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ORIGINAL PAPER

Correlation of Sugar-Sweetened Beverage Consumption and School Free and Reduced Lunch Eligibility as a Measure of Socioeconomic Status

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Abstract
To determine whether a correlation exists between sugar-sweetened beverage consumption (SSB) and school free and reduced lunch (FRL) eligibility as a measure of socioeconomic status (SES). In January 2016, a modified version of the Bev 15 survey was anonymously administered to 5th and 6th grade students in 14 Chicago suburban public elementary schools. Students were asked to recall and record their beverage intake over the last 24 h for five predefined beverage groups [SSB, real fruit juice (RFJ), diet or sugar free beverages, milk, and water]. Concurrently, data regarding FRL eligibility for each of the 14 schools was obtained from the Illinois State Board of Education website. Mean student consumption of the five beverage categories in each school was correlated with the school's respective FRL status. A total of 1389 student surveys were used for analysis. FRL eligibility ranged from 16 to 64% in the 14 schools. There was a significant correlation between school FRL eligibility and consumption of SSB ($p=0.001$), RFJ ($p=0.004$) and diet or sugar-free beverage ($p=0.04$). There was no significant correlation between FRL eligibility and consumption of water ($p=0.5$), and milk ($p=0.2$). This study shows that consumption of SSB highly correlates with school FRL eligibility, which can be a measure of SES. These findings reinforce the idea that there is a link between lower SES and unhealthy behaviors pertaining to dietary choices. Knowing this relationship between SSB consumption and FRL eligibility, specific schools can be targeted to reduce SSB consumption and its negative health consequences.

Keywords Sugar sweetened beverages · Free and reduced lunch · Obesity · Prevention

Introduction

Obesity is a significant public health challenge in the United States. Since the 1960s, obesity rates increased by almost three fold and, currently, about 37% of adults and 17% of children in the United States are obese [1, 2]. While many factors appear to be associated with obesity, sugar sweetened beverages (SSB) have recently been at the forefront of obesity-related policy debates as multiple studies link SSB consumption with increased body weight and risk of obesity [3, 4]. SSBs are also associated with chronic illness such as type 2 diabetes mellitus and cardiovascular diseases [5, 6]. Given this association with adverse health outcomes, the American Academy of Pediatrics recommends limited daily SSB consumption [3].

SSB are the largest source of added sugar in the American youth diet, and the highest consumers of SSB are adolescents [7–10]. In previous studies, investigators explored the association of SSB with demographic and behavioral factors among youth, however little attention has been paid to a youth's socioeconomic status (SES) in relation to SSB consumption [11]. In the United States, children receiving free reduced lunch (FRL), a widely used proxy for lower SES, have a higher incidence of obesity [12]. This study examines if a correlation exists between consumption of SSB and

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FRL eligibility in a small population of schools. Having this knowledge could allow schools and communities to better target certain neighborhoods and populations to implement educational strategies to reduce SSB consumption while ensuring access to more healthful beverages.

Methods

Participants of this study included male and female elementary students in the 5th and 6th grade from 14 suburban Chicago public schools. In January 2016, a school board approved beverage survey was administered to 1389 students during their physical education class without any identifiers. This survey was developed by a local School Wellness Committee and was initially used to develop an educational program entitled "sugar show", which educated students on the American Heart Association's recommended daily added sugar limits to the amount of sugar contained in popular beverages. As this program was conducted as a school wellness project led by parents and teachers, submission to the local medical center's institutional review board was not required. Prior to administration, all school families received a letter explaining the survey and providing the option for parents and guardians to notify their child's teacher if they did or did not want their child's survey data collected.

The survey created was an anonymous 24-h beverage recall survey based on an adult standard survey called the Bev 15 (Fig. 1) [13]. Students were instructed to circle "Yes" if they had consumed any of the listed beverages in the preceding 24 h during breakfast, lunch, after school, dinner, or after dinner. The beverages were listed individually, but for analyzing purposes, the beverages were grouped into five categories: SSB, real fruit juice (RFJ), diet or sugar free soda, milks, and water. SSBs were defined as drinks with added sugar including non-diet soft drinks/sodas, flavored juice, sports, energy, and electrolyte replacement drinks. Students were provided the option of handwriting any intake of beverages not listed in the survey.

The percentage of students receiving FRL for each of the 14 schools was obtained from the Illinois State Board of Education (ISBE) Nutrition and Wellness website [14].

STUDENT DRINK SURVEY

This is a voluntary survey about what students drink. Do not write your name on this page. The answers are private. Please be honest.
Please think of the last time that you ate breakfast and lunch, and think of what you drank yesterday afterschool, with dinner, and after dinner.

	Did you drink any with **BREAKFAST?** Circle if yes	Did you drink any with **LUNCH?** Circle if yes	Did you drink any with **SNACK AFTER SCHOOL?** circle if yes	Did you drink any with **DINNER?** circle if yes	Did you drink any **AFTER DINNER?** circle if yes
100% Real Fruit Juice	YES	YES	YES	YES	YES
Plain Milk (including soy, almond, and other plain milks)	Yes	YES	YES	YES	YES
Chocolate, strawberry, or other flavored milks	YES	YES	YES	YES	YES
Mixed Fruit Flavored Drinks: Snapple, Capri Sun, Kool Aid, Izze, Cranbery juice cocktail	YES	YES	YES	YES	YES
Sports Drinks (examples: gatorade, powerade, energy drink)	YES	YES	YES	YES	YES
Lemonade or Sweetened Tea	YES	YES	YES	YES	YES
Regular Soda (examples: Coke Pepsi, Mt Dew, 7-Up, Sprite)	YES	YES	YES	YES	YES
Diet Drinks (example: Diet Coke, Diet Snapple)	YES	YES	YES	YES	YES
Water	YES	YES	YES	YES	YES
Other					

Fig. 1 A sample of the student drink survey, a modified version of the Bev-15 survey, filled out by anonymous, voluntary participants

The FRL eligibility statistics were obtained from 2016 data, the same year the survey was distributed. The Illinois Free Lunch and Breakfast Programs requires all public schools to offer a free meal (lunch required, and breakfast required if the school operates a free breakfast program) to students eligible to receive such meals as determined by the regulations governing the federal School Breakfast Program and the National School Lunch Program. Students were deemed eligible to receive a FRL if they received food stamps or Temporary Assistance to Needy Families (TANF), or if their household income fell within the guidelines published annually by the United States Department of Agriculture (USDA). Other students qualified if they were directly certified by the local educational agencies (LEA). At the end of each year, ISBE publishes the percentage of students who were eligible for receiving FRL for public access.

Statistical Analysis

Prior to statistical analysis, the schools were de-identified and the data was analyzed and adjudicated by two separate reviewers. The average school consumption of SSB, RFJ, diet or sugar free beverages, milk and water were then tabulated and compared to FRL eligibility. A linear least square regression was used to determine the coefficient of determination (R^2), and the Pearson correlation coefficient (r) was calculated from it. P-values were obtained with the statistical significance set to ≤ 0.05. Data was summarized using descriptive statistics for measure of central tendency, including mean and standard deviation for continuous variables. The liner trend of percentage of FRL eligibility compared to consumption of each beverage category across the 14 schools was illustrated in five comparative graphs (Fig. 2).

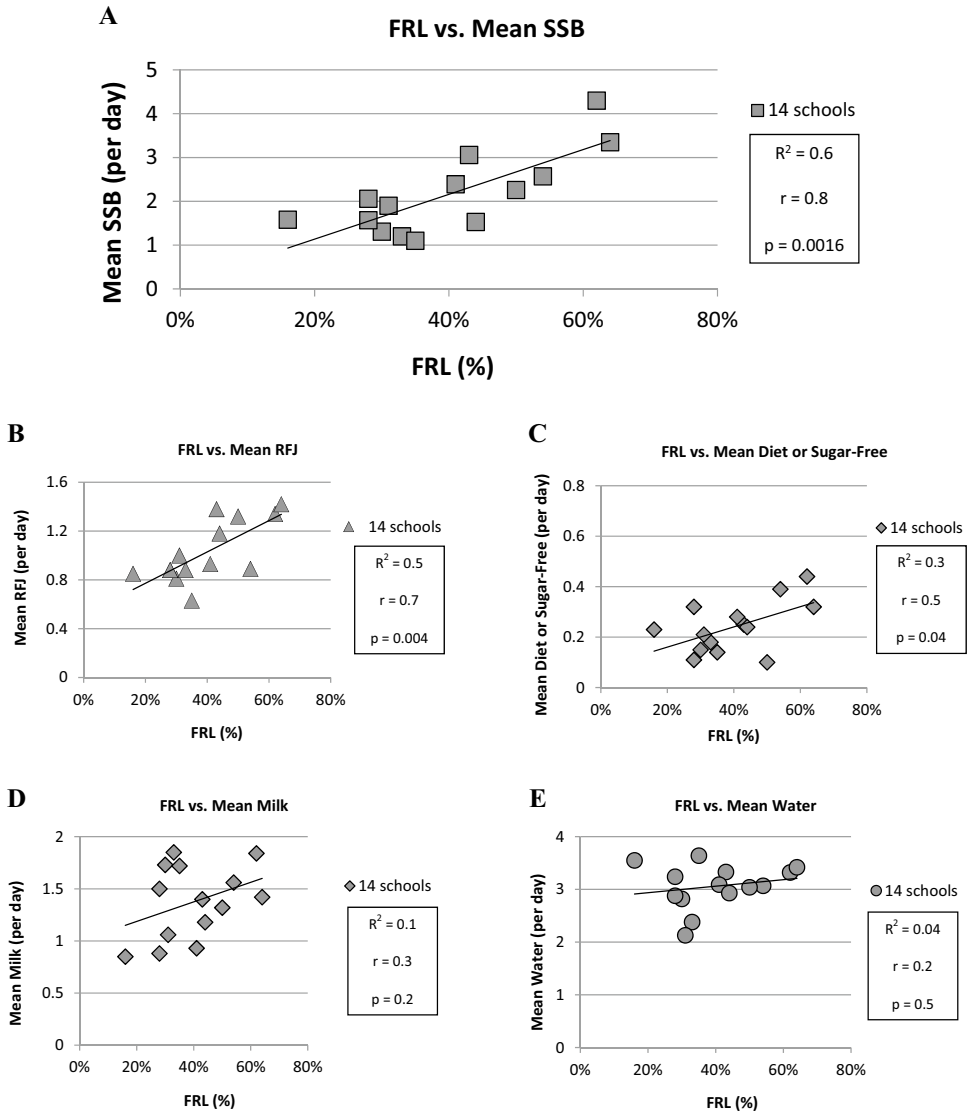

Fig. 2 Graphs **a**–**e** represents the means of the five beverage groups in each school plotted against the FRL percentage. Values for the coefficient of determination (R^2), correlation coefficient (r), and p are shown

Results

A total of 1389 anonymous surveys from 14 schools were used for analysis. FRL percentages ranged from 16 to 64% among the 14 schools. The highest average SSB consumption (4.3 ± 5) was from School 1, which had the 2nd highest FRL eligibility (62% eligibility) (Table 1). The lowest SSB consumption was from School 7, which had a FRL eligibility percentage of only 35% (Table 1). A positive correlation was observed between FRL eligibility and all five beverage groups with the SSB group being closest to 1.0 (actual r of 0.8) and the least positive group being water (actual r of 0.2) (Fig. 2). Among the five beverage groups, significant p-values were found for three categories—SSB ($p = 0.001$), RFJ ($p = 0.004$) and diet or sugar-free ($p = 0.04$) beverages. There was no significant correlation between FRL eligibility and water ($p = 0.5$) or milk ($p = 0.2$).

Discussion

A large body of data exists which analyzes consumption patterns of SSBs [15–17]. However, to our knowledge, there are limited studies which assess socio-demographic determinants of SSB consumption in children. This present study builds on previous literature providing new associations of SSB consumption and FRL eligibility using representative data from elementary school students. Additionally, this study also explores intake of other beverage groups, namely RFJ, diet or sugar free drinks, milk, and water, and their relationship to FRL eligibility. Findings from our study demonstrate a positive correlation among all five beverage groups and FRL eligibility; however, the SSB group had the most positive correlation. Schools with higher numbers of students eligible for FRL consumed higher amounts of SSB.

Table 1 FRL from highest to lowest with respective SSB from that school

	FRL (%)	SSB total (mean ± SD)
School 10	64	3.4 ± 4.4
School 1	62	4.3 ± 5
School 2	54	2.6 ± 3.7
School 12	50	2.3 ± 2.7
School 13	44	1.5 ± 2
School 5	43	3.1 ± 4.2
School 9	41	2.4 ± 3.7
School 7	35	1.1 ± 2.4
School 6	33	1.2 ± 1.8
School 8	31	1.9 ± 2.6
School 3	30	1.3 ± 1.9
School 4	28	2.1 ± 3.3
School 14	28	1.6 ± 2.2
School 11	16	1.6 ± 1.9

Over the past several decades there has been little scientific consensus on the daily amount of sugar that is dangerous to health. In August 2016 the American Heart Association provided recommendations that children and teens should consume no more than six teaspoons or 24 g of added sugar per day [18]. This seems an achievable target, however, over the past 60 years, larger and larger serving sizes contain up to three times this amount in a single serving container. For example, the standard bottle in the 1950s was 6.5 ounces (approximately 21 g of sugar), compared to current serving sizes of 20 ounces (approximately 65 g of sugar), far exceeding the AHA recommendation. As soda bottle sizes have increased, so has the average BMI of children and adolescents in the US, making them a crucial group to focus efforts for controlling the obesity epidemic.

Today, one out of three children in the US is overweight or obese, and lifetime medical costs for treating obesity-related health conditions in 10-year-olds alone are estimated to be $14 billion [19]. Several studies indicate that low-income children have higher odds of heavy total SSB consumption and higher caloric intake from SSBs than high-income children [8, 15, 20]. Specifically, in 2008, a study in the American Journal of Clinical Nutrition concluded that "higher-quality diets are, in general, consumed by better educated and more affluent people," and also that "lower quality diets tended to be consumed by groups of lower SES and more limited economic means" [21]. Again, our present study augments this idea, but uses higher FRL eligibility as a proxy for measuring SES.

From this study, it is evident that low SES populations are vulnerable to increased SSB consumption. By first identifying the population group, a targeted plan can be created to reduce overall SSB consumption. This was previously attempted in 2004 when the Healthy Corner Store Initiative was developed to increase the availability of healthy foods to underserved communities [22]. A nonprofit organization called The Food Trust partnered with store owners in Philadelphia who were committed to making healthy changes for their customers and their businesses. While a large effort was placed into this program, a randomized controlled study showed that there was no significant change in the content of corner store purchases or in youth obesity measurements [23]. These are just two examples of attempts at facilitating healthier lifestyles in urban areas. There needs to be more studies that target the years that are habit-forming and more specifically where there are higher rates of children consuming FRL.

This study demonstrates a correlation with school FRL eligibility and increased intake of SSB. Children spend the

majority of their waking time in schools, and schools provide a major developmental setting for children and adolescents that can influence children's obesity related behaviors. One possible approach could include an educational component to schools curricula that emphasizes the amount of sugar present in beverages compared to what the USDA of American Heart Association deems appropriate for one day's worth of consumption. In Illinois, for example, a simple "sugar show" shown in physical education class was used to demonstrate the amount of sugar in beverages to elementary school children [24]. In this pilot study, self-reported average daily SSB beverage consumption decreased after the "sugar show," suggesting that grade school students were receptive to information about the adverse effects of SSBs on health. Similar simple tactics can be used as interventions that can be added to school curricula.

Another possible approach to reducing SSB consumption in at-risk populations could include imposing higher taxes on SSBs. After a tax was implemented on SSBs in Mexico in 2014, all three SES groups (low, middle, and high) reduced their purchases of taxed beverages. Households in the lower socioeconomic level demonstrated the largest decreases. This effect was sustained over 2 years [25]. Similarly, Berkeley, California became the first city in the United States to pass a SSB tax in 2014 and studies showed a 21% decrease in SSB consumption and 63% increase in water consumption [26]. Other variables to consider include removal of SSBs completely from schools. This was studied in 2012 and conclusions showed that state policies that banned all SSBs in middle schools reduced in-school access and purchasing of SSBs but did not reduce overall consumption [27]. However this was a single cross section study and nonetheless still resulted in positive changes in school food environments. Finally, several toolkits (one specifically by the CDC and another by University of California San Francisco) have been developed in hopes that parents and schools will leverage the strategies provided to simply promote water as a healthy beverage [28, 29]. By increasing knowledge of the negative consequences of SSBs, implementing tax reforms, or utilizing even simpler ideas, dietary habits of specific groups at higher risk for obesity can be reformed.

The present study had several limitations. Even though a moderate number of schools were examined, all the schools that participated in the survey were from a northern Chicago suburb. This region has socioeconomic variability, but it does not have as much diversity as larger urban cities. This survey was specifically directed at children in the 5th and 6th grade. This is an age when youths are beginning to make their own decisions regarding dietary intake, but they do not yet have control of home purchases. Many students at this age still have lunches packed for them or meals prepared for them. This leaves much of their food or beverage choices dependent on their parents or guardians. The administered survey only examined beverage intake for the previous 24 h, which may not be sufficient amount of time to get a true representation of the average daily beverage intake. The results were also self-reported and were based on recall, which can have its limitations.

The results of the present study can serve as a stepping stone for an array of next possible steps. By understanding the correlation between FRL eligibility and SSB intake, one can work towards primordial prevention and implementing policies that target children's consumption of various SSB from an economic, social, and behavioral viewpoint. Schools play an important role in a child's learning environment, and by introducing healthy eating behaviors at a young age, one can hope to have a positive impact in their lives.

Compliance with Ethical Standards

Conflict of interest The authors whose names are listed have no conflict of interests or financial ties to disclose.

Disclosures The authors whose names are listed certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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