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The Relationship between Health-Related Knowledge and Sugar-Sweetened Beverage Intake among US Adults

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Abstract

Because there is limited information on associations between health-related knowledge and sugar-sweetened beverage (SSB) intake, our cross-sectional study examined this question using the 2010 HealthStyles Survey data for 3,926 adults (aged ≥18 years). Multivariable logistic regression analysis was used to estimate the adjusted odds ratios and 95% CIs for drinking SSBs ≥2 times per day. About 31% of adults consumed SSBs ≥1 time per day, with 20% doing so ≥2 times per day. About eight of 10 adults agreed that drinking SSBs can contribute to weight gain, yet, eight of 10 adults in this study did not know the actual kilocalorie content of a 24-oz fountain soda. After controlling for age, sex, race/ethnicity, education level, annual household income, and geographic region, the odds for drinking SSBs ≥2 times per day were significantly higher among adults who neither agreed nor disagreed (ie, were neutral) that drinking SSBs can contribute to weight gain (odds ratio 1.61, 95% CI 1.15 to 2.25 vs agree); however, knowledge about the energy content of regular soda was not associated with SSB intake. Our finding that knowledge about the adverse effects of SSB intake is significantly associated with SSB intake among adults suggests that health education regarding the potential contribution of excess energy intake from SSBs to weight gain could contribute to lowered consumption and lower rates of obesity. Although knowledge about the kilocalorie content of regular soda was unrelated to SSB intake, health education on the kilocalorie content of SSBs may still be beneficial because most adults did not know the actual kilocalorie content of SSBs. Longitudinal studies are needed to explore associations between knowledge about energy provided by SSBs and SSB intake.

Keywords

Sugar-sweetened beverages; Knowledge; Calories; Adults

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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The Prevalence of Obesity Among us Adults is high. For example, in 2009–2010, about 36% of US adults aged ≥20 years were obese (ie, body mass index ≥30).[1] This high prevalence of obesity is a major public health concern because of associated adverse health and economic consequences.[2,3] Furthermore, one of the factors associated with obesity is the consumption of sugar-sweetened beverages (SSBs).[4–6] Based on the 2010 Dietary Guidelines for Americans, SSBs are defined as "liquids that are sweetened with various forms of sugars that add calories. These beverages include, but are not limited to, soda, fruit ades and fruit drinks, and sports and energy drinks."[7] SSBs are the largest source of added sugars and an important contributor of energy in the diet of US adults.[8] Based on the National Health and Nutrition Examination Survey (NHANES) data in 2009–2010, about 50% of Americans consumed SSBs on any given day.[9] In addition to obesity, SSB intake has been associated with increased risk for type 2 diabetes,[6,10,11] cardiovascular disease, [6,12–14] and decreased diet quality.[15]

Individual knowledge influences behaviors associated with obesity.[16] Because one weight-related behavior is the consumption of SSBs, it is possible that knowledge about SSBs may influence their consumption. Previous studies examined associations between knowledge and SSB intake using a small sample size, but findings were inconsistent.[17,18] For example, one study among adults in the rural Lower Mississippi Delta reported that those in the lowest health literacy category consumed 230 kcal/day SSBs, whereas those in the adequate health literacy category consumed 111 kcal/day SSBs.[18] With the exception of this Mississippi study, little is known about whether knowledge about SSBs is associated with their consumption among US adults. Another study conducted among adolescents reported that knowledge about energy-related issues (eg, energy intake, expenditure, and balance) was not significantly associated with their SSB intake.[17] Therefore, the purposes of our study were to assess knowledge about SSBs and examine whether these are associated with SSB intake after controlling for sociodemographic factors among US adults. The authors hypothesized that correct knowledge about SSBs would be associated with a lower consumption of SSBs.

METHODS

Sample and Survey Administration

Our cross-sectional study was based on the HealthStyles Survey conducted by Porter Novelli during fall 2010. The HealthStyles Survey is a mail survey of US adults (aged ≥18 years) and is designed to assess a wide variety of respondents' health-related attitudes, knowledge, behaviors, and conditions surrounding important public health issues. The HealthStyles Survey is sent to the same individuals who complete and return Porter Novelli's ConsumerStyles Survey, which is a consumer mail panel survey. The ConsumerStyles Survey assesses consumer habits, lifestyles, attitudes, purchasing behaviors, traditional and social media habits, and technology use among US adults. The sampling and data collection are conducted by Synovate, Inc, a market research firm.[19] The consumer mail panel consists of about 200,000 members throughout the United States; this is a convenience sample. The ConsumerStyles Survey is sent to a stratified random sample drawn from the panel (n=20,000). Although the survey participants are drawn from a

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convenience sample, the sampling is stratified on region, household income, population density, age, and household size to create a sample distribution similar to the national distribution. In 2010, a total of 10,328 people completed the ConsumerStyles survey, yielding a response rate of 51.6%. A total of 6,255 Health-Styles Surveys were sent to a stratified random sample of households that returned the ConsumerStyles Survey. Responses were received from 4,184 HealthStyles participants, yielding a response rate of 66.9%. Participants in Health-Styles Survey 2010 were assigned weights based on sex, age, income, race, and household size to match US Current Population Survey proportion in 2009. This analysis was exempt from the Centers for Disease Control and Prevention Institutional Review Board process because personal identifiers were not included in the data provided to the Centers for Disease Control and Prevention. Among the 4,184 adults who completed the survey, a total of 258 participants were excluded from the study because of missing data on SSB intake (n=101), knowledge about SSBs (n=129), and education level (n=28). Comparing adults who were excluded from the study, those who were included had significantly higher proportions of women and lower-income adults, but did not differ according to age, race/ethnicity, education level, marital status, annual household income, and knowledge about SSBs.

Outcome Variable

SSB intake was determined by the following question: “During the past 7 days, how many times did you drink sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks.” Response choices were none, one to six times per week, one time per day, two times per day, three times per day, and ≥4 times per day. For bivariate analyses, four mutually exclusive categories were created: none, one to six times per week, one time per day, and ≥2 times per day. For logistic regression analysis, SSB intake variable was dichotomized (<2 and ≥2 times per day). The cutpoint of two times per day was based on the estimated 85th percentile of energy intake from SSB on any given day, which was about 300 kcal (two 12-oz cans of soda) among Americans (US Department of Agriculture National Nutrient Database for Standard Reference, Release 26, 2013).[20]

Knowledge about SSBs

The main exposure variables were two knowledge questions about SSBs, and mutually exclusive response categories were created. For the following statement, participants were asked to rate their agreement with: “Drinking regular sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks can cause weight gain.” Response options available were strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, and strongly agree. Three categories were created for this variable: agree (strongly/somewhat agree), neither, and disagree (strongly/somewhat disagree). For the second parameter, participants were asked to response to the following statement: “How many calories does a regular 24-oz fountain drink, such as a non-diet cola, have?” Response options available for this question were 150 kcal or less, 151 to 250 kcal, 251 to 350 kcal, 351 to 400 kcal, >400 kcal, and do not know. Four response categories were created for this variable: ≤250 kcal (underestimate), 251 to 350 kcal (correct), ≥351 kcal (overestimate), and

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do not know. Because this question was asking about knowledge, “do not know” was considered as a valid response category.

Sociodemographic Variables

Sociodemographic variables included were age (18 to 24 years, 25 to 44 years, 45 to 64 years, and ≥65 years), sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), education level (<high school, high school, some college, and college graduate), and marital status (married/domestic partnership and not married). Not married included widowed, divorced, separated, or never married. Annual household income was categorized as <$35,000, $35,000 to $74,999, $75,000 to $99,999, or ≥ $100,000. Geographic regions were categorized as New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific based on the Census regions.

Statistical Analysis

The relationship between SSB intake and the variables described above was examined using χ^2 tests and a *P* value <0.05 was the cutpoint for statistical significance. Multivariable logistic regression analysis was used to estimate adjusted odds ratios and 95% CIs for health-related knowledge associated with SSB intake ≥2 times per day after controlling for age, sex, race/ethnicity, education level, annual household income, and geographic regions. The multivariable logistic regression model included two knowledge variables and aforementioned covariates in one model. All statistical analyses were performed with Statistical Analysis Software (version 9.2, 2009, SAS Institute Inc) and incorporated appropriate procedures to account for the sample design by using SURVEYFREQ and SURVEYLOGISTIC with WEIGHT statements.

RESULTS AND DISCUSSION

The final analytic sample included 3,926 adults. About 31% of adults reported consuming SSBs ≥1 time per day during the past 7 days, including 20.0% who reported doing so ≥2 times per day. SSB intake significantly differed by age, sex, race/ethnicity, education level, annual household income, and geographic region (χ^2 tests, $P<0.05$) (Table 1). The proportion of adults who consumed SSBs ≥2 times per day was highest among adults aged 18 to 24 years, men, non-Hispanic others, those with less than high school education, those with household income of ≤$34,999 per year, and those living in the East South Central region.

