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Home Matters: Adolescents Drink More Sugar-Sweetened Beverages When Available at Home

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Abstract

Objectives—To examine the association between sugar-sweetened beverage availability at home and sugar-sweetened beverage consumption, and to evaluate whether this association was consistent across school and school neighborhood sugar-sweetened beverage availability.

Study design—Secondary data analyses were performed from the 2014 cross-sectional, Internet-based Family Life, Activity, Sun, Health, and Eating (FLASHE) study of 1494 adolescents (age 12–17 years). Ordinal logistic regression analyses were conducted to examine the association between sugar-sweetened beverage availability in the home and adolescents' frequency of sugar-sweetened beverage consumption (nondaily, <1; daily, 1-<2; daily, ≥2), adjusting for adolescent age, sex, race, and body mass index and parent marital status and housing insecurity. Stratified ordinal logistic regression analyses were used to examine the associations by school and school neighborhood sugar-sweetened beverage availability.

Results—One-third (32.6%) of adolescents were nondaily consumers of sugar-sweetened beverages, 33.9% consumed 1-<2 sugar-sweetened beverages daily, and 33.5% consumed ≥2 sugar-sweetened beverages daily. Almost one-half (44.4%) reported that sugar-sweetened beverages were often or always available in the home. Frequency of sugar-sweetened beverage availability at home was associated with greater sugar-sweetened beverage consumption (OR, 2.88; 95% CI, 2.86–2.89 for rarely/sometimes available at home; OR. 5.62; 95% CI, 5.60–5.64 for often/always available at home). Similar associations were found regardless of the availability of sugar-sweetened beverages in the adolescent's school or school neighborhood.

Conclusions—Sugar-sweetened beverage availability in the home was associated with adolescent sugar-sweetened beverage consumption, regardless of sugar-sweetened beverage

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availability in other settings, and may be a key target for obesity prevention efforts. *(J Pediatr 2018;202:121–8)*.

Sugar-sweetened beverage consumption has increased by more than 300% over the past 3 decades and constitutes the largest source of added sugar in US adolescents' diets.[1,2] Sugar-sweetened beverages, which include sodas, fruit drinks, and sport drinks, contain added caloric sweeteners, are energy-dense, and provide little to no nutritional value.[3] Studies point to increased sugar-sweetened beverage intake as a major contributor to the rising prevalence of overweight and obesity,[4] with one-third of US adolescents currently overweight or obese.[5] Despite recent national declines in sugar-sweetened beverage consumption, adolescents remain the highest consumers among all youth age groups.[1] The 2015 Dietary Guidelines for Americans recommends keeping added sugars to <10% of total daily calories, and limiting the consumption of beverages with any added sugars.[6] The American Academy of Pediatrics supports these guidelines and recommends that pediatric practices and clinicians advise removing all sugar-sweetened beverages from youths' diets.[7,8] However, almost two-thirds of adolescents consume at least 1 sugar-sweetened beverage on a given day,[9,10] with sugar-sweetened beverages estimated to constitute 15% of their total daily calories.[10] Thus, understanding determinants and reducing adolescent sugar-sweetened beverage consumption remain national priorities for public health and obesity prevention efforts.[11]

The aim of this study was to examine the association between availability of sugar-sweetened beverages at home and adolescents' sugar-sweetened beverage consumption, and whether this association was consistent across school and school neighborhood sugar-sweetened beverage availability. We hypothesized that home sugar-sweetened beverage availability would be positively associated with self-reported sugar-sweetened beverage consumption. We also hypothesized that the association between home availability of sugar-sweetened beverages and sugar-sweetened beverage consumption would be attenuated by sugar-sweetened beverage availability in school and/or in the school neighborhood, because if sugar-sweetened beverages were available outside the home, then adolescents would have opportunities to consume sugar-sweetened beverages elsewhere even when not available at home.

Methods

We conducted a secondary analysis of data from the Family Life, Activity, Sun, Health and Eating (FLASHE) study, a cross-sectional, Internet-based study of parent-adolescent dyads sponsored by the National Cancer Institute (NCI).[12] Data are publicly available and include parent and adolescent self-reported lifestyle behaviors that relate to cancer risk (eg, diet, physical activity, sun safety, tobacco use). The FLASHE sample was selected from the Ipsos' Consumer Opinion Panel, a web-based panel with approximately 700 000 participants. The sample was selected to match US population distributions of sex, race/ethnicity, income, age, household size, and region. Eligible parents were at least 18 years old, a parent or legal guardian to an eligible adolescent, and living with the adolescent at least 50% of the time. Eligible adolescents were age 12–17 years. Parental consent was provided online via email invitation, and once completed, the adolescent was asked to provide assent online via email invitation.

Each enrolled dyad completed 4 online surveys consisting of multiple questionnaires about diet and physical activity behaviors. The parent and adolescent each completed 2 surveys (1 on diet and 1 on physical activity) over a 6-month period. Details of the FLASHE study have been reported elsewhere.[12,13]

Adolescent Reported Sugar Sweetened Beverage Consumption: Adolescent sugar-sweetened beverage consumption was measured by questions adapted from a validated dietary screener survey[14,15] to capture usual consumption. Participants' recall of what and how often they drank different beverages during the previous week was captured through 5 questions about sugar-sweetened beverages with the following response options: "I did not drink [beverage] during the past 7 days,""1–3 times in the past 7 days," "4–6 times in the past 7 days,""1 time per day," "2 times per day," or "3 or more times per day." The National Cancer Institute's dietary screening method for converting frequency responses to daily frequency was used to calculate total sugar-sweetened beverage consumption from the questions that asked about sugar-sweetened beverages (sweetened fruit drinks/teas, fruit juices, soda, energy drinks, and sports drinks). We categorized sugar-sweetened beverage consumption as nondaily consumption (<1 beverage consumed daily), daily consumption (1-<2 beverages consumed daily), or heavier daily consumption (≥2 beverages consumed daily).

The availability of sugar-sweetened beverages in the home was assessed from a single survey item: "How often are the following foods and drinks available in your home?".[15,16] The question that asked about "sugary drinks like regular soda, sports drinks, fruit drinks, sweetened teas, and other drinks with added sugar" was used to determine household sugar-sweetened beverage availability. This item was reviewed by scientific advisors for public relevance and consistency with existing validated measures and surveys.[12,13] Parents were asked the same question, and parental responses to this question were 73.4% in agreement with adolescent responses. Self-reported adolescent responses ranged from "never" to "always" on a 5-point Likert scale. Household sugar-sweetened beverage availability was collapsed as "never," "rarely/sometimes," or "often/always."

The availability of sugar-sweetened beverages at school was assessed using 2 questions adapted from the Active Where? Study Adolescent Survey.[17] Adolescents answered yes or no to the questions "Are there vending machines at your school?" and "If yes, then do they sell sodas, salty snacks, and/or candy?" We categorized school sugar-sweetened beverage availability as either the presence or absence of vending machines that sell sodas, salty snacks, and/or candy at school.

The availability of sugar-sweetened beverages in the neighborhood was assessed by an adapted survey that asked adolescents to "Think about the local area around your school, within a 10–15-minute walk in any direction. Do you have any of the following in walking distance from school?".[18] Responses of either "yes" or "no" were given to each of the following 4 store types: convenience store/corner store/small grocery store/bodega, supermarket/midsize grocery store, fast food restaurant, and non-fast food restaurant. The 4 responses were tallied to determine the total number of stores available in the school neighborhood. We dichotomized school neighborhood sugar-sweetened beverage availability as having 0 stores or at least 1 store available within walking distance of school.

Adolescents and parents self-reported age, sex, race/ethnicity, height, and weight. We classified adolescent age into 2 groups (12–14 and 15–17 years) to capture differences in autonomy of early and late adolescence[19] and divided parent age into 3 groups (18–34, 35–44, and 45+ years). Race/ethnicity was categorized as reported in the FLASHE dataset and included categories for Hispanic, Black/African American, White, and Other. Body mass index (BMI) was calculated from self-reported height and weight and categorized as underweight, normal weight, overweight, and obese in accordance with percentile cutoffs based on Centers for Disease Control and Prevention BMI percentiles for adults and adolescents.[20,21] Additional parental factors examined include parent sugar-sweetened beverage consumption (nondaily, <1; daily, 1–2; daily, ≥2), education (high school or less, some college, 4-year college), marital status (married/coupled, divorced/widowed/separated, never married), and housing insecurity as a monetary proxy determined by how often they were worried or stressed about having enough money to pay for rent/mortgage (never, almost never, sometimes, fairly/very often). In each stratified analysis (school and school neighborhood), sugar-sweetened beverage availability in the other location was controlled for in the model.

Statistical Analyses

FLASHE study analysis weights created by raking procedures for the survey's nonprobability sampling strategy were applied in all analyses to reduce sampling bias in individual-level analyses and to account for the survey design that aims to yield a sample similar to the general US population in key demographic characteristics.[13,22] Descriptive statistics of all variables were computed. Given that the sugar-sweetened beverage consumption variable represented ordered values, ordinal logistic regression models estimated associations. Ordinal logistic regression analysis was conducted to estimate the association between the measures of sugar-sweetened beverage availability in the home and adolescent sugar-sweetened beverage consumption behaviors. Analyses were conducted to test for statistical interaction of sugar-sweetened beverage availability in the school and sugar-sweetened beverage availability in the school neighborhood, respectively. Although we did not find evidence of statistically significant interactions, additional ordinal logistic regression analyses were conducted stratified by school sugar-sweetened beverage availability and school neighborhood sugar-sweetened beverage availability, respectively, to demonstrate the association between the measures of sugar-sweetened beverage availability in the home and adolescent sugar-sweetened beverage consumption regardless of sugar-sweetened beverage availability at school or in the school neighborhood. The proportional odds assumptions were tested and met for all final models. The proportional odds assumption assumes that the log odds ratio associated with an increase in category of household sugar-sweetened beverage availability is constant across the different category levels of adolescent sugar-sweetened beverage consumption.[23] Models were initially tested with an alternative categorization of sugar-sweetened beverage consumption that included a "no sugar-sweetened beverage consumption" group (n = 71), but this did not meet proportional odds assumptions, resulting in the 3-category sugar-sweetened beverage consumption outcome used in all study analyses.

We decided a priori to include key adolescent demographic characteristics (age, sex, race, and BMI) in adjusted regression models based on previous research.[9,24,25] Additional variables were assessed and included in the model if there was a 10% change in association. All models controlled for adolescent age, sex, race, and BMI and parent sugar-sweetened beverage consumption, marital status, and housing insecurity. The main model examining the association between sugar-sweetened beverage availability at home and adolescent sugar-sweetened beverage consumption was adjusted for sugar-sweetened beverage availability at school and in the school neighborhood. Models stratified by sugar-sweetened beverage availability at school were adjusted for sugar-sweetened beverage availability in the school neighborhood, and models stratified by school neighborhood availability were adjusted for sugar-sweetened beverage availability at school. To explore the potential influence of the accuracy of adolescent reporting of sugar-sweetened beverage availability at home, sensitivity analyses were performed that included only dyads in which the reports of sugar-sweetened beverage availability at home were concordant, and used the parent report of sugar-sweetened beverage availability at home. Results are reported as OR with 95% CI. Analyses were conducted in Stata version13.1 (StataCorp, College Station, Texas).

Results

Among the 1737 adolescents in the FLASHE study, 1632 had complete data for both sugar-sweetened beverage consumption and sugar-sweetened beverage availability variables. We excluded 138 participants owing to missing data on covariates, resulting in a sample of 1494 adolescents age 12–17 years (mean age, 14.47 ± 1.61). One-third (32.6%) were nondaily consumers of sugar-sweetened beverages, 33.9% were daily consumers of 1-<2 sugar-sweetened beverages, and 33.5% were daily consumers of ≥2 sugar-sweetened beverages. The sample was almost evenly distributed across sex and age groups, with the majority having a normal BMI (68.5%) and self-identified race as white (55.2%) (Table I). Most participants had parents that were married or coupled (77.6%), and almost one-half of the parents (46.6%) had completed 4 years of college.

Almost one-half (44.4%) of the adolescents reported that sugar-sweetened beverages were often/always available in the home. Adolescents for whom sugar-sweetened beverages were rarely/sometimes available at home had 3-fold greater odds of higher sugar-sweetened beverage consumption compared with those for whom sugar-sweetened beverages were never available at home (OR, 2.88; 95% CI, 2.86–2.89), and adolescents for whom sugar-sweetened beverages were often/always available had 5.5-fold greater odds of higher sugar-sweetened beverage consumption compared with those for whom sugar-sweetened beverages were never available at home (OR, 5.62; 95% CI, 5.60–5.64) (Table II).

One-half (51.9%) of the adolescents reported that sugar-sweetened beverages were available at school, 80.6% reported that sugar-sweetened beverages were available in the school neighborhood, 42% reported that sugar-sweetened beverages were available both at and near school, and 11% reported that sugar-sweetened beverages were not available at school or in the school neighborhood. Among adolescents who reported sugar-sweetened beverages were never available in the home, two-thirds were nondaily sugar-sweetened beverage consumers, and 10% or less were daily ≥2 sugar-sweetened beverage consumers. Among adolescents

who reported that sugar-sweetened beverages were often/always available in the home, approximately 20% were nondaily sugar-sweetened beverage consumers and approximately 40% were daily ≥2 sugar-sweetened beverage consumers. These percentages were similar across all stratum categories. Analyses did not indicate a statistically significant interactions between sugar-sweetened beverage availability at home and sugar-sweetened beverage availability in the school ($P = .269$) and sugar-sweetened beverage availability in the school neighborhood ($P = .182$).

Adolescents with more frequent availability of sugar-sweetened beverages in the home were more likely to report greater sugar-sweetened beverage consumption compared with adolescents for whom sugar-sweetened beverages were never available in the home regardless of sugar-sweetened beverage availability at school and in the school neighborhood (Table III). When sugar-sweetened beverages were available at school, adolescent sugar-sweetened beverage consumption was higher among those with more frequent availability of sugar-sweetened beverages in the home: never available or rarely/sometimes available, OR, 3.06 (95% CI, 3.04–3.07); often/always available (OR, 5.59; 95% CI, 5.56–5.62). When sugar-sweetened beverages were not available at school, adolescent sugar-sweetened beverage consumption was higher among those with more frequent availability of sugar-sweetened beverages in the home (rarely/sometimes available at home: OR,2.75 [95% CI, 2.73–2.76]; often/always available at home: OR,5.83 [95% CI, 5.80–5.86]) compared with adolescents living in homes in which sugar-sweetened beverages were never available. When sugar-sweetened beverages were available in the school neighborhood, adolescent sugar-sweetened beverage consumption was higher among those with more frequent availability of sugar-sweetened beverages in the home (rarely/sometimes available at home: OR, 2.89 [95% CI, 2.88–2.90]; often/always available at home: OR, 5.76 [95% CI, 5.74–5.79]) compared with adolescents living in homes in which sugar-sweetened beverages were never available. When sugar-sweetened beverages were not available in the school neighborhood, adolescent sugar-sweetened beverage consumption was higher among those with more frequent availability of sugar-sweetened beverages in the home (rarely/sometimes available at home: OR, 3.00 [95% CI, 2.97–3.02]; often/always available at home: OR, 5.45 [95% CI, 5.41–5.50]) compared with adolescents living in homes in which sugar-sweetened beverages were never available.

The models were formally tested for presence of interaction, and neither school sugar-sweetened beverage availability nor school neighborhood sugar-sweetened beverage availability was found to modify the association between home sugar-sweetened beverage availability and adolescent sugar- sweetened beverage consumption. Results were similar in sensitivity analyses using parent reports of sugar-sweetened beverage home availability and including only dyads in which the reports of sugar-sweetened beverage home availability were concordant; statistically significant associations identified in the main analysis were statistically significant, although the odds ratios were modestly attenuated (data not shown).

Discussion

In this study, adolescents with more frequent availability of sugar-sweetened beverages at home reported higher sugar-sweetened beverage consumption. In contrast with our

hypotheses, our results indicate that the association between availability of sugar-sweetened beverages in adolescents' home and self-reported sugar-sweetened beverage consumption did not differ by the availability of sugar-sweetened beverages in their school and school neighborhood. These findings are consistent with previous studies that demonstrated positive associations between sugar-sweetened beverage availability in the home environment and dietary behaviors, including sugar-sweetened beverage consumption.[26,27] Published evidence indicates that the local environment may be an important determinant of dietary behaviors and obesity.[28,29] Studies have generally shown an association between living in a neighborhood in close proximity to certain types of food outlets and the availability of healthy food options, dietary quality, dietary intake, and risk of overweight.[30–33] However, there is a gap in understanding how sugar-sweetened beverage availability in various food environmental settings (home, school, neighborhoods) are linked with adolescent sugar-sweetened beverage consumption.[28,34,35]

Given the increasing autonomy and independence associated with adolescence,[36] in addition to the opportunities for adolescents to make their own decisions about drink choices in environments outside the home,[37] we could consider that parents may believe they have limited influence on their child's sugar-sweetened beverage consumption. Parents may be concerned that even if they limit sugar-sweetened beverage availability at home, the adolescent will consume these beverages elsewhere. However, more than one-half of adolescents' calories are consumed at home,[38] and findings from this study emphasize that the home does matter. The study results highlight the important role parents continue to play in adolescents' sugar-sweetened beverage consumption through the drinks they make available in the home. Numerous studies demonstrate that the home food environment can either facilitate or inhibit healthful eating.[39–44] The present study adds to the literature with the finding that the availability of sugar-sweetened beverages in the home remains a critical factor positively associated with adolescent sugar-sweetened beverage consumption, regardless of sugar-sweetened beverage availability in other key food environment settings. Thus, parents can be empowered to make small changes in the home to reduce sugar-sweetened beverage availability and promote healthier diets for their adolescents.

Our findings have implications for pediatric clinical practice. Pediatric providers have the opportunity to facilitate discussions with adolescents and parents about obesity prevention and the importance of healthy dietary choices during this critical period of development. The American Academy of Pediatrics supports the pediatric provider's role in primary prevention of obesity among youth.[8] The guidelines recommend that providers encourage families to limit sugar-sweetened beverages at home and to focus on family-based approaches for obesity prevention. The findings of this study support this approach and highlight the critical role of sugar-sweetened beverage availability in the home in sugar-sweetened beverage consumption by adolescents, even when they are exposed to environments outside the home in which sugar-sweetened beverages are readily available. Pediatric providers can share this message with parents to highlight the key role they play as parents, and to support their efforts to improve their home's dietary environment by eliminating or reducing sugar-sweetened beverages.

Parental modeling of behaviors related to sugar-sweetened beverage consumption, such as their own sugar-sweetened beverage consumption and availability of sugar-sweetened beverages at home, may be internalized by adolescents and potentially influence their beverage choices away from the home. Thus, parental influence on adolescent sugar-sweetened beverage consumption may extend further than consumption in the home. Future studies can further explore the possible role of parents in affecting adolescents' sugar-sweetened beverage consumption through parental modeling and practices, and evolving youth independence.[41,44,45]

Study findings should be considered in light of the following limitations. Compared with the national US population, a higher percentage of study participants were of healthy weight, had married parents, and had parents with 4 years of college education.[41] This may limit the generalizability of our results, because sugar-sweetened beverage consumption may differ among US adolescents not well represented in the FLASHE cohort. Further examination of the associations in this study with more ethnically diverse populations is needed. In addition, this study was of cross-sectional design, and thus causal inferences are not possible. Regarding the primary outcome of interest (sugar-sweetened beverage consumption), there is potential for recall or social desirability bias in self-reporting. Individuals tend to underreport their consumption of foods perceived to be unhealthy by underestimating the quantity consumed or omitting them altogether.[46–48] This study captured multiple types of sugar-sweetened beverages, but did not capture coffee-based drinks to include in daily sugar-sweetened beverage consumption behaviors. Nonetheless, the reporting of sugar-sweetened beverage consumption in this study among adolescents is similar to published national sugar-sweetened beverage consumption estimates.[48] Even though the sugar-sweetened beverage consumption measure has limitations, it provides a reasonable estimate of consumption and is a feasible option for large-scale studies, given the cost and participant burden of gold standard dietary assessments. Another limitation is that the school availability measure captures both sugary drinks and junk food in vending machines. The impact of this may be minimal, however, given that soda is the most common offering in school vending machines, and that 71% of children's purchases from school vending machines are sodas and other sugary drinks.[49] Policies around competitive foods (vending machines) in schools apply only during school hours, allowing opportunities for students to purchase sugar-sweetened beverages before and after school.[50] Although the school neighborhood availability measure captures the environment around the school, the FLASHE data do not include information on the neighborhood around adolescents' homes or other locations that they frequent. These aspects of adolescents' environments can be explored in future studies. Additional limitations of the data include the absence of information around the season of data collection, which limits the ability to examine for seasonal differences in sugar-sweetened beverage consumption. Self-reported height and weight were used to calculate adolescent BMI. A review of the accuracy of self-reported height and weight among adolescents found that females underestimated weight more than males (range, −4.0 to −1.0 kg vs −2.6 to 1.5 kg), and that height was both overestimated and underestimated for both males and females (range, −1.1 cm to 2.4 cm).[51] Thus, there may be residual confounding by adolescent BMI.

Our present findings show that, despite the availability of sugar-sweetened beverages in school and school neighborhood environments, the home food environment remains an important determinant of adolescent sugar-sweetened beverage consumption and hence for obesity prevention efforts. Parents can play a critical role in reducing adolescent sugar-sweetened beverage consumption by limiting or cutting back on the availability of sugar-sweetened beverages in the home. Pediatric providers are well positioned to reinforce these recommendations and to support patients and their families in meeting these guidelines. ■

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Glossary

BMI	Body mass index
FLASHE	Family Life Activity, Sun, Health, and Eating

References

1. Bleich SN, Vercammen KA, Koma JW, Li Z. Trends in beverage consumption among children and adults, 2003–2014. Obesity (Silver Spring) 2018;26:432–41. [PubMed: 29134763]
2. Reedy J, Krebs-Smith SM. Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. J Am Diet Assoc 2010;110:1477–84. [PubMed: 20869486]
3. Centers for Disease Control and Prevention. The CDC guide to strategies for reducing the consumption of sugar-sweetened beverages. Atlanta (GA): CDC; 2010.
4. Bucher Della Torre S, Keller A, Laure Depeyre J, Kruseman M. Sugar-sweetened beverages and obesity risk in children and adolescents: a systematic analysis on how methodological quality may influence conclusions. J Acad Nutr Diet 2016;116:638–59. [PubMed: 26194333]
5. Ogden CL, Carroll MD, Lawman HG, Fryar CD, Kruszon-Moran D, Kit BK, et al. Trends in obesity prevalence among children and adolescents in the United States, 1988–1994 through 2013–2014. JAMA 2016;315:2292–9. [PubMed: 27272581]
6. US Department of Health and Human Services, US Department of Agriculture. 2015–2020 dietary guidelines for Americans. 8th ed 2015.
7. Davis MM, Gance-Cleveland B, Hassink S, Johnson R, Paradis G, ResnicowK. Recommendations for prevention of childhood obesity. Pediatrics 2007;120(Suppl 4):S229–53. [PubMed: 18055653]
8. Daniels SR, Hassink SG. The role of the pediatrician in primary prevention of obesity. Pediatrics 2015;136:e275–92. [PubMed: 26122812]
9. Rosinger A, Herrick K, Gahche J, Park S. Sugar-sweetened beverage consumption among US youth, 2011–2014. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2017.
10. Slining MM, Popkin BM. Trends in intakes and sources of solid fats and added sugars among US children and adolescents: 1994–2010. Pediatr Obes 2013;8:307–24. [PubMed: 23554397]
11. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. Int J Obes Relat Metab Disord 1999;23(Suppl 2):S2–11.
12. Nebeling LC, Hennessy E, Oh AY, Dwyer LA, Patrick H, Blanck HM, et al. The FLASHE study: survey development, dyadic perspectives, and participant characteristics. Am J Prev Med 2017;52:839–48. [PubMed: 28526360]
13. Oh AY, Davis T, Dwyer LA, Hennessy E, Li T, Yaroch AL, et al. Recruitment, enrollment, and response of parent–adolescent dyads in the FLASHE study. Am J Prev Med 2017;52:849–55. [PubMed: 28526361]

14. National Cancer Institute, Epidemiology and Genomics Research Program. Dietary Screener Questionnaire (DSQ) in the NHANES 2009–2010: Background. Available at: http://epi.grants.cancer.gov/nhanes/dietscreen/. Accessed September 15, 2016.
15. Centers for Disease Control and Prevention (CDC). 2010 National Youth Physical Activity and Nutrition Survey (NYPANS). Available at: ftp://ftp.cdc.gov/pub/data/yrbs/nypans/2010nypans_questionnaire.pdf. Accessed September 15, 2016.
16. University of Minnesota. Project Eat-II Survey: Project EAT. Available at: http://www.sphresearch.umn.edu/epi/project-eat/. Accessed September 15, 2016.
17. Kerr J, Sallis J, Rosenberg DE, Norman G, Saelens B, Durant N, et al. Tools and measures: active where? Surveys Available at: http://activelivingresearch.org/active-where-surveys. Accessed September 15, 2016.
18. Rosenberg D, Ding D, Sallis JF, Kerr J, Norman GJ, Durant N, et al. Neighborhood Environment Walkability Scale for Youth (NEWS-Y): reliability and relationship with physical activity. Prev Med 2009;49:213–8. [PubMed: 19632263]
19. Wigfield A, Byrnes JP, Eccles JS. Development during early and middle adolescence In: Alexander PA, Winne PH, eds. Handbook of educational psychology. Mahwah (NJ): Lawrence Erlbaum; 2006, p. 87–113.
20. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC Growth Charts for the United States: methods and development. Vital Health Stat 11 2002;246:1–190.
21. Centers for Disease Control and Prevention. About adult BMI. Available at: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html. Accessed September 20, 2016.
22. Tourangeau R, Conrad FG, Couper MP. The science of web surveys. Oxford University Press; 2013.
23. Brant R Assessing proportionality in the proportional odds model for ordinal logistic regression. Biometrics 1990 12 1:1171–8.
24. Centers for Disease Control and Prevention (CDC). Beverage consumption among high school students—United States, 2010. MMWR Morb Mortal Wkly Rep 2011;60:778–80. [PubMed: 21681174]
25. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. Am J Public Health 2007;97:667–75. [PubMed: 17329656]
26. Loth KA, MacLehose RF, Larson N, Berge JM, Neumark-Sztainer D. Food availability, modeling and restriction: how are these different aspects of the family eating environment related to adolescent dietary intake? Appetite 2016;96:80–6. [PubMed: 26327222]
27. Luszczynska A, de Wit JB, de Vet E, Januszewicz A, Liszewska N, Johnson F, et al. At-home environment, out-of-home environment, snacks and sweetened beverages intake in preadolescence, early and mid-adolescence: the interplay between environment and self-regulation. J Youth Adolesc 2013;42:1873–83. [PubMed: 23354418]
28. de Vet E, de Ridder DT, de Wit JB. Environmental correlates of physical activity and dietary behaviours among young people: a systematic review of reviews. Obes Rev 2011;12:e130–42. [PubMed: 20630024]
29. Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: a systematic review. Health Place 2012;18:1172–87. [PubMed: 22717379]
30. Laska MN, Hearst MO, Forsyth A, Pasch KE, Lytle L. Neighbourhood food environments: are they associated with adolescent dietary intake, food purchases and weight status? Public Health Nutr 2010;13:1757–63. [PubMed: 20529405]
31. Powell LM, Auld MC, Chaloupka FJ, O'Malley PM, Johnston LD. Associations between access to food stores and adolescent body mass index. Am J Prev Med 2007;33(4 Suppl):S301–7. [PubMed: 17884578]
32. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. Am J Prev Med 2009;36:74–81. [PubMed: 18977112]
33. Odoms-Young A, Singleton CR, Springfield S, McNabb L, Thompson T. Retail environments as a venue for obesity prevention. Curr Obes Rep 2016;5:184–91. [PubMed: 27099166]

34. van der Horst K, Oenema A, Ferreira I, Wendel-Vos W, Giskes K, van Lenthe F, et al. A systematic review of environmental correlates of obesity-related dietary behaviors in youth. Health Educ Res 2007;22:203–26. [PubMed: 16861362]
35. Lucan SC. Concerning limitations of food-environment research: a narrative review and commentary framed around obesity and diet-related diseases in youth. J Acad Nutr Diet 2015;115:205–12. [PubMed: 25443565]
36. Spear HJ, Kulbok P. Autonomy and adolescence: a concept analysis. Public Health Nurs 2004;21:144–52. [PubMed: 14987214]
37. Sawyer SM, Afifi RA, Bearinger LH, Blakemore SJ, Dick B, Ezeh AC, et al. Adolescence: a foundation for future health. Lancet 2012;379:1630–40. [PubMed: 22538178]
38. Poti JM, Popkin BM. Trends in energy intake among US children by eating location and food source, 1977–2006. J Am Diet Assoc 2011;111:1156–64. [PubMed: 21802561]
39. Van Lippevelde W, te Velde SJ, Verloigne M, De Bourdeaudhuij I, Manios Y, Bere E, et al. Associations between home-and family-related factors and fruit juice and soft drink intake among 10-to 12-year old children. The ENERGY project. Appetite 2013;61:59–65. [PubMed: 23154218]
40. Haerens L, Craeynest M, Deforche B, Maes L, Cardon G, De Bourdeaudhuij I. The contribution of psychosocial and home environmental factors in explaining eating behaviours in adolescents. Eur J Clin Nutr 2008;62:51–9. [PubMed: 17299461]
41. Bogart LM, Cowgill BO, Sharma AJ, Uyeda K, Sticklor LA, Alijewicz KE, et al. Parental and home environmental facilitators of sugar-sweetened beverage consumption among overweight and obese Latino youth. Acad Pediatr 2013;13:348–55. [PubMed: 23680295]
42. Bere E, Glomnes ES, te Velde SJ, Klepp KI. Determinants of adolescents' soft drink consumption. Public Health Nutr 2008;11:49–56. [PubMed: 17582242]
43. Tak NI, te Velde SJ, Oenema A, Van der Horst K, Timperio A, Crawford D, et al. The association between home environmental variables and soft drink consumption among adolescents. Exploration of mediation by individual cognitions and habit strength. Appetite 2011;56:503–10. [PubMed: 21241761]
44. Ezendam NPM, Evans AE, Stigler MH, Brug J, Oenema A. Cognitive and home environmental predictors of change in sugar-sweetened beverage consumption among adolescents. Br J Nutr 2010;103:768–74. [PubMed: 20003610]
45. van der Horst K, Kremers S, Ferreira I, Singh A, Oenema A, Brug J. Perceived parenting style and practices and the consumption of sugar-sweetened beverages by adolescents. Health Educ Res 2006;22:295–304. [PubMed: 16908496]
46. Lafay L, Mennen L, Basdevant A, Charles M, Borys JM, Eschwège E, et al. Does energy intake underreporting involve all kinds of food or only specific food items? Results from the Fleurbaix Laventie Ville Santé (FLVS) study. Int J Obes Relat Metab Disord 2000;24:1500–6. [PubMed: 11126348]
47. Rasmussen LB, Matthiessen J, Biltoft-Jensen A, Tetens I. Characteristics of misreporters of dietary intake and physical activity. Public Health Nutr 2007;10:230–7. [PubMed: 17288619]
48. Centers for Disease Control and Prevention. Get the facts: sugar sweetened beverages and consumption. Available at: https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html. Accessed June 28, 2017.
49. Lopez SJ. Gallup student poll national report. Washington (DC): Gallup, Inc.; 2009.
50. USDA: United States Department of Agriculture Food and Nutrition Service. Smart snacks in school. Available at: https://www.fns.usda.gov/school-meals/tools-schools-focusing-smart-snacks. Accessed July 1, 2017.
51. Sherry B, Jefferds ME, Grummer-Strawn LM. Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. Arch Pediatr Adolesc Med 2007;161:1154–61. [PubMed: 18056560]

Table I.

Characteristics of adolescents age 12–17 years by daily sugar-sweetened beverage consumption (n = 1494) presented as weighted percentages in the FLASHE study, 2014

Characteristics	Total	Nondaily consumption, <1 per day	Daily consumption, 1- <2 per day	Daily consumption, ≥2 per day
Unweighted, n	1494	476	519	499
Weighted, n	22 781 104	7 427 122	7 712 569	7 641 412
Adolescent characteristics				
Age, y, %				
12–14	49.8	50.5	48.9	50.0
15–17	50.2	49.5	51.1	50.0
Sex, %				
Female	48.8	55.5	52.0	39.0
Male	51.2	44.5	48.0	61.0
Race/ethnicity, %				
White	55.2	56.6	58.9	50.2
Black	13.5	10.7	13.0	16.7
Hispanic	15.9	14.0	17.5	16.1
Other	15.4	18.7	10.6	17.0
BMI, %				
Underweight (<5)	4.3	5.5	3.8	3.6
Normal (≥5-<85)	68.5	68.0	68.6	69.0
Overweight (≥85-<95)	14.8	15.7	13.8	14.8
Obese (≥95)	12.4	10.8	13.8	12.6
Parent characteristics				
Age, y, %				
18–34	11.8	9.7	12.0	13.6
35–44	43.8	42.7	44.6	44.1
45+	44.4	47.6	43.3	42.3
Sex, %				
Female	73.5	75.6	75.5	69.3
Male	26.5	24.4	24.5	30.7

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Characteristics	Total	Nondaily consumption, <1 per day	Daily consumption, 1- <2 per day	Daily consumption, ≥2 per day
Marital status, %				
Married/coupled	77.6	79.5	77.8	75.4
Divorced/widowed/separated	12.1	10.6	12.0	13.6
Never married	10.4	9.9	10.2	11.0
Education, %				
High school or less	18.4	17.4	17.7	20.1
Some college	35.0	35.1	38.5	31.6
4-year college	46.6	47.5	43.9	48.4
Housing insecurity, %				
Never	37.1	38.0	37.8	35.6
Almost never	21.3	23.2	21.5	19.2
Sometimes	22.4	19.7	22.3	25.0
Fairly/very often	19.2	19.2	18.4	20.2

All reported percentages are weighted percentages.

Table II.

Multivariable ordinal logistic regression model (n = 1494) of the association between sugar-sweetened beverage availability in the home and adolescent (age 12–17 y) sugar-sweetened beverage consumption behaviors in the FLASHE study, 2014

Sugar-sweetened beverage availability at home	Nondaily consumption, <1 per day, n (weighted %)	Daily consumption, 1-<2 per day, n (weighted %)	Daily consumption, ≥2 per day, n (weighted %)	Consumption	
				Crude OR (95% CI)	aOR* (95% CI)
Never	68 (65.7)	28 (26.0)	10 (8.3)	Reference	Reference
Rarely/sometimes	277 (38.6)	252 (33.3)	196 (28.1)	3.28 (3.26–3.29)	2.88 (2.86–2.89)
Often/always	131 (20.4)	239 (35.7)	293 (43.9)	7.20 (7.18–7.23)	5.62 (5.60–5.64)

*Model adjusted for school and school neighborhood sugar-sweetened beverage availability; adolescent age, sex, race, and BMI; and parent sugar-sweetened beverage consumption, marital status, and housing insecurity.

Table III.

Multivariable ordinal logistic regression models predicting adolescent (age 12–17 y) sugar-sweetened beverage consumption (nondaily, <1; daily, 1-<2; daily, ≥2) stratified by availability of sugar-sweetened beverages in the school and local school neighborhood in the FLASHE study, 2014

	Sugar-sweetened beverage consumption			
	Sugar-sweetened beverages not available in school (n = 726)		Sugar-sweetened beverages available in school (n = 768)	
Sugar-sweetened beverage availability at home	**aOR** *	**95% CI**	**aOR** *	**95% CI**
Never	Reference	Reference	Reference	Reference
Rarely/sometimes	2.75	2.73–2.76	3.06	3.04–3.07
Often/always	5.83	5.80–5.86	5.59	5.56–5.62
	Sugar-sweetened beverage consumption			
	Sugar-sweetened beverages not available in school neighborhood (n = 303)		Sugar-sweetened beverages available in school neighborhood (n = 1191)	
Sugar-sweetened beverage availability at home	**aOR** *	**95% CI**	**aOR** *	**95% CI**
Never	Reference	Reference	Reference	Reference
Rarely/sometimes	3.00	2.97–3.02	2.89	2.88–2.90
Often/always	5.45	5.41–5.50	5.76	5.74–5.79

*The sugar-sweetened beverage availability in school model was adjusted for school neighborhood sugar-sweetened beverage availability; adolescent age, sex, race, and BMI; and parent sugar-sweetened beverage consumption, marital status and housing insecurity. The sugar-sweetened beverage availability in school neighborhood model was adjusted for school sugar-sweetened beverage availability; adolescent age, sex, race, and BMI; and parent sugar-sweetened beverage consumption, marital status, and housing insecurity.