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Worksite Access to Fluoridated Tap Water and Retail Beverages: An Assessment of the University of California, San Francisco Campuses

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Abstract

Background: Employees with fluoridated drinking water access at work can reap oral health benefits. The purpose of this study was to assess the availability, appeal, and promotion of fluoridated tap water in publicly accessible spaces, compared to retail beverages, at the University of California, San Francisco (UCSF).

Methods: Information on beverages available in publicly accessible spaces at UCSF hospitals and campuses in San Francisco, CA was collected from December 2019 to February 2020 using a web-based survey tool. Data collected included fluoridated water and retail beverage locations, type of water or retail beverage source, number of water sources per station, cleanliness, flow, and any obstruction of water sources, proximity of water stations to retail beverage locations, signage

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near the beverage locations about water/beverage consumption, and type of retail beverages available.

Results: Fluoridated water stations were identified in 230 locations, and contained 377 water sources (e.g., traditional drinking fountain, motion-sensor bottle filling station). One water station was available for every 80 students/employees, however, 25% were obstructed, dirty or had unsatisfactory flow. Approximately 1 in 5 water coolers lacked disposable cups. Out of 41 retail beverage locations identified, 29% had a water station within sight. Only 11% of beverage locations had signage encouraging healthier beverage choices.

Conclusions: A systematic assessment of worksite access to fluoridated water can provide actionable evidence to improve availability, appeal, and promotion.

Practical Implications: This study provides a model to assess worksite availability of fluoridated drinking water that can be used for future evaluations.

Keywords

Beverages; Fluoridation; Health Promotion; Occupation Health

Introduction

Worksite wellness programs that incorporate nutrition interventions can be an effective strategy to change employee dietary behaviors.[1–4] Recognizing that nearly half of all sugar-sweetened beverages (SSBs) are consumed outside the home,[5] The University of California, San Francisco (UCSF) University implemented a comprehensive workplace SSB sales ban in 2015 called the 'Healthy Beverage Initiative (HBI)', which phased out SSBs from all campus sites and medical facilities.[1,6] In a before and after study, Epel et al found a significant reduction in mean daily SSB intake, in addition to a significant reduction in waist circumference among employees, within 10 months.[1,6] Using this data, Basu et al conducted simulation modeling to estimate that a SSB sales ban equal in effectiveness to the UCSF ban would save nearly $300,000 per 10,000 people over ten years in similar worksites.[6,7]

Building on the success of the UCSF HBI program, the University of California Healthy Campus Network, a coalition of all 10 UC campuses, launched the UC Healthy Beverage Initiative" UC HBI) in June 2019[8] with the goal to improve access to tap water as a healthy alternative to SSBs. Replacing SSBs with water in the workplace can lower excessive energy intake and lead to weight loss.[9] Provision of bottled water can prove to be a useful alternative to SSBs, but the associated cost may produce inequitable access to drinking water. Moreover, despite FDA recommending 0.7 mg/L fluoride concentration in bottled water; some bottled water products which are labeled as de-ionized, purified, demineralized or distilled may contain very little or no traces of fluoride.[10] Fluoridated water as a replacement to SSBs not only decreases energy intake, but it also acts as a protective agent for oral health.[11,12]

Accessibility and the appeal of publicly available fluoridated water outlets, such as water fountains, play an important role in determining consumption.[13,14,15] In a qualitative study of stakeholders in four unified school districts in California, Patel et al. explored attitudes,

and beliefs about school drinking water accessibility.[13] They found that there are negative perceptions of tap water in terms of appeal, taste, appearance and safety of water from drinking fountains.[13] The aim of this study was to empirically assess the availability, appeal, placement, and promotion of fluoridated tap water in publicly accessible spaces in and around UCSF campuses, compared to retail beverage locations, that could be a model for other worksites.

Methods

All UCSF owned hospitals and campuses in San Francisco, CA were included in the study. The types of buildings screened included hospital, academic and recreational facilities. Dormitories, research buildings, private office spaces, restricted access in hospital buildings or any buildings requiring special access were excluded. Tap water and retail beverage locations were included in the assessment if they were publicly accessible to students, employees, and visitors. The retail beverage environment was inclusive of vending machines, food courts and cafeterias. Tap water locations and retail beverages in areas with restricted access or requiring key entry such as private offices or employee only floors and workspaces were excluded.