The majority of adults (84.4%) agreed that drinking SSBs can contribute to weight gain (Table 2). However, the majority of adults did not know actual kilocalorie content of a 24-oz soda (19% underestimated, 17% overestimated, and 45% did not know). Knowledge about SSBs showed significant variation by certain characteristics (χ^2 tests, $P<0.05$). Specifically, none of the knowledge items varied by geographic regions. Both knowledge items significantly varied by race/ethnicity, education level, and annual household income. In addition, knowledge that drinking SSBs can contribute to weight gain varied by sex as well as by age and marital status for knowledge of the kilocalorie content of a 24-oz soda.

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Among sociodemographic groups with significant differences in knowledge, the proportion of adults who agreed that drinking SSBs can contribute to weight gain was highest among women, non-Hispanic whites, college graduates, and those with household income of $75,000 to $99,999 per year. The proportion of adults who knew the actual kilocalorie content of a 24-oz soda was highest among adults aged 25 to 44 years, non-Hispanic whites, college graduates, adults who were married or in a domestic partnership, and adults with household incomes of $75,000 to $99,999 per year (Table 2).

SSB intake significantly differed by knowledge about SSBs. In the bivariate analysis, the proportions of adults drinking SSBs ≥2 times per day were higher among adults who disagreed or neither agreed nor disagreed (ie, were neutral) that drinking SSBs can contribute to weight gain compared with those who agreed, and those who underestimated the kilocalorie content of a 24-oz regular soda. Results of multivariable logistic regression analyses showed that the odds for drinking SSBs ≥2 times per day were significantly higher among adults who neither agreed nor disagreed that drinking SSBs can contribute to weight gain (odds ratio 1.61 vs agreed) after controlling for age, sex, race/ethnicity, education level, annual household income, and geographic region. Knowledge about the kilocalorie content of regular soda was not associated with drinking SSBs ≥2 times per day (Table 3). Based on further analyses examining associations between the kilocalorie content of regular soda and SSB intake among SSB consumers only as well as comparing no SSB consumers with high SSB consumers (≥2 times per day), the results remain the same (data not shown).

The prevalence of adults drinking SSBs at least once per day during the past 7 days was somewhat lower in our study compared with 2009–2010 NHANES data, which showed that about half of adults aged ≥20 years reported consuming any SSB on a given day.[9] Discrepancies between studies could be due to differences in sampling approaches or dietary measurement tools. The NHANES study used 24-hour dietary recalls, whereas HealthStyles is based on a single food-frequency question to determine the number of times respondents consumed SSBs during the past 7 days. Regardless of discrepancies, SSB intake among US adults is high. Drinking one 12-oz can of regular soda twice per day could provide about 280 extra kilocalories daily (US Department of Agriculture National Nutrient Database for Standard Reference, Release 26). Also, our results have similar subgroup differences as previous studies,[20,21] which showed that young adults, men, non-Hispanic blacks, adults with less than a high school education, and lower-income adults were more likely to consume SSBs than their counterparts. In our study, SSB intake differed significantly by geographic regions. Although potential reasons for this finding are unclear, it could be partially explained by cultural norms,[22] differences in availability of SSBs, and/or state and local obesity prevention programs. For example, some research suggests that adults who live in rural areas may be more likely to consume SSBs than their urban counterparts.[15] Furthermore, some state and local communities are more actively involved in programs to reduce SSBs than other communities.[23]

Moreover, our findings indicate that knowledge about SSBs were significantly associated with SSB intake even after controlling for sociodemographic characteristics. Adults who were neutral regarding the influence of SSBs on weight gain had 61% greater odds for SSB intake ≥2 times per day than those who agreed. Although adults who disagreed had 68%

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higher odds for SSB intake ≥2 times per day than those who agreed, this finding was not statistically significant. This may be partially due to the small sample size. These results suggest that health education regarding the potential contribution of excess energy intake from SSBs to weight gain might contribute to reduced intakes and reduced rates of obesity. The significant findings of these associations in our study might be explained by the fact that individual knowledge may influence behaviors.[16,24] For example, one study reported that adults in the lowest health literacy group consumed about 119 kcal more per day from SSBs compared with those in adequate health literacy groups in the rural Lower Mississippi Delta.[18] Another study reported that nutrition knowledge was significantly associated with fruit, vegetable, and fat intake among 1,040 British adults.[25] Although there is limited information on the association between health-related knowledge about SSBs and intake of SSBs among adults, a few studies were conducted among adolescents.[17,26] However, findings are inconsistent. Nelson and colleagues[17] reported that nutrition knowledge about energy intake, expenditure, and balance was not significantly associated with SSB intake among 349 US adolescents. In contrast, another study conducted among 445 Italian adolescents reported that poorer nutrition knowledge was significantly associated with higher consumption of SSBs.[26] Nonetheless, our finding suggests that health education for improving nutrition knowledge is worth examining as a potentially effective strategy to change dietary behaviors among adults.

The majority of adults (81%) did not know the actual kilocalorie content of a 24-oz fountain soda in our study. However, knowledge about the kilocalorie content of regular soda was not associated with SSB intake after controlling for sociodemographic characteristics. This finding was not what we hypothesized but can be explained by at least three potential reasons. First, knowledge about SSB energy content may not influence SSB intake. Previous studies showed mixed findings on the effect of energy content knowledge on food choices.[27–29] Some studies reported that providing energy content information was not significantly related to food selection, food consumption, or energy purchased among adults,[27,28] whereas another study reported that displaying energy content information on the menu board at fast-food restaurants reduced energy purchased by patrons,[29] although these previous studies did not specifically focus on SSB intake. Second, this is a cross-sectional study, in which data are collected at one specific point in time. Thus, it does not capture associations between changes in knowledge about SSB energy content and changes in SSB intake. Longitudinal studies are needed to examine whether changes in knowledge about SSB energy content modify the consumption of SSBs and to further explore what other knowledge might be associated with SSB intake. Third, some adults who are aware of the kilocalorie content of SSBs might compensate energy intake from other foods or beverages throughout the day; therefore, knowledge about SSB energy content would not affect their SSB intake. Findings from our study suggest that knowing the energy content of SSBs may not be sufficient to initiate healthful behavior change.

There are several limitations to this study. First, the findings may not be generalizable nationally because of selection bias associated with the use of a convenience sample from a mail panel survey with a relatively low response rate. However, a previous study has shown that the prevalence of certain items from HealthStyles (ie, health conditions and behaviors) are comparable to the Behavioral Risk Factor Surveillance System, which uses a probability

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sampling technique.[30] Second, the HealthStyles data are self-reported, and could be subject to recall and social desirability response biases. However, other studies have shown that estimates of beverage intake derived from responses to food-frequency questionnaires were similar to estimates derived from responses to 24-hour dietary recalls or to food records.[31–33] Third, because of the somewhat limited number of categories of race/ethnicity, it is difficult to interpret associations observed with subjects whose ethnicity was classified as "other." Fourth, the associations are cross-sectional and do not permit assessment of causality or ascertaining the direction of the association. Finally, the frequency of SSB consumption was surveyed, so the relationship by the amount of SSB consumption cannot be assessed.

CONCLUSIONS

About eight of 10 adults agreed that drinking SSBs can contribute to weight gain, yet eight of 10 adults did not know the actual energy content of a 24-oz fountain soda in this study. Furthermore, our study showed that adults who neither agreed nor disagreed that drinking SSBs can contribute to weight gain had significantly greater odds for drinking SSBs ≥2 times per day after controlling for socio-demographic factors. These findings suggest that knowledge that drinking SSBs can contribute to weight gain is significantly associated with consumption of SSBs among adults and can be used to identify individuals who may need additional nutrition education regarding the potential contribution of excess energy intake from SSBs to weight gain. In addition, adults with less education, lower-income individuals, men, and minorities should be targets of nutrition education because their knowledge level is lower but SSB intake is higher in these groups.

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References

1. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010. JAMA. 2012; 307(5):491–497. [PubMed: 22253363]
2. Wang YC, McPherson K, Marsh T, Gortmaker SL, Brown M. Health and economic burden of the projected obesity trends in the USA and the UK. Lancet. 2011; 378(9793):815–825. [PubMed: 21872750]
3. Finkelstein EA, Ruhm CJ, Kosa KM. Economic causes and consequences of obesity. Annu Rev Public Health. 2005; 26:239–257. [PubMed: 15760288]
4. Ebbeling CB, Feldman HA, Osganian SK, Chomitz VR, Ellenbogen SJ, Ludwig DS. Effects of decreasing sugar-sweetened beverage consumption on body weight in adolescents: A randomized, controlled pilot study. Pediatrics. 2006; 117(3):673–680. [PubMed: 16510646]
5. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: A systematic review. Am J Clin Nutr. 2006; 84(2):274–288. [PubMed: 16895873]

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6. Malik VS, Hu FB. Sweeteners and risk of obesity and type 2 diabetes: The role of sugar-sweetened beverages. Current Diabet Rep. 2012; 12:195–203.
7. Nutrition and Your Health: Dietary Guidelines for Americans, 2010. 7. Washington, DC: US Government Printing Office; 2010.
8. Welsh JA, Sharma AJ, Grellinger L, Vos MB. Consumption of added sugars is decreasing in the United States. Am J Clin Nutr. 2011; 94(3):726–734. [PubMed: 21753067]
9. Kit BK, Fakhouri TH, Park S, Nielsen SJ, Ogden CL. Trends in sugar-sweetened beverage consumption among youth and adults in the United States: 1999–2010. Am J Clin Nutr. 2013; 98(1):180–188. [PubMed: 23676424]
10. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: A meta-analysis. Diabetes Care. 2010; 33(11): 2477–2483. [PubMed: 20693348]
11. de Koning L, Malik VS, Rimm EB, Willett WC, Hu FB. Sugar-sweetened and artificially sweetened beverage consumption and risk of type 2 diabetes in men. Am J Clin Nutr. 2011; 93(6): 1321–1327. [PubMed: 21430119]
12. Duffey KJ, Gordon-Larsen P, Steffen LM, Jacobs DR Jr, Popkin BM. Drinking caloric beverages increases the risk of adverse cardiometabolic outcomes in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. Am J Clin Nutr. 2010; 92(4):954–959. [PubMed: 20702604]
13. Stanhope KL, Bremer AA, Medici V, et al. Consumption of fructose and high fructose corn syrup increase postprandial triglycerides, LDL-cholesterol, and apolipoprotein-B in young men and women. J Clin Endocrinol Metab. 2011; 96(10):E1596–E1605. [PubMed: 21849529]
14. de Koning L, Malik VS, Kellogg MD, Rimm EB, Willett WC, Hu FB. Sweetened beverage consumption, incident coronary heart disease, and biomarkers of risk in men. Circulation. 2012; 125(14):1735–1741. S1731. [PubMed: 22412070]
15. Sharkey JR, Johnson CM, Dean WR. Less-healthy eating behaviors have a greater association with a high level of sugar-sweetened beverage consumption among rural adults than among urban adults. Food Nutr Res. 2011:55.
16. Kumanyika, S.; Morssink, C. Overweight and weight management. In: Dalton, S., editor. Cultural Appropriateness of Weight Management Programs. Gaithersburg, MD: Aspen Publishers; 1997. p. 69-106.
17. Nelson MC, Lytle LA, Pasch KE. Improving literacy about energy-related issues: The need for a better understanding of the concepts behind energy intake and expenditure among adolescents and their parents. J Am Diet Assoc. 2009; 109(2):281–287. [PubMed: 19167955]
18. Zoellner J, You W, Connell C, et al. Health literacy is associated with Healthy Eating Index scores and sugar-sweetened beverage intake: Findings from the rural Lower Mississippi Delta. J Am Diet Assoc. 2011; 111(7):1012–1020. [PubMed: 21703379]
19. Porter Novelli Public Services. ConsumerStyles 2010 Methodology. Washington, DC: Deanne Weber; 2010.
20. Ogden CL, Kit BK, Carroll MD, Park S. Consumption of sugar drinks in the United States, 2005–2008. NCHS Data Brief. 2011; (71):1–8.
21. Bleich SN, Wang YC, Wang Y, Gortmaker SL. Increasing consumption of sugar-sweetened beverages among US adults: 1988–1994 to 1999–2004. Am J Clin Nutr. 2009; 89(1):372–381. [PubMed: 19056548]
22. Tucker KL, Maras J, Champagne C, et al. A regional food-frequency questionnaire for the US Mississippi Delta. Public Health Nutr. 2005; 8(1):87–96. [PubMed: 15705249]
23. Yale Rudd Center for Food and Policy & Obesity. [Accessed November 5, 2013] Organizations addressing sugar-sweetened beverages and taxes. http://www.yaleruddcenter.org/what_we_do.aspx?id=368
24. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? Obes Res. 2003; 11(suppl): 23S–43S. [PubMed: 14569036]
25. Wardle J, Parmenter K, Waller J. Nutrition knowledge and food intake. Appetite. 2000; 34(3):269–275. [PubMed: 10888290]

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26. Grosso G, Mistretta A, Turconi G, Cena H, Roggi C, Galvano F. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutr. 2013; 16(10):1827–1836. [PubMed: 22931967]
27. Girz L, Polivy J, Herman CP, Lee H. The effects of calorie information on food selection and intake. Int J Obes (Lond). 2012; 36(10):1340–1345. [PubMed: 21750521]
28. Elbel B, Kersh R, Brescoll VL, Dixon LB. Calorie labeling and food choices: A first look at the effects on low-income people in New York City. Health Aff (Millwood). 2009; 28(6):w1110–w1121. [PubMed: 19808705]
29. Bassett MT, Dumanovsky T, Huang C, et al. Purchasing behavior and calorie information at fast-food chains in New York City, 2007. Am J Public Health. 2008; 98(8):1457–1459. [PubMed: 18556597]
30. Pollard, WE. Use of a Consumer Panel Survey for Public Health Communication Planning: An Evaluation of Survey Results. New York, NY: Proceedings of the American Statistical Association, Section on Health Policy Statistics; 2002. p. 2120-2124.
31. Segovia-Siapco G, Singh P, Haddad E, Sabate J. Relative validity of a food frequency questionnaire used to assess food intake during a dietary intervention study. Nutr Cancer. 2008; 60(5):603–611. [PubMed: 18791923]
32. Hedrick VE, Comber DL, Estabrooks PA, Savla J, Davy BM. The beverage intake questionnaire: Determining initial validity and reliability. J Am Diet Assoc. 2010; 110(8):1227–1232. [PubMed: 20656099]
33. Hedrick VE, Savla J, Comber DL, et al. Development of a Brief Questionnaire to Assess Habitual Beverage Intake (BEVQ-15): Sugar-sweetened beverages and total beverage energy intake. J Acad Nutr Diet. 2012; 112(6):840–849. [PubMed: 22709811]

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Table 1

Characteristics of respondents and their associations with sugar-sweetened beverage (SSB) intake among US adults participating in the HealthStyles Survey, 2010[a] (N=3,926)

		SSB Intake During the Past 7 d[b]				
Characteristic	**All**	**None**	**1–6 times/wk**	**1 time/d**	**≥2 times/d**	***P* value[c]**
		←———%±*standard error*——→				
Total sample	100	36.6±1.2	32.9±1.3	10.5±0.8	20.0±1.0	
Age (y)						
18–24	11.9±1.7	29.4±7.0	32.8±8.0	7.6±5.1	30.2±6.7	<0.0001
25–44	36.4±1.1	25.1±1.5	36.7±1.7	13.1±1.2	25.1±1.6	
45–64	35.3±1.0	43.1±1.3	31.5±1.2	9.2±0.7	16.2±0.9	
≥65	16.4±0.7	53.4±1.9	27.6±1.6	9.5±1.1	9.6±1.1	
Sex						
Male	47.5±1.3	30.5±1.5	34.5 ±1.7	10.8±0.9	24.2±1.6	<0.0001
Female	52.5±1.3	42.1±1.8	31.5±1.8	10.2±1.3	16.2±1.3	
Race/ethnicity						
White, non-Hispanic	69.5±1.2	40.4±1.4	31.8±1.4	10.0±1.0	17.8±1.2	<0.0001
Black, non-Hispanic	11.5±0.8	21.2±3.2	39.9±4.1	13.4±2.4	25.5±2.7	
Hispanic	13.2±1.0	32.1±3.4	34.3±4.5	11.5±1.9	22.1±3.0	
Other, non-Hispanic	5.7±0.5	31.5±3.4	29.1±3.8	8.6±1.6	30.8±5.0	
Education level						
<High school	4.7±0.5	24.8±3.6	26.5±4.7	13.2±2.9	35.4±5.6	<0.0001
High school	20.1±1.0	33.9±2.6	29.8±2.1	10.9±1.3	25.4±2.2	
Some college	41.7±1.3	33.5±2.0	34.8±2.4	10.0±1.6	21.7±1.9	
College graduate	32.7±1.0	43.9±1.6	33.4±1.6	10.4±1.0	12.3±1.2	
Marital status						
Married/domestic partnership	59.4±1.4	38.1±1.3	34.0±1.2	9.3±0.6	18.6±1.2	0.10
Not married[d]	40.6±1.4	34.4±2.1	31.3±2.6	12.1±1.8	22.2±1.9	
Annual household income						
≤$34,999	35.8±1.3	33.5±2.1	28.0±2.0	10.2±1.1	28.3±2.2	<0.0001
$35,000–$74,999	30.4±1.1	36.7±2.0	34.4±1.9	11.0±1.1	17.9±1.6	

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Characteristic	All	SSB Intake During the Past 7 d[b]				P value[c]
		None	1–6 times/wk	1 time/d	≥2 times/d	
$75,000–$99,999	17.5±1.2	35.8±3.1	39.0±4.2	11.9±3.3	13.3±1.9	
≥$100,000	16.4±0.7	43.9±2.0	34.5±2.1	8.6±1.1	13.1±1.7	
Geographic region						
New England	3.8±0.6	49.0±7.9	23.6±4.8	10.8±3.7	16.6±7.9	0.04
Middle Atlantic	15.5±1.0	38.9±3.1	36.0±3.6	8.5±1.3	16.7±2.4	
East North Central	17.6±1.0	34.8±2.9	34.0±3.2	8.2±1.3	23.0±2.7	
West North Central	8.2±0.8	34.5±4.7	36.9±4.4	8.7±2.0	19.9±4.4	
South Atlantic	20.9±1.0	36.6±2.3	29.9±2.2	13.6±2.9	19.8±2.0	
East South Central	6.1±0.5	31.6±3.7	26.5±3.4	9.8±2.3	32.0±4.7	
West South Central	9.1±0.6	33.6±3.1	29.8±3.0	11.3±2.1	25.4±3.5	
Mountain	5.4±0.5	39.9±4.2	34.4±4.7	8.3±1.9	17.4±3.5	
Pacific	13.3±0.9	37.1±3.3	37.3±4.1	12.5±2.0	13.2±1.9	

[a]Weighted percent may not add up to 100% because of rounding.

