HHS Public Access

Author manuscript

J Nutr Educ Behav. Author manuscript; available in PMC 2016 February 08.

Published in final edited form as:

J Nutr Educ Behav. 2014 ; 46(4): 277–285. doi:10.1016/j.jneb.2014.02.009.

Associations between sugar-sweetened beverage consumption and fast food restaurant frequency among adolescents and their friends

Meg Bruening, PhD, MPH, RD[1], **Richard MacLehose, PhD**[2], **Marla E Eisenberg, ScD, MPH**[3], **Marilyn S. Nanney, PhD, MPH, RD**[4], **Mary Story, PhD, RD**[2], and **Dianne Neumark-Sztainer, PhD, MPH, RD**[2]

[1]School of Nutrition and Health Promotion, Arizona State University

[2]Division of Epidemiology and Community Health, University of Minnesota

[3]Pediatrics, Division of Adolescent Health and Medicine, University of Minnesota

[4]Dept. Family Medicine & Community Health, Program in Health Disparities Research, University of Minnesota

Abstract

Objective—To assess associations between adolescents and their friends with regard to sugar-sweetened beverage (SSB)/diet soda intake, and fast food (FF) restaurant visits.

Design—Population-based, cross-sectional survey study with direct measures from friends.

Setting—Twenty Minneapolis/St. Paul schools during 2009–2010.

Participants—Adolescents (n=2,043; mean age=14.2±1.9; 46.2% female; 80% non-white).

Main outcome measures—Adolescent SSB/diet soda intake and FF visits.

Analysis—Generalized estimating equation logistic models were used to examine associations between adolescents' SSB/diet soda intake and FF visits and similar behaviors in nominated friends (friend groups, best friends). School-level (middle vs. high school) interactions were assessed.

Results—Significant associations were found between adolescents and friends behaviors for each of the beverages assessed ($P<0.05$), but varied by friendship type and school level. Five of

Corresponding author: Meg Bruening, 500 N. 3rd Street, Phoenix, AZ 85004, meg.bruening@asu.edu, Tel: 602.827.2266, Fax: 602.827.2253.

At the time the work was conducted, Dr. Bruening was a PhD student in Nutrition at the University of Minnesota (Twin Cities, Minnesota).

Authors do not have any conflicts of interest to disclose.

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

six models of FF visits (including all FF visits) were significantly associated (P <0.05) among adolescents and their friends. Significant interactions by school level were present among adolescents' and friends' FF visits, with associations generally for high school participants compared to middle school participants (P <0.05).

Conclusions and implications—Findings suggest for many beverages and FF restaurant types, friends' behaviors are associated, especially FF visits for older adolescents. Nutrition education efforts may benefit by integrating the knowledge of the impact of adolescents' friends on FF visits.

Introduction

Given the high prevalence of poor dietary intakes during adolescence,[1] a clearer understanding is needed regarding factors involved in adolescents' eating behaviors, especially the role that friends play. Friends exert substantial influence on the development of life-long behaviors and beliefs during adolescence,[2] including health behaviors.[3–5] Much of the literature to date has been on adolescents' perceptions of their friends' behaviors, which is clouded by their own attitudes.[3,6] Further research on how friends' behaviors are related to adolescents' behaviors is needed to elucidate friends' potential part in these relationships.

A small body of literature has examined associations between direct measures of nominated friends' eating behaviors and adolescents' eating behaviors;[9–12] findings from these studies have not been consistent. These studies generally focused on early adolescence, and with few exceptions,[7,8] drew from small, homogeneous samples. For example, de la Haye et al.[9] found that boys' intake of unhealthy foods such as fast food (FF), but not sugar-sweetened beverages (SSBs), was associated among friends in two Australian middle schools. In another study involving mostly white youth in five moderate/high-income middle schools, friends' snack food and SSB intake were associated with adolescent intake of snack food and SSBs.[10] Research has shown an association among high school friends' FF restaurant usage, but not for eating breakfast, intake of fruit/vegetables, or high-calorie snacks.[8]

Adolescence is a critical time in the establishment of life-long eating patterns.[11,12] Dietary practices of adolescents shift as youth mature, with older youth reporting poorer overall nutritional quality compared to younger adolescents.[12,13] According to adolescent development theory,[14,15] as adolescents move into high school they become increasingly independent from their parents; with this independence, youth spend more time with their friends, who may have an impact on their eating behaviors.[7] However, it is not apparent that adolescent developmental stage (middle vs. high school) has been examined in studies assessing nominated friends' relationship to adolescent eating behaviors.