Based on an observational protocol developed by Patel and Hecht,[16] the UCSF HBI team defined the categories of information to be collected about the UCSF beverage environment including: 1) location of tap-water station (physical placement of water source in a building, e.g. lobby, common space or hallway) or retail beverage location (e.g., café, hallway); 2) water source (e.g., traditional drinking fountain, motion-sensor bottle filling station) or retail beverage source (e.g., vending machine, cafeteria or dining hall); 3) type of retail beverages available,; 4) water stations in close proximity to the SSB sources; 5) any advertisement or signage near tap-water or retail beverage location about water/beverage/SSB consumption. 6) number of water sources in the same location; 7) any obstructions to the water source (e.g., no obstructions, mildly or entirely obstructed); 8) cleanliness of the water source (e.g., presence of leaves/natural debris, unsanitary items like mops, trash in basin, clogged water, mold, rust); 9) flow of the water source (e.g., satisfactory, high, low, erratic, none—broken).

To capture the data, the UCSF HBI team developed a web-based survey tool utilizing REDCap software, a secure web application for building and managing online surveys and databases, designed to be completed by researchers in the field.[17] This tool included a dynamic survey which allowed recording detailed information about the location and the source and allowed for the capture of images. Before submitting the survey, the tool had an open-ended option for additional comments.

Two researchers (NK, LM)) conducted the mapping of the UCSF beverage environment utilizing the web-based survey tool. The researchers were trained on how to navigate the survey instrument via a webinar and live in-person by an expert (LJ). This expert is a senior team member of the UCSF HBI who contributed to the survey design. In the webinar, the expert discussed the survey instrument in detail which was followed by an in-person walkthrough on one floor of one of the campus buildings. The expert then walked with the two recorders at the Laurel Heights campus building on one floor and discussed how

to record the survey. During the walkthrough, the expert and the researchers mapped tap water locations and retail beverage locations. For tap water locations, the expert explained different options in the survey instrument on how to record (i) obstructions, (ii) cleanliness, and (iii) flow of the water source. For example, the water source was first looked for any physical obstruction, then, the water location was checked for cleanliness and if not clean, presence of dirt, rust, mold, etcetera was noted. This was followed by accessing the water source and noting the flow of the water. For retail beverage locations, researchers were trained on how to look for presence of any SSBs, promotional advertisements, and presence of water source in view around these retail beverage locations. To record any water stations in sight of retail beverage locations, recorders were asked to spin 360 degrees to look for water locations in all directions. To ensure inter-observer agreement, both recorders then mapped two building sites on the Mission Bay campus and Parnassus campus together and consulted with the expert to resolve any disagreements. The survey tool included a reference sheet to reinforce field researchers' training on 1) how to locate tap water sources, 2) how to identify SSBs, and 3) how to identify beverages with no added sugar.

The data were collected between December 2019 and February 2020 before the country-wide shut down in March 2020 due to the COVID-19 pandemic. Building maps and fire-escape maps on each floor were used as guides for publicly accessible areas. The mapping was performed by walking through the publicly accessible areas of each floor in a building. Using a smart phone or tablet, researchers completed the web-based survey and captured images when more than one type of water station was available at one site. To avoid mapping a water source or beverage location type twice, a landmark near the location and time of starting the survey was noted.

Data were exported from REDCap into MS Excel and were cleaned and extracted for the water and retail beverage locations. Subsequently, counts and proportions for beverage locations, physical characteristics of water stations (cleanliness, obstruction, flow), promotional signage, and total counts of retail beverages locations were calculated in MS Excel.

Results

Beverages are available in 271 public locations on UCSF campuses (Parnassus Heights, Mission Bay, Mt. Zion, Mission Hall, Laurel Heights, Buchanan Dental Clinic), out of which 230 were stand-alone tap water stations and 41 were retail beverage locations (Table 1). All tap-water stations and retail beverage locations were found indoors. Retail beverage locations were found in cafés/restaurants/places that serve food/drink; commercial retail locations (i.e., store or gift shop) and lobbies, common spaces or hallways. The tap water locations were found in lobbies, common spaces or hallways; cafés/restaurants; classrooms or offices; commercial retail locations and recreation buildings.

The UCSF tap water stations receive fluoridated water from the main water supply in the City of San Francisco which is maintained optimally at 0.7 parts per million by San Francisco Water Power Sewer.[18] The water filtration system, supplied by Elkay Water Sentry Plus, does not filter fluoride from the water but reduces lead and aesthetic chlorine

and class I particulates (0.5-1.0 microns) e.g., particles of rust, dirt, sand. UCSF pro-actively tests the quality of water supplied in its water stations, including a lead contamination test.[19]

Tap water sources

At the 230 water stations, there were 377 water sources present (Table 2) The number of tap water sources in one location ranged from one to three sources with approximately 43% having one source, 49% having two, and 7% having three. The most common tap water source was water fountain with traditional drinking faucets (300), followed by water coolers (25), water fountains with bottle fillers e.g., gooseneck (25), motion sensor bottle filling stations (10), push button bottle filling stations (9), and push-in type (3). Five water sources were classified as unsure/missing data (5). In some locations, water sources were hidden behind a wall or in corners of a corridor with limited foot traffic. Most water locations were also found near restroom locations. Of the 25 water coolers, 22 coolers had disposable drinking cup next to them. This was mainly seen in waiting areas of classrooms or offices.

Physical Characteristics of Water Source

Water sources were assessed for obstructions, cleanliness and flow (Table 2). Of the 377 water sources evaluated, 281 (74.5%) water sources had none of these issues. Of the remaining water sources, 81 had one issue (32 sources lacked cleanliness; 49 lacked satisfactory water flow), 14 water sources had two issues (4 had obstructions; 11 lacked cleanliness; 13 lacked satisfactory flow) and one water source had all three issues. Obstructions included a paper shredder, caution tape or polythene cover, a dustbin, and another had wire roll on the floor. Cleanliness issues included visible natural debris in the form of leaves, dirt, rust, mold, trash in basin, hair, stagnant water, food, bodily fluids, and unsanitary items such as mops and buckets lying close to the tap water station. Water flow issues included low or high-water pressure with the water stream arching very little or too high making it challenging to drink water or fill a cup, erratic flow or no flow, or physically broken.

Signage and advertisements

Signage was identified in 16 retail beverage locations and at 13 water stations (Table 2). Five signs were notices regarding the quality of water denoting '*decreased levels of lead and cleared for drinking water,*' '*ongoing water quality testing for levels of lead and contaminants*' with indication of bottled water availability nearby, or '*power cut down for the water station to conserve energy*.' The remaining signs and posters contained cautionary messages about SSBs and encouraged healthier choices such as '*Choice plus beverages are lower in calories and added sweeteners*', '*Healthy Beverages- drink to your health, make the SMART choice*', '*SMART choice. Drink to your health*' and were located in retail beverage locations and on vending machines. No signage promoting SSBs were found in and around retail beverage locations or water locations on the campus.

Physical density of water sources

UCSF has approximately 6,000 students, residents and postdoctoral scholars and employs 24,140 employees [20]. For the 30,410 individuals at UCSF, there are 80 persons per water

'source' excluding patients and other visitors on the campus. However, as only 281 water sources are accessible with clean and satisfactory flow of water, there are 108 persons (students/staff) per water source at UCSF.

Retail beverage locations

At the 41 different retail beverage locations, beverages were sold in vending machines (20); cafeteria or dining hall (5); restaurants or coffee shops (15); store or gift shop (1). Of the 20 vending machines available, 17 were placed in a lobby, common area or hallway while three were in a café/restaurant. Of the 41 retail beverage locations, 12 had a tap water source in sight. Five of these water stations were near dining commons or food courts' seating areas and 7 were near vending machines.

All 41 retail beverage locations sold beverages with no added sugars. Types of unsweetened beverages available included diet drinks (32), fruit juices (26), sports drinks (10), energy drinks (10), and sparkling water/bottled water (30).

Discussion

Publicly accessible spaces at UCSF facilities in San Francisco contain one fluoridated water source per 80 students/employees. Considering that nearly 25% of water stations were impaired, and that UCSF hospitals have a large number of patients; this ratio is actually much higher. Several barriers to fluoridated water consumption were identified. Out of 377 water sources found at 230 locations, 96 water sources were not functional due to an obstruction, cleanliness or a flow issue. Approximately 1 in 5 water coolers lacked a disposable cup to drink the water. Only 30% of retail beverage locations had a tap water station within sight. When considering both water and retail beverage locations, only eleven percent had signage promoting healthier beverage choices.

Lack of appeal of tap water stations discourages water consumption.[13,14] In a randomized controlled trial conducted in school children, the amount of tap water consumption doubled when safe and appealing water sources were available compared unappealing sources.[14] Further, provision of cups and promotional signage on tap water around the water source can also encourage drinking tap water.[15] Simple improvements to increase fluoridated water consumption at UCSF locations include timely scheduled maintenance and mandated spot checks to ensure the water stations have the proper water flow, remain unobstructed, are clean, and have paper cups where appropriate. Another strategy is to post clear and engaging promotional messages for promoting drinking water especially near the water stations. These promotional messages can include graphic, self-explanatory, and simple depictions of health benefits including oral health to have a greater impact, as well as information about water safety.

Using California school building code, which requires one drinking water fountain for every 150 students,[13] as a comparison, UCSF may have an adequate number of water stations available to serve its students/employees. If replacement of water sources or installation of additional water stations are planned, water source types should include motion-censored bottle filling stations or push-in type bottle filling stations as these are found to increase

water consumption in comparison to traditional water fountains.[21,22] New stations should be located around retail beverage locations and in areas with high foot-traffic. Increased availability of water stations or water coolers around the vending machines, and cafeterias would provide people with a choice to drink water. The COVID-19 pandemic, which led to water fountains being roped off to prevent diseases transmission, provides additional motivation to install bottle filling water stations to help address the availability of water on the campus.

When installing a new water source, it is also important to avoid a filtration system that removes fluoride. In a pilot study, Jobson et al. studied the efficacy of three different water filtration systems to determine the fluoride content of the water after filtration.[23] They found that the carbon filters remove statistically significant amounts of fluoride in the drinking water.[23] In another study, the activated carbon filters were known to absorb fluoride, but little absorption was detected after 210 Liters of the solution was filtered.[24] Reverse osmosis and distillation systems are known to reduce fluoride ion levels in tap water.[25]

This study can act as an example for other locations/non-academic settings to evaluate their beverage environment to assess whether adequate fluoridated tap water is available for consumption. However, replacing SSBs with fluoridated tap water is only one part of a larger strategy to promote healthier beverages choices. Reducing SSB consumption should be the primary focus of healthy beverage initiatives, which can be challenging to implement, even in a campus environment.[26] The Healthy Campus Initiative at UCSF included an objective to increase access to tap water as a replacement of SSBs.[8] This objective had strong institutional support and funding, which would likely be required to implement similar initiatives in other contexts. The results of this report were disseminated to the campus officials as an assessment to inform interventions to overcome challenges with drinking water at the campus. The HBI at UCSF is one of the first initiatives to include both campus and hospital settings.”

A limitation of this study is that the entire beverage landscape at UCSF was not mapped. Due to limited time and resources, this study could not map private office areas which may have additional water sources or supply of sugar sweetened beverages. Additionally, the water sources and their physical characteristics at water stations within sight of retail beverage locations could not be uniquely identified as they were not mapped in relation to the retail beverage location. Understanding the water source type and characteristics could provide insight into choices made by the consumers when retail beverages and fluoridated tap water are in close proximity. Finally, the exposure to fluoride from bottled water sources at retail beverage locations is unknown. A strength of this study is that it was built on an established protocol to assess the physical characteristics of water stations on the UCSF campus in terms of access, appeal and promotion with an added focus on fluoridated water sources. To our knowledge, this is the first assessment of the fluoridated drinking tap water availability in a worksite setting.

Conclusion

The tap water mapping protocol elaborated in this study can be applied in future campus or worksite assessments to supply worksite wellness administrators with actionable strategies to increase fluoridated water consumption. Improved access to fluoridated tap water, particularly in conjunction with worksite SSB bans, is a safe, effective, and inexpensive way to prevent dental caries, reduce energy intake, and improve weight-related outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Types of locations where retail beverages and tap water are available on UCSF Campuses

Beverage Locations	Retail Beverages (n)	%	Tap-Water (n)	%	Total (n)	%
Café/restaurant	23	56.0	1	0.004	24	8.8
Classroom or office	0	0.0	13	5.6	13	4.7
Commercial retail location	1	2.4	0	0.0	1	0.003
Dorm or residential building	0	0.0	1	0.004	1	0.003
Lobby, common space or hallway	17	41.5	214	93.0	231	85.2
Recreation building	0	0.0	1	0.004	1	0.003
Total	41	100.0	230	100.0	271	100.0

Table 2

Description of tap water sources (number, type, and physical characteristics) and retail beverage sources (number, type) and signage around them on the UCSF campuses.

	Count	Percentage (%)
Tap Water Sources	N=377	
One	100	26.5
Two	113	30.0
Three	17	4.5
Tap Water Type	N=377	
Traditional drinking water fountain	300	79.5
Water coolers	25	6.6
Water fountains with bottle fillers (gooseneck)	25	6.6
Motion sensor bottle filling station	10	2.6
Push button bottle filling station	9	2.3
Push-in	3	0.7
Unsure/missing	5	1.3
Physical Characteristic of the water source	N=377	
Fully functional	281	74.5
Obstruction	5	1.3
Cleanliness	44	14.3
Flow	63	16.7
Retail Beverage Source	N=41	
Vending machines	20	48.7
Restaurant/ coffee shop	15	36.5
Cafeteria/ dining hall	5	12.1
Store/gift shop	1	2.4
Signage and advertisement	N=29	
Around retail beverages	16	55.0
Around water sources	13	45.0