.09
% African American (mean (SD))	5.5 (10.3)	9.5 (15.2)	0.01
% Asian American (mean (SD))	4.0 (5.5)	4.4 (6.8)	0.64
% Hispanic (mean (SD))	8.1 (9.0)	16.2 (21.5)	<0.001
% Multiracial (mean (SD))	2.1 (1.3)	2.1 (1.7)	1.00
% White (mean (SD))	79.8 (17.7)	67.6 (31.1)	<0.001
% Female (mean (SD))	49.2 (2.7)	48.1 (6.8)	0.02
% receiving free or reduced-price lunch (mean (SD))	23.5 (14.6)	32.1 (26.7)	<0.001
School type (n(%))			
Middle school	28 (47.5)	–	
High school	29 (49.2)	–	
Middle/High combined	2 (3.4)	–	

Sources: http://profiles.doe.mass.edu/

[1] p-values are from two-sample t-tests comparing sampled middle and high schools to middle and high schools that were not sampled.

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Table 2

Drinking water access provided by Massachusetts middle and high schools participating in baseline water access data collection for the NOURISH study, spring 2012 (n=59).

Drinking Water Access Indicators, Whole School Building	***Mean (SD) or N(%)***
Total free water sources per school (mean(SD))	15.66 (8.43)
Average sources per 75 students per school (mean (SD)	1.47 (0.63)
Percentage of sources that are fountains (mean (SD)	95% (8%)
Percentage of sources that are functioning (mean (SD)	82% (20%)
Percentage of sources that are both clean and functioning (mean (SD)	70% (21%)
Time to fill a 9 oz cup in seconds, all free water sources (mean (SD)	10.20 (1.73)
Fountain (mean (SD)	10.34 (1.67)
Cooler (mean (SD)	6.60 (1.74)
Temperature (in degrees Fahrenheit), all free water sources	60.02 (6.53)
Fountain (mean (SD)	60.45 (6.60)
Cooler (mean (SD)	45.51 (5.16)
Number (%) of schools with at least one functional drinking water source per gym	20 (33.9%)
Number (%) of schools selling bottled water in at least one location in the school	51 (86.4%)
Drinking Water Access Indicators, Cafeteria Only	
Average number of free water sources per cafeteria per school	1.15 (1.83)
Functioning free water sources per cafeteria	0.97 (1.46)
Clean and functioning free water sources per cafeteria	0.90 (1.43)
Number (%) of schools with both free water and bottled water for sale in cafeteria	14 (23.7%)
Number (%) of schools with free water and no bottled water in cafeteria	13 (22.0%)
Number (%) of schools with bottled water for sale only (no free water)	18 (30.5%)
Number (%) of schools with NO water access (either free or bottled water for sale) in cafeteria	14 (23.7%)