This study examined associations between adolescents' and friends' frequency of SSB intake and FF restaurant visits from a large, diverse sample. Frequency of SSB intake and FF restaurant visits were selected, as intake of SSBs and fast food have been found to predict obesity, generally result in a higher calorie intake, and are of lower nutrition quality.[16,17] Friendship type (friend groups and best friends) and two stages of adolescence (middle vs. high school) were examined so that the findings would have more utility for

intervention development. Given the developmental changes throughout adolescence, it was hypothesized that friends would have greater effects during high school than middle school.

Methods

Study design and participants

Data were drawn from surveys that were part of EAT-2010 (Eating Among Teens), which is a multi-level investigation of adolescents (n=2793) eating behaviors, physical activity patterns, and weight-related outcomes,[18] integrating an ecological perspective[19] with the Social Cognitive Theory.[20] Given the importance of friends during adolescence, the current study focused on interpersonal (friend) level of the ecological model and how friends' behaviors are associated with adolescents' behaviors. Youth (mean age 14.4 ± 2.0) from 20 Minneapolis/St. Paul middle schools and high schools completed in-class nutrition, physical activity, and nominated friend surveys. Trained research staff administered surveys in 106 required health, gym, or science classes. Parental consent for study participation was received by students under 18 at least 10 days prior to data collection. All participating students provided assent and received a $10 gift card. The University of Minnesota's Institutional Review Board Human Subjects Committee and the research boards of the participating school districts approved all study protocols. Overall, the sample was 46% female, 80% non-white, 83% US-born, and over 50% from low/low-middle SES groups (Table 1).

Instruments

EAT-2010 student survey—The student survey was a 235-item self-report instrument assessing factors of relevance to weight-related behaviors among adolescents. Survey development was guided by a review of previous Project EAT surveys,[21,22] underwent expert review for content validity, and was pilot tested with adolescents (n=129) for reliability.[18]

Food frequency questionnaire—Dietary intake was assessed with the 152-item Youth/Adolescent Food Frequency Questionnaire (YAQ), which has undergone extensive testing for validation and reproducibility.[23,24] This instrument offered the most suitable mechanism for examining dietary intake in a large and diverse population of adolescents.

Friend nomination—Participants nominated up to six of their fellow students as their friends[25,26] from a roster of all enrolled students at their school. Generic codes were used to indicate having no friends or having friends who did not attend their school. Nominated friends who were ranked first in either gender category were identified as "best friends." Participants nominated an average of 5.2±1.3 friends, and an average of 2.1±1.7 of those friends also participated in EAT-2010 themselves. Friends' survey data were linked for analyses. Overall, 77% of the original sample of adolescents had at least one friend in the dataset (n=2126). Because students were sampled from required classes, inclusion in the sample is presumed to be random, and any friend that was nominated is also expected to be a random sample of any individual's nominated friends. A sensitivity analysis was conducted and results indicated that using all participants with at least one friend provided

substantively similar results to analyses using a more stringent inclusion criterion (e.g. a majority of nominated friends). Some students were absent or were unable to complete the YAQ and/or reported biologically implausible caloric intake (n=83); thus, the analytic sample for this study was slightly smaller (n=2043).

Measures

Frequency of beverage intake—Five variables assessed SSB and diet soda intake among adolescents and their friends in order to examine relatively low nutrient beverages. Participants were asked to report on their past year intake of regular soda and diet soda on the YAQ. Response items ranged from "never/less than 1 glass per month" to "3 or more glasses per day." On the EAT-2010 student survey, students were asked to report past year consumption of "*energy drinks* such as Red Bull, Full Throttle, Rockstar, etc." and "*sports drinks* such as Gatorade, Powerade, etc." Response options ranged from "never" to "more than 2 per day." All SSBs was created as an aggregate of regular soda, sports drinks and energy drinks. Based on the distribution of these variables, intake of each beverage type was dichotomized to "1 or more servings per week" and "less than 1 serving per week."

Frequency of fast food restaurant visits—Participants reported their frequency of FF restaurant visits with the following question in the student survey: "In the past month, how often did you eat something from the following types of restaurants (include take-out and delivery)?" Participants selected one of six response categories ("Never," "1–3 times per month," "1–2 times per week," "3–4 times per week" "5–6 times per week," and "1 + times per day") for each of the following restaurant types: a) Traditional "*burger-and-fries*" fast food restaurant (such as McDonald's, Burger King, Wendy's, or Culver's); b) *Mexican* fast food restaurant (such as Taco Bell, Taco John's, or Chipotle); c) *fried chicken* (such as KFC); d) *sandwich or sub shop* (such as Subway, Panera, or Quiznos); and, e) *pizza place. Fast food restaurant visits* was assessed continuously as an aggregate (*all fast food*) of each type of FF restaurant. Based on the distributions, *all fast food* restaurant visits was dichotomized as "3 or more restaurant visits per week" and "less than 3 restaurant visits per week"; each sub-category of FF restaurant was dichotomized as "one or more visit/week" and "less than one restaurant visit per week". *Friend predictor variables.* SSBs, diet soda intake, and FF restaurant visits of each nominated friend were linked by ID number to each individual student, allowing for the creation of friends' predictors that were unique to each participant. The friend variable cut-offs are identical to those used for the dependent variables. Friendship types included friend groups and best friends. The *friend group* measure included all nominated friends with available data; descriptions of these groups can be found elsewhere.[27] If more than half of the friends of those in the adolescents' friend group reported the behaviors (> 1 SSBs/week, >3 FF restaurant visits/week, >1 visit/week to each sub-category of FF restaurant), then the friend group was considered to have the frequency of the behavior. For example, if an adolescent had 4 friends in the sample and 2 friends reported 1 or more SSB/week, then the friend group was considered to have the frequency of the behavior. This coding allows us to differentiate between the associations in behaviors of a group as compared to the nominated best friend. *Best friends* were nominated/ranked first in either gender category. The prevalence of each adolescent self-reported behavior was estimated by the friends' self-reported behaviors. When examining

associations among best friends, the predicted prevalence of adolescents' behaviors was estimated by the best friends' reporting the key behaviors (>1 SSBs/week, > 3 restaurant visits/week, >1 visits/week to each sub-category of restaurant) versus not.

Sociodemographic characteristics and body mass index—*School-level, gender, race/ethnicity, US-born status,* and *socioeconomic status (SES)* were self-reported from the from the EAT-2010 student survey. Participants in 6th–8th grade were classified as being in middle school; those in 9th–12th grade were categorized as being in high school. *Race/ethnicity* was based on the question: "Do you think of yourself as: 1) White; 2) Black or African America; 3) Hispanic or Latino; 4) Asian American; 5) Hawaiian or Pacific Islander; 6) American Indian or Native American?" Adolescents could choose more than one category, and those with multiple responses were coded as "mixed/other" for analyses. The primary determinant of *SES* was parental education level, defined by the higher level of educational attainment of either parent. Other variables used to assess SES included: family eligibility for public assistance, eligibility for free or reduced-cost school meals and parental employment status. An algorithm was developed to avoid classifying youth as high SES, based on parental education levels, if they were on public assistance, eligible for free/reduced school meals or had two unemployed parents (or one unemployed parent if from a single parent household). These variables were also used to assess SES in cases for which there were missing data or "don't know" responses for both parents' educational level.[22] Five categories were created (Low, Low-Middle, Middle, Upper-Middle, High). Height and weight were collected by trained research assistants, using standardized equipment and procedures.[28] Body mass index percentiles-for-age and gender and weight cut-offs were calculated based on the Center for Disease Control and Prevention guidelines.[29]

Other covariates—In order to give an equal weight to adolescents with a different number of friends included in the sample, a variable was created based on the *number of friends with data*. *Sports team participation* was assessed on the student survey using the following question: "During the past 12 months, on how many sports teams did you play?" Responses were coded as "none" or "one or more teams," and this variable was included only in models of sports drink intake for the full sample.

Statistical analyses

Adolescents' FF restaurant visits and SSB/diet soda intake were examined by school level (middle vs. high school) and across gender, racial/ethnic, US-born status and SES groups. Chi-square and t-tests were used to estimate whether FF restaurant visits and beverage intake differed by demographic characteristics. As recommended for these types of social network analyses,[30] generalized estimating equation logistic regression models (accounting for clustering of students within schools) were used to estimate the association between SSB/diet soda intake and FF restaurant visits among adolescents and their friends. These models were adjusted for socio-economic status, racial/ethnic group, US-born status, and number of friends with data. Sports participation was included as a covariate in sports drinks models. Adolescents' FF and SSB behaviors were estimated from friend groups' and best friends' behaviors (separately). The predicted prevalence of FF visits and SSB/diet soda intake (at the mean or modal value of other covariates in the regression model) was

estimated from these models for adolescents whose friends were above and below the cut point for each outcome variable (see measures for cut points). Adjusted differences and 95% confidence intervals were calculated from these predicted prevalences. Interactions by school-level and gender were tested to examine differences in associations by 1) middle school and high school participants and 2) girls and boys. Since gender was found not to have a significant interaction in the associations among friends, gender was included as an adjustment variable in all models, rather than conducting analyses separately for girls and boys. Statistical significance was assessed at $P \leq 0.05$. Analyses were run using Stata Statistical Software: Release 12, College Station, TX: StataCorp LP, 2012.

Results

Associations with frequency of adolescent beverage intake

On average, participants consumed a total of 4.7 SSBs per week (median=4.2; range:0–42) including 2.5 servings of regular soda (median=1.9; range:0–7) and 1.9 servings of sports drinks (median=0.7; range:0–14) (Table 1). Among friend groups, significant SSB associations were observed only among high school friend groups and only for diet soda and sports drinks (Table 2). For example, the prevalence difference among high school students whose friend group reported one or more sports drink per week was 6.2% greater compared to those whose friends did not consume sports drinks ($P<0.001$). Among best friends, significant associations were observed only for sports drinks (middle school), and regular soda and energy drinks (high school). No significant school-level interaction was observed for the aggregate variable, all SSBs.

School-level interactions were observed for friend groups (but not among best friends) for diet soda and sports drink intake. Among high school students' and their friend groups', the risk difference of diet soda intake was significantly smaller compared to middle school students. Conversely, compared to middle school students, the association between high school students' and their friend groups' sports drink intake was significantly greater ($P<0.05$).

Associations with frequency of adolescent fast food restaurant visits

The overall mean number of visits to all FF restaurants was 3.7 times per week among participants; the mean number of visits to specific types of FF restaurants ranged from 0.5 to 0.9 times per week; (Table 1). FF visits was associated among adolescents and their friends, and the magnitude of the associations was greater for high school participants as compared to middle school students (Table 3); although, these differences were not always statistically significant.

Among middle school students, the only significant association was found for fried chicken restaurant visits ($P<0.001$). Among high school students, statistically significant associations between adolescent and friend group FF visits were observed for all types of restaurants except pizza restaurants. Significant interactions were observed between high school friend groups as compared to middle school friend groups for all FF restaurants ($P=0.007$) and

sandwich restaurants (P=0.003), with associations significantly stronger among high school friend groups.

Among middle school best friends, only pizza restaurant visits was significantly associated with adolescents' pizza restaurant visits (P=0.016). Conversely, among high school best friends, there were statistically significant associations between best friend FF visits for all restaurant visits except burger-and-fries restaurants. This pattern of results was similar for all associations among high school best friends' FF visits.

Discussion

The purpose of this study was to examine associations between SSB/diet soda intake and FF visits among adolescents and their friends, using direct measures of friends' behaviors among a large, socioeconomically and racially diverse sample. Differences in these associations were compared between adolescent developmental stage (middle versus high school) and also explored differences by friendship type (best friends versus friend group). Overall, associations were observed among friend groups and best friends for all of the SSBs, diet soda, and FF visits assessed; however, the magnitudes of the associations were modest and statistical significance varied for the associations were by friendship type. Several significant differences between middle and high school students were found in associations among friend groups' and best friends SSB and restaurant visit behaviors: associations in high school friends' behaviors were consistently greater compared to middle school participants.

Variations were observed in the associations between friends' and adolescents' SSB intake. In particular, differences were observed across school-level, beverage, and friendship type. Consistent with Wouters et al,[10] this study did not find gender differences among friends. According to the review of the literature, no studies have assessed specific associations between friends' and adolescents' sports and energy drink intake. Also new to the literature, the current study examined associations among friend groups' and best friends' SSB and diet soda intake with adolescents' intake. The variability in the results suggests that specific dietary behaviors, such as beverage intake, may be more norm-based, which is supported by observational studies of high SSB intake across all adolescents.[31,32]

Contrary to expectations, there was an inverse association between high school adolescents' diet soda intake and their friend groups' intake of diet soda. While the results were not significant for best friends, the directionality of the findings was similar as the findings for friend groups. This finding suggests that consuming diet soda may have a negative connotation among friends. However, given that this was the only inverse association that was observed among friends' eating and beverage-related behaviors in this study and others,[9] and this was the first study to assess diet soda intake, it may be a spurious finding.

Similar to previous studies,[8,33] FF visits was significantly associated with friends' FF visits, but new to the literature are the differences in the associations between high school and middle school students. These results may be explained by adolescent development theory,[14] as adolescents assert their independence from parents and have increasing reliance

on their friends for socialization.[34] For example, as compared to middle school students, high school students are more likely to have more disposable spending money and mobility (i.e., ability to drive), which could result in visiting FF restaurants more often. In addition, high school adolescents may meet friends at FF restaurants because FF restaurants may be as a safe, easy place to spend time with friends.[35]

This study has several strengths; EAT-2010 a large, diverse sample, aids in the generalizability of findings. Data obtained from nominated friends were used, which avoids the pitfall of measuring young people's biased perceptions of their friends' behaviors. This study examined associations for two types of friends (best friends and friend groups) and also examined school-level interactions, which had not previously been tested. While associations between adolescent and friend FF and SSB intake have previously been examined, no studies have examined specific subsets of beverages and FF restaurants (e.g. sports drinks, fried chicken restaurants).

Limitations should be considered when interpreting findings. Self-reported intake was used which may introduce bias; however, food frequency questionnaires offer the most suitable method for examining dietary intake in a large, diverse adolescent population.[23] Face validity of student survey items were tested; however, test-retest correlations of the measures in this study were moderate. Given that youth were sampled from one geographic location findings may not be generalizable to other areas of the US. Also youth were sampled across an academic year, so there may be seasonal variability in reports of eating/beverage behaviors. In addition, although visits to specific types of FF restaurants were assessed, students were not asked to report specific foods consumed at each restaurant. Unmeasured confounding, missing peer data and endogeneity have the potential to produce biased results. Not knowing the temporality of the relationships in this cross-sectional study limits the ability to make causal inferences.[36] The findings may be a result of adolescents choosing friends with similar behaviors and/or friends influencing adolescents to have these behaviors. Nonetheless, associations between friends' behaviors found in the current study, and theories of adolescent development[14,15] suggest that interventions aimed at improving adolescent eating behaviors may benefit from the inclusion of friends.

Implications for Research and Practice

Different reasons (i.e., friend influence vs. selection) may explain the observed associations. However, disentangling whether these associations were due to choosing friends or friend influence may not be necessary to guide interventions. Based on the results from the current study, interventions aimed at improving eating behaviors could be strengthened by engaging friend groups and best friends. Given the differences in associations between high school and middle school friends, the approach of incorporating friends into interventions may be most appropriate for older adolescents. For example, an intervention could be designed for adolescent friends in which youth could support each other in selecting healthy choices at FF restaurants.[17] In addition, parents, schools, and communities should work with adolescents to identify other places where adolescents could independently spend time together without having to be exposed to unhealthy foods.

This is the first study to assess the role of different types of friends on specific unhealthy dietary behaviors; findings will need to be confirmed through additional research in other settings, including international settings, as cultural differences of the role of friends may differ across the globe. Longitudinal and qualitative research studies are needed to examine if and how friends influence eating behaviors, especially as youth transition through different stages of adolescence. Studies need to be able to identify the mechanisms by which friends impact adolescent behaviors and contextual factors (length of friendship, how much time spent together, when and where these behaviors take place, etc.) that can explain these relationships. Having this understanding will allow nutrition educators and other health professionals to create highly targeted interventions.

Acknowledgments

We would like to thank the adolescents who participated in EAT-2010, and the Minneapolis and Saint Paul school districts for their support in this research. We would also like to thank Drs. Melanie Wall, David Knoke, and John Sirard for their contributions. This study was a portion of Dr. Bruening's dissertation on the role of friends on adolescent eating behaviors and weight status. EAT-2010 was supported by Grant Number R01HL084064 from the National Heart, Lung, and Blood Institute (PI: Neumark-Sztainer). A portion of the first author's time was supported by R01HL084064-01A2 (PI: Sirard). Methods and analysis (Maclehose) was supported by NIH grant number U01HD061940 (PI: M. Wall) from the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

List of abbreviations

SSB	sugar-sweetened beverage
EAT	Eating and Activity in Teens
YAQ	Youth/Adolescent Food Frequency Questionnaire
ID	Identification

References

1. Briefel RR, Johnson CL. Secular trends in dietary intake in the United States. Annu Rev Nutr. 2004; 24:401–431. [PubMed: 15189126]
2. Gifford-Smith M, Dodge KA, Dishion TJ, McCord J. Peer influence in children and adolescents: Crossing the bridge from developmental to intervention science. J Abnorm Child Psychol. 2005; 33(3):255–265. [PubMed: 15957555]
3. Eisenberg ME, Neumark-Sztainer D, Story M, Perry C. The role of social norms and friends' influences on unhealthy weight-control behaviors among adolescent girls. Soc Sci Med. 2005; 60(6):1165–1173. [PubMed: 15626514]
4. Thompson JK, Shroff H, Herbozo S, Cafri G, Rodriguez J, Rodriguez M. Relations among multiple peer influences, body dissatisfaction, eating disturbance, and self-esteem: A comparison of average weight, at risk of overweight, and overweight adolescent girls. J Ped Psychol. 2007; 32(1):24–29.
5. Eisenberg ME, Wall M, Shim JJ, Bruening M, Loth K, Neumark-Sztainer D. Associations between friends' disordered eating and muscle-enhancing behaviors. Soc Sci Med. 2012
6. Smolak L, Murnen S. Sociocultural influences and muscle building in adolescent boys. Psychol Men Masc. 2005; 6:227–239.
7. Bruening M, Eisenberg M, MacLehose R, Nanney MS, Story M, Neumark-Sztainer D. Relationship between Adolescents' and Their Friends' Eating Behaviors: Breakfast, Fruit, Vegetable, Whole-Grain, and Dairy Intake. J Acad Nutr Diet. 2012; 112(10):1608–1613. [PubMed: 23017570]

8. Ali MM, Amialchuk A, Heiland FW. Weight-Related Behavior among Adolescents: The Role of Peer Effects. Plos One. 2011; 6(6)
9. de la Haye K, Robins G, Mