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Tapping Into Water: Key Considerations for Achieving Excellence in School Drinking Water Access

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Objectives. We examined free drinking water access in schools.

Methods. We conducted cross-sectional interviews with administrators from 240 California public schools from May to November 2011 to examine the proportion of schools that met excellent water access criteria (i.e., location, density, type, maintenance, and appeal of water sources), school-level characteristics associated with excellent water access, and barriers to improvements.

Results. No schools met all criteria for excellent water access. High schools and middle schools had lower fountain:student ratios than elementary schools (odds ratio [OR] = 0.06; 95% confidence interval [CI] = 0.02, 0.20; OR = 0.30, 95% CI = 0.12, 0.70). Rural schools were more likely to offer a nonfountain water source than city schools (OR = 5.0; 95% CI = 1.74, 14.70). Newer schools were more likely to maintain water sources than older schools (OR = 0.98; 95% CI = 0.97, 1.00). Schools that offered free water in food service areas increased from pre- to postimplementation of California's school water policy (72%–83%; $P < .048$). Barriers to improving school water included cost of programs and other pressing concerns.

Conclusions. Awareness of the benefits related to school drinking water provision and funding may help communities achieve excellence in drinking water access. (*Am J Public Health.* 2014;104:1314–1319. doi:10.2105/AJPH.2013.301797)

Consumption of water is associated with a number of health benefits, including a reduction in energy intake and obesity prevention, dental caries reduction (with fluoridated tap water), and improved cognitive functioning among children.[1–11] Access to free, potable, and appealing drinking water in schools is important because children spend substantial time in school settings, and students may come to school already dehydrated.[12,13]

Policymakers have responded to concerns regarding the association of intake of sugar-sweetened beverages, such as sodas and sports drinks, with health conditions such as obesity and dental caries by passing legislation that restricts sales of sugar-sweetened beverages in schools.[14] Such policy has led to a change in the product mix of beverages that are available for purchase in schools, including an increase in access to bottled water.[14,15] In some cases, bottled water available for purchase may be the only source of potable drinking water in certain school locations, thus creating a conspicuous inequity in which water may only be accessible to students with the means to purchase it. Having schools offer free single-use bottled water to students also poses environmental concerns, particularly for schools that do not recycle used plastic bottles on campus.[16]

Although historically some states did specify that a certain number of water access points (i.e., drinking fountains) be available per a certain number of students, there was generally no guidance regarding the location of those fountains.[17] However, now both federal and some state laws require that free water be available in cafeteria areas.[18–20] In September 2010, California enacted SB 1413, legislation that requires kindergarten to 12th grade public schools to provide access to free drinking water during meal times in school food service areas (FSAs), defined in California law as locations where meals are served or eaten.[18] In December 2010, the president signed the Healthy, Hunger-Free Kids Act of 2010, which includes a provision requiring access to free drinking water where meals are served (but not where they are consumed).[19]

In small studies conducted primarily in California to examine water access in schools, drinking fountains—the primary source of free water access in most schools—were perceived to be inadequate by students, parents, and school staff.[21–24] Drinking fountains were viewed as nonfunctional, unclean, having a low flow rate, or dispensing unpalatable water, thereby discouraging student water intake. By contrast, in emerging studies, nonfountain sources of drinking water, such as insulated coolers or built-in water dispensers or stations, appeared to encourage student water consumption.[25–27] Unavailability of free drinking water in key school locations such as cafeterias, gyms, and classrooms where students eat, are active, and learn is cited as another barrier to water access at school.[21]

There have been no comprehensive large-scale cross-sectional studies that examine free drinking water access in schools. To gain a better understanding of this issue, we conducted phone interviews with school administrators from a representative sample of public schools in California that spanned from pre- to postimplementation of the 2010 California state water-in-schools regulation. The main objectives of this study were to describe free drinking water access in schools by source (e.g., water fountain, pitcher) and school location, as well as to examine school-level characteristics associated with schools that have excellent drinking water access. We also sought to understand how water access in FSAs changed from pre- to postimplementation of the water-in-FSAs regulation. In addition, we asked questions about barriers to improving water availability that would inform our recommendations for ways to increase drinking water access in school settings.

On the basis of prior literature, we hypothesized the following: (1) few schools would have nonfountain sources of drinking water,

(2) free water would be most readily accessible in common areas of the schools (i.e., hallways), and (3) schools serving higher-income students would have better drinking water access.

METHODS

From May to November 2011, we conducted semistructured telephone interviews with school administrators from a random sample of 240 standard California public schools. Schools were drawn from the National Center for Education Statistics' Common Core of Data.[28] We excluded nontraditional schools, such as kindergarten to 8th grade, kindergarten to 12th grade, special education, vocational, and alternative schools, leaving a total sample of 7066 eligible schools. We stratified these schools by urbancentric location and school type (i.e., elementary, middle or junior, high) and used this sampling frame to obtain the 240 schools in our study. We developed the interview questionnaire on the basis of previous related studies conducted by the first author (A. I. P.), revised it according to content expert input, and pilot tested it with ineligible schools (private schools, out-of-state schools).[21,26,27] Before administering the questionnaire to school administrators, we validated it through school observations described in detail elsewhere.[27]

To recruit participants, we first mailed a study invitation letter to the principals of eligible schools. After the mailings, a research assistant or the first author (A. I. P.) contacted school administrators to answer questions, gauge interest in participation, and schedule an interview time. A research assistant or the first author (A. I. P.) contacted school administrators until they declined participation. If a school declined, we sampled the next randomly chosen school from the study stratum. We obtained consent from survey respondents before conducting audio-recorded interviews, which lasted 10 to 20 minutes. We provided study participants with $10 gift cards for participation.

Outcome Measures

We asked school administrators about drinking water access in schools, including the source (e.g., public or municipal, private such as a well on the school site), type (e.g., tap, bottled), delivery system (e.g., fountains, pitchers), location (e.g., cafeteria, gym), number of water sources, and the appeal and upkeep of water access points. In addition, we also questioned administrators about barriers to implementing school drinking water programs (e.g., cost, other pressing concerns). Because schools may have access to water but water sources such as drinking fountains may not be appealing to students, we defined excellent drinking water access as water availability throughout school settings that most facilitates water consumption among students. We created categorical variables that signified excellent drinking water access. In particular, schools were characterized as having excellent free drinking water access if they

1. provide water in at least 4 of 5 key school locations (e.g., FSA, classroom, gym, outdoor exercise area) where students learn, eat, and are active,
2. have a high density of free water available (i.e., ≥ 1 fountain for every 25 students),
3. provide water via a nonfountain source that encourages increased water intake (e.g., pitcher, water dispenser, hydration station),
4. provide tap water that is safe and appealing (i.e., palatable, safe to drink, cold), and
5. maintain drinking fountains (i.e., fully functional and clean).

A checklist of considerations for schools to provide excellent water access, including the aforementioned variables, is shown in the box on this page.

We also gathered school-level characteristics from the Education Data Partnership.[29] These characteristics included school type (elementary, middle or junior, high), locale (city, suburb, town, rural), school age in years, student enrollment or number of students attending the school, academic performance index score based on student testing results, percentage of English learners, percentage of Latino students, and percentage of students eligible for free and reduced-price meals.

Statistical Analyses

We analyzed data using STATA version 11 (StataCorp LP, College Station, TX). We conducted descriptive analyses (e.g., frequencies, percentages, means) to summarize school-level characteristics and main outcome measures (e.g., schools that offer drinking water via a nonfountain source). We used multivariate logistic regression to examine whether school-level characteristics were associated with the

Key Considerations for Providing Excellent Drinking Water Access in Schools

Location of water sources:

At least 1 water source is available in the following key school locations:

- Food service area
- Outdoor physical activity area
- Indoor physical activity area
- Classrooms, including modular buildings
- Common areas

Number of water sources:

The school has 1 water source for every 25 students

Nonfountain sources:

At least 1 nonfountain source of water accessible for students throughout the school day

Water source maintenance:

Water sources in the school are maintained (clean of debris and trash, working, and with adequate flow rates)

Water quality and safety:

School drinking water is tested for lead or other contaminants

The school posts drinking water quality testing results for staff and students to see

Drinking water at the school is clear

Drinking water at the school is cold

Drinking water at the school tastes good

aforementioned indicators of excellent free drinking water access. We also conducted a χ^2 test to determine whether the proportion of schools that reported offering water in FSAs differed before and after implementation of SB 1413.

RESULTS

Of schools that were eligible and contacted for this study (n = 259), 93% agreed to participate. The majority of surveyed respondents (n = 240) were either school principals (54%) or vice principals (22%). Nearly one quarter of respondents consisted of other respondents (e.g., facilities managers, food service directors) who were knowledgeable about drinking water and water-related policies and practices at the school site. Schools that participated in the study had similar characteristics as compared with California public schools in aggregate (Table 1).

Drinking Water Access in California Public Schools

All study schools offered water in at least 1 location, with 95% of schools reporting free water access in common areas such as hallways; 82%, in gyms; 80%, in outdoor physical activity spaces; 75%, in FSAs, 63%, in classrooms; and 37%, in temporary structures set up to accommodate additional students. Only 37% of schools reported offering at least 1 source of free drinking water in 4 of these 5 key school locations. Of note, 1 in 4 schools did not meet the current California and federal requirement to make free drinking water available in school FSAs. By contrast, 93% of schools reported having free drinking water available in teacher or staff lounges.

The most commonly cited source of free drinking water in schools was drinking fountains. Ninety-six percent of schools stated they had at least 1 nonrefrigerated, unfiltered drinking fountain; 18% reported they had at least 1 filtered drinking fountain, and 17% had a refrigerated drinking fountain. Three percent of schools noted that they had at least 1 fountain that was both refrigerated and filtered. In teachers' lounges, however, the most common source of water was large bottles of commercially available water, such as Alhambra, which was present in nearly a quarter of schools. The density of fountains in schools was generally acceptable. The mean fountain-to-student ratio was 1 fountain per 24 students (range = 0–1 fountain per 3 students); 1 study school, a California Necessary Small School serving a remote population, had 1 fountain and a population of 3 students. Five percent of schools did not meet the fountain-to-student ratio of 1:150 as specified by the California state building code. Eighty-three percent of administrators strongly agreed or agreed that the fountains at their school were well maintained, and 60% thought that the tap water offered at their school was safe and appealing.

Twenty percent of schools reported offering any nonfountain sources of drinking water. Thirteen percent of schools had large (5-gallon) bottles of drinking water available in school. Nine percent of schools had water coolers, dispensers, or pitchers, and only 3% made disposable single-serving bottled water available for free. Eighteen percent of schools reported offering containers such as cups to encourage water consumption. In the majority of cases in which water coolers or cups were available, they were located in places less accessible to the general student population (e.g., guidance offices, nursing office, administrative areas). No schools met all key considerations for providing excellent drinking water access (see the box on page e2).

TABLE 1—Characteristics of Participating Study Schools and All California Public Schools: May–November 2011

Characteristic	Participating Schools (n = 240)	California Public Schools (n = 10 152)
Student enrollment, mean		
Elementary	536	530
Middle or junior high	808	806
High	1343	1404
Academic performance index, mean	776	768
Students qualifying for free or reduced-price meals, %	53	55
English learners, %	20	22
Latino students, %	46	51
School age, y, mean	48	N/A

School-Level Characteristics and Free Drinking Water Access

In our analysis, having free drinking water available in at least 4 of 5 key school locations (e.g., FSA, classroom, gym, outdoor exercise area) was not associated with school-level characteristics (Table 2). When compared with elementary schools, middle and high schools were less likely to have at least 1 fountain for every 25 students. Compared with city schools, rural schools were more likely to offer a nonfountain source of free drinking water such as via a water cooler. The availability of safe and appealing drinking water was not associated with school-level characteristics, yet newer schools were more likely to better maintain water sources than older schools (odds ratio = 0.98; 95% confidence interval = 0.97, 1.00; Table 2).

Senate Bill 1413 and Drinking Water Access in Food Service Areas

The study was completed from May 10, 2011, through November 8, 2011, dates spanning before and after the July 1, 2011, date by which SB 1413 was to be implemented in all California public schools. Of school administrators, 72% reported having at least 1 source of free water available to students in FSAs before the implementation date; this increased to 83% after July 1, 2011 ($P = .048$). The number of schools that offered a nonfountain source of drinking water in school FSAs did not change from pre- to postimplementation of the legislation (7%–10%; $P = .45$).

Barriers to Improving Drinking Water Access in California Schools

We asked school administrators to report barriers to improving drinking water access and intake in schools. When asked whether they had heard of SB 1413 or the Healthy,

Hunger-Free Kids Act, which require schools to offer free water at mealtimes, only 36% of administrators (33% before the July 1 implementation vs 42% after implementation) during the entire study period had heard of either the state or the federal legislation. As seen in Figure 1, more than half of school administrators strongly agreed or agreed that other pressing concerns, for example, academic demands, hindered their ability to improve drinking water access on their school campus. Also, concern over the use of bottled water and the cost of improving drinking water infrastructure, such as plumbing or installing new drinking fountains, were also commonly cited barriers. One in 4 school administrators strongly agreed or agreed that the drinking water quality at their school was poor (e.g., contained contaminants, was not cold, or tasted bad).

TABLE 2—School-Level Characteristics Associated With Excellent Drinking Water Access in California Public Schools: May–November 2011

	Water in ≥ 4 of 5 School Locations			Fountain:Student Ratio ≥ 1:25			Access to Nonfountain Source			Tap Water Is Safe and Appealing			Fountains Are Clean and Functioning		
Characteristic	Unadjusted % or Mean (SD)	*P*	Adjusted OR (95% CI)	Unadjusted % or Mean (SD)	*P*	Adjusted OR (95% CI)	Unadjusted % or Mean (SD)	*P*	Adjusted OR (95% CI)	Unadjusted % or Mean (SD)	*P*	Adjusted OR (95% CI)	Unadjusted % or Mean (SD)	*P*	Adjusted OR (95% CI)
School type		.09			< .001			.84			.95			.77	
Elementary (Ref)	54		1.00	75		1.00	10		1.00	60		1.00	84		1.00
Middle/junior	70		1.42 (0.67, 3.00)	43		0.30* (0.12, 0.70)	21		1.30 (0.51, 3.28)	59		1.16 (0.55, 2.44)	84		0.86 (0.31, 2.39)
High	65		0.72 (0.27, 1.90)	11		0.06* (0.02, 0.20)	24		1.87 (0.59, 5.95)	61		1.41 (0.54, 3.72)	80		0.94 (0.26, 3.33)
Locale		.69			.04			.25			.64			.41	
City (Ref)	63		1.00	30		1.00	15		1.00	63		1.00	82		1.00
Suburb	65		0.99 (0.44, 2.23)	38		2.03 (0.76, 5.46)	22		1.65 (0.57, 4.83)	65		0.85 (0.39, 1.85)	83		1.14 (0.40, 3.22)
Town	67		1.60 (0.70, 3.67)	52		2.21 (0.82, 5.98)	20		2.41 (0.82, 7.09)	67		1.48 (0.66, 3.32)	88		1.75 (0.56, 5.49)
Rural	57		1.10 (0.48, 2.54)	52		1.91 (0.70, 5.16)	30		5.06* (1.74, 14.70)	57		0.72 (0.32, 1.64)	77		0.44 (0.16, 1.24)
School age, y	48 (32)	.93	1.00 (0.99, 1.01)	45 (29)	.24	0.99 (0.98, 1.01)	51 (36)	.4	1.01 (1.00, 1.02)	47 (32)	.51	1.00 (1.00, 1.00)	45 (29)	.02	0.98 (0.97, 1.00)
Student enrollment, no.	1014 (707)	.001	1.00* (1.00, 1.00)	554 (300)	< .001	1.00 (1.00, 1.00)	927 (723)	.71	1.00* (1.00, 1.00)	866 (691)	.41	1.00 (1.00, 1.00)	890 (659)	.78	1.00 (1.00, 1.00)
API score	777 (75)	.74	1.00 (0.99, 1.00)	789 (79)	.03	1.00 (0.99, 1.01)	781 (74)	.58	1.00 (1.00, 1.01)	787 (81)	.01	1.00 (1.00, 1.01)	780 (78)	.14	1.00 (0.99, 1.01)
English learners		.05			.13			.96			.005			.6	
≥ 50%	56		0.68 (0.29, 1.57)	48		0.78 (0.29, 2.12)	22		1.05 (0.38, 2.87)	49		0.72 (0.32, 1.60)	81		1.98 (0.68, 5.78)
< 50% (Ref)	68		1.00	39		1.00	22		1.00	67		1.00	83		1.00
Latino students		.42			.41			.77			.004			.1	
≥ 50%	47		0.84 (0.37, 1.89)	40		0.52 (0.18, 1.47)	21		1.93 (0.73, 5.11)	50		0.77 (0.36, 1.68)	78		0.44 (0.16, 1.20)
< 50% (Ref)	65		1.00	46		1.00	23		1.00	68		1.00	86		1.00
FRP-eligible students		.36			.02			.74			.01			.34	
≥ 50%	61		1.00 (0.42, 2.41)	50		2.49 (0.78, 7.90)	21		1.18 (0.42, 3.32)	53		0.86 (0.37, 1.99)	81		0.92 (0.30, 2.79)
< 50% (Ref)	66		1.00	35		1.00	23		1.00	68		1.00	85		1.00

Note. API = academic performance index; CI = confidence interval; FRP = free and reduced price meal; OR = odds ratio. Unless otherwise specified, numbers included in the table are for the percentage of schools. The sample size was n = 240.
*$P < .05$.

DISCUSSION

Although water provision in schools has the potential to affect numerous student health outcomes, in this first comprehensive examination of school drinking water availability, no schools met all the criteria for excellent drinking water access (i.e., ≥ 1 fountain per 25 students, had water in ≥ 4 of 5 key locations, offered a nonfountain source of water, made safe and appealing tap water available, and maintained drinking fountains). In addition, we also found that secondary schools, schools in urban locations, and older schools may need the most assistance in improving their drinking water access. Despite the need for improvements, administrators cited cost and other pressing academic issues as barriers to increasing drinking water access in schools.

Historically, few policies have provided guidance regarding drinking water access in schools. In California and many other US states, water policy has been limited to building code specifications regarding the number of water access points required per a given number of students.[17] Even among building code requirements, there is great variability among states. For example, although Massachusetts has a building code of 1 fountain per 75 students, in California schools must have 1 fountain per 150 people.[17,30] Although nearly all schools in our study met the building code requirement, merely having fountains in place

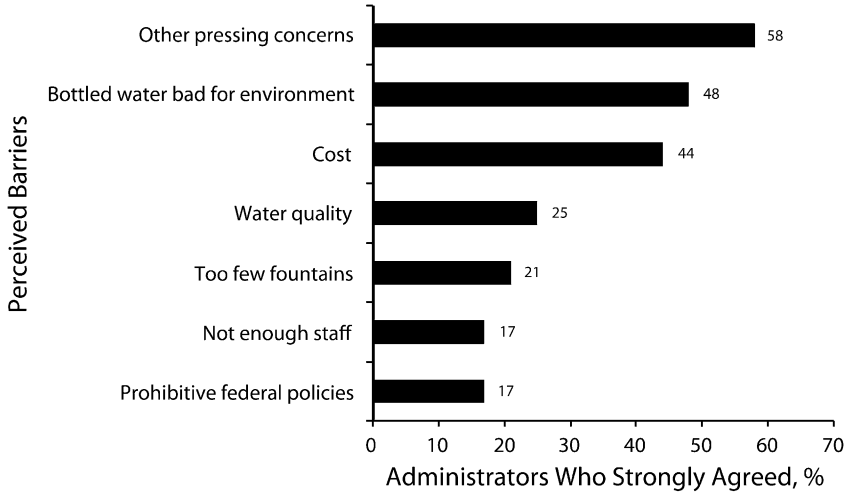

FIGURE 1—California school administrators' perceived barriers to improving drinking water access in schools (n = 240): May–November 2011.

may be insufficient for increasing water intake among students. This is particularly true if fountains are not maintained or if students perceive water from fountains to be unsafe.[21,24,31] Furthermore, even though fountains are the most common source of drinking water in schools,[17,27,32] studies have suggested that nonfountain sources of water, such as water coolers or dispensers, may more effectively increase student water intake in school settings.[17,25,26,27]

Having ready access to drinking water in all locations throughout the school campus is also integral to ensuring excellent water access. Although legislation now requires free drinking water access in FSAs, this is only a first step toward improving school drinking water access at mealtimes. Consistent with a national study of water access in school cafeterias,[32] in this early study we found a significant increase in the number of California schools that reported free water availability in FSAs after implementation of related state and federal legislation. However, further efforts are needed to ensure that all schools comply with these policies. In California, for example, the initial notices of the water-in-school FSA policy went out primarily to food service directors. Better dissemination of information regarding the water-in-schools law, including implementation strategies and funding opportunities, to all key school officials (e.g., principals, facilities staff, and food service directors) may help increase water access not only in school FSAs, but across school campuses. In addition, because school administrators cited other pressing academic concerns as a barrier to improving water availability in schools, relaying information to school officials about the potential link between water intake and improved cognitive functioning[4–6,12,13] may pique school administrators' interest in making improvements in drinking water access.

Even though SB 1413 and the Healthy, Hunger-Free Kids Act are steps in the right direction toward improving school drinking water access, future school water access policies should seek improvements beyond the cafeteria walls. As of 2004, the Child Nutrition Reauthorization Act has required schools participating in federal school meal programs to develop wellness policies that outline nutrition and physical activity goals for schools.[33] Previous studies have suggested that water access in schools is rarely mentioned in school wellness policies.[27,30,34] Developing language related to water access (e.g., improving fountain: student ratios, allowing water in classroom settings) within these local policies provides a great opportunity for schools to set goals to ensure excellent drinking water access throughout their campuses.[35] Now that the USDA released a proposed rule, Local School Wellness Policy Implementation, that suggests that school wellness policies should include language about where and when free drinking water will be provided during the school day and about maintenance of drinking water sources, it is an ideal time to examine water-related language in local school wellness policies.[36] Furthermore, parents and other community stakeholders (e.g., public health officials, pediatricians, obesity prevention advocates) can also play a role by investigating and advocating for improvements in water access in schools in their own local communities.

Limitations

Our study has several limitations. Although this study is representative of the state of California—the most populous US state, with significant diversity in terms of race/ethnicity and socioeconomic background—findings may not be generalizable to other jurisdictions. Indeed, because California has been a leader in water-in-schools policies and practices, water accessibility in school FSAs and awareness of federal water-in-schools requirements may be higher in California than in other states. Future studies should explore water access in schools in other states and nationally. Another limitation of this study is that it relies on reports by school administrators. Although the survey instrument used in this study has been validated using school observational visits, school administrators are likely to report more positively about drinking water access on their campuses than would students. Future studies should examine water access from the perspective of students, the consumers whose consumption behaviors we want to affect. Also, because this study was conducted very soon after SB 1413 went into effect, study results reflect early policy implementation. Additional monitoring is needed to examine how compliance with the water-in-schools law changes over time.

Conclusions

Schools have made great strides in reducing availability of sugar-sweetened beverages, yet ensuring excellence in drinking water access in schools is still an area of significant need, especially in schools in which students have high rates of sugar-sweetened beverage consumption and associated health conditions such as obesity and dental caries. Implementation and enforcement of federal and state legislation that requires drinking water in

school FSAs is a first step toward improving water accessibility in schools, but additional efforts are needed to make free, potable, and appealing drinking water available both inside and beyond cafeteria walls. Ensuring that water is a ready part of the students' daily environment is one important component of a variety of strategies that need to be incorporated as part of childhood obesity prevention and overall child health strategies. ■

About the Authors

At the time of the study, Anisha I. Patel, Jacob M. Grumbach, and Claire D. Brindis were with the Division of Pediatrics and Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco. Kenneth Hecht and Ellen Braff-Guajardo were with California Food Policy Advocates, Oakland. Karla E. Hampton was with Changelab Solutions, Oakland.

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Contributors

A. I. Patel conceptualized and designed the study, conducted the data analyses, drafted the initial article, and approved the final article. J. M. Grumbach helped collect data and conduct some data analyses, reviewed and revised the article, and approved the final article. C. D. Brindis and K. Hecht helped conceptualize and design the study, reviewed and revised the article, and approved the final article. E. Braff-Guajardo and K. E. Hampton helped conceptualize the study, reviewed and revised the article, and approved the final article.

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Human Participant Protection

This study was approved by the committee of human research at the University of California, San Francisco. School administrators gave their informed consent before participation in this study.

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