[b]Determined by the question, "During the past 7 days, how many times did you drink sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks."

[c]Differences across categories for each variable were examined using χ^2 tests.

[d]Not married included widowed, divorced, separated, or never married.

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Table 2

Characteristics of respondents by knowledge about sugar-sweetened beverages (SSBs) among US adults participating in the HealthStyles Survey, 2010[a] (N=3,926)

	Drinking SSBs Can Contribute to Weight Gain[b]				Energy Content in a 24-oz Fountain Drink (kcal)[c]				
Characteristic	**Disagree**	**Neither**	**Agree**	***P* value[d]**	**≤250 (Under-estimate)**	**251–350 (Correct)**	**≥351 (Over-estimate)**	**Do not know**	***P* value[d]**
	←——%±*standard error*——→				←——%±*standard error*——→				
Total sample	4.1±0.4	11.5±0.7	84.4±0.8		18.7±1.0	19.6±1.1	17.0±0.9	44.7±1.3	
Age (y)				0.78					<0.0001
18–24	2.2±1.7	11.5±4.2	86.4±4.5		24.1±6.8	20.8±6.7	15.5±4.8	39.6±7.9	
25–44	3.5±0.6	11.9±1.2	84.5±1.3		19.2±1.3	26.1±1.6	19.1±1.4	35.6±1.7	
45–64	4.9±0.6	10.8±0.8	84.3±1.0		17.1±0.9	17.8±0.9	18.8±1.0	46.3±1.3	
≥65	4.9±0.8	12.0±1.2	83.1±1.4		17.1±1.4	7.9±0.9	9.8±1.1	65.2±1.7	
Sex				<0.0001					0.38
Male	5.5±0.7	15.0±1.2	79.5±1.4		17.9±1.3	20.8±1.7	15.8±1.1	45.5±1.7	
Female	2.7±0.4	8.4±0.8	88.9±0.9		19.4±1.6	18.4±1.3	18.2±1.3	44.0±1.9	
Race/ethnicity				0.01					0.01
White, non-Hispanic	3.6±0.5	10.7±0.9	85.7±1.0		18.3±1.3	20.3±1.3	18.6±1.0	42.7±1.4	
Black, non-Hispanic	6.7±1.3	13.4±2.0	79.9±2.4		16.9±2.2	16.8±3.1	8.6±1.7	57.7±3.7	
Hispanic	3.7±0.8	11.0±1.9	85.3±2.1		20.6±2.8	19.3±3.0	15.1±3.0	45.0±4.1	
Other, non-Hispanic	5.3±2.0	18.2±3.2	76.5±3.6		22.1±4.6	17.0±3.3	19.0±3.4	42.0±4.2	
Education level				0.001					<0.0001
<High school	5.0±1.9	12.5±2.5	82.5±3.1		20.8±5.1	13.4±3.8	6.0±1.9	59.7±5.4	
High school	5.0±0.8	16.1±1.8	79.0±1.9		18.6±1.9	14.5±1.9	11.8±1.3	55.1±2.5	
Some college	3.7±0.7	11.6±1.3	84.7±1.4		19.8±2.0	20.4±2.1	16.8±1.6	43.1±2.4	
College graduate	3.8±0.6	8.3±1.0	87.9±1.1		17.0±1.2	22.7±1.4	22.3±1.4	38.0±1.6	
Marital status				0.06					0.03
Married/domestic partnership	3.5±0.4	10.5±0.8	86.0±0.9		18.9±1.0	21.0±1.1	18.7±1.0	41.4±1.3	
Not married[e]	4.8±0.8	13.0±1.4	82.2±1.6		18.3±2.1	17.5±2.1	14.6±1.5	49.5±2.5	
Annual household income				0.03					<0.0001
≤$34,999	5.0±0.6	13.7±1.3	81.3±1.4		18.8±1.8	15.3±1.8	13.0±1.5	53.0±2.3	
$35,000–$74,999	4.2±0.9	12.1±1.3	83.7±1.5		16.9±1.4	20.5±1.6	18.2±1.7	44.4±2.0	

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	Drinking SSBs Can Contribute to Weight Gain[b]				Energy Content in a 24-oz Fountain Drink (kcal)[c]				
Characteristic	**Disagree**	**Neither**	**Agree**	***P* value[d]**	**≤250 (Under-estimate)**	**251–350 (Correct)**	**≥351 (Over-estimate)**	**Do not know**	***P* value[d]**
$75,000–$99,999	2.9±0.7	8.2±1.9	89.0±2.0		22.9±3.6	24.2±3.5	19.1±2.3	33.8±3.6	
≥$100,000	3.1±0.7	9.1±1.7	87.8±1.7		17.3±1.5	22.3±1.7	21.5±1.6	38.8±2.1	
Geographic region				0.85					0.46
New England	3.5±1.7	5.2±1.9	91.3±2.6		26.6±8.6	15.6±3.7	12.3±3.2	45.6±7.8	
Middle Atlantic	4.7±1.4	11.7±1.5	83.6±2.0		14.9±1.9	24.1±3.8	16.1±2.1	44.9±3.3	
East North Central	3.3±0.7	10.3±1.8	86.3±1.9		18.0±2.2	19.5±2.6	18.4±2.4	44.1±3.2	
West North Central	2.6±1.2	9.5±2.9	87.9±3.1		17.7±3.2	22.0±4.5	20.1±3.8	40.2±4.7	
South Atlantic	4.4±0.8	11.4±1.6	84.2±1.7		20.8±2.8	19.4±2.1	16.5±1.7	43.3±2.5	
East South Central	4.2±1.2	15.7±3.9	80.2±4.0		17.6±2.8	20.7±3.5	15.6±2.7	46.1±4.4	
West South Central	4.3±1.1	12.7±2.3	83.0±2.5		23.5±3.5	14.6±2.0	16.9±2.7	45.0±3.4	
Mountain	4.1±2.3	12.2±2.8	83.7±3.4		22.3±4.7	22.6±3.5	12.5±2.3	42.6±4.4	
Pacific	4.6±0.9	12.9±2.2	82.5±2.4		14.8±1.8	16.0±2.2	19.2±2.8	50.0±3.7	

[a]Weighted percent may not add up to 100% because of rounding.

[b]Determined by the question, “Drinking regular sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks can cause weight gain.”

[c]Determined by the question, “How many calories does a regular 24-oz fountain drink, such as a regular cola, have?”

[d]*P* value was based on χ^2 tests across categories.

[e]Not married included widowed, divorced, separated, or never married.

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Table 3

Knowledge about sugar-sweetened beverages (SSBs) and their associations with SSB intake[a] among US adults participating in the HealthStyles Survey, 2010[b] (N=3,926)

	Bivariate Analysis[c]				Multivariable Logistic Regression Analysis[d]	
	SSB Intake During the Past 7 d				SSB Intake ≥2 Times/d	
Knowledge	**None**	**1–6 times/wk**	**1 time/d**	**≥2 times/d**	**Odds ratio**	**95% CI**
	←———%±*standard error*———→					
Drinking SSBs can contribute to weight gain[e]						
Disagree	30.5±4.2	29.8±4.0	10.7±2.6	29.0±5.2	1.68	0.94–3.00
Neither	22.7±2.4	33.0±3.4	14.6±2.2	29.6±3.2	1.61[f]	1. 15–2.25
Agree	38.8±1.3	33.0±1.4	9.9±0.9	18.3±1.1	Reference	
Energy content in a 24-oz fountain drink (kcal)[g]						
≤250 (Underestimate)	29.0±2.5	33.1±2.6	13.0±3.1	24.9±2.9	1.29	0.84–1.97
251–350 (Correct)	31.1±2.6	37.2±3.1	11.2±1.8	20.5±2.6	Reference	
≥351 (Overestimate)	40.5±2.6	35.1±2.7	7.6±1.2	16.7±2.4	0.88	0.55–1.39
Do not know	40.7±1.8	30.2±1.9	10.2±0.9	19.0±1.3	0.90	0.62–1.31

[a]Determined by the question, "During the past 7 days, how many times did you drink sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks."

[b]Weighted percentage may not add up to 100% because of rounding.

[c]P value was <0.01 for both knowledge variables based on χ^2 tests across categories.

[d]The multivariable logistic regression model included two knowledge variables and covariates (ie, age, sex, race/ethnicity, education level, annual household income, and geographic regions) in one model. Reference category included adults who drank SSBs <2 times/d.

[e]Determined by the question, "Drinking regular sodas, fruit drinks, sports or energy drinks, and other sugar-sweetened drinks can cause weight gain."

[f]Significant findings based on the 95% CI (ie, the CI does not include 1).

[g]Determined by the question, "How many calories does a regular 24-oz fountain drink, such as a regular cola, have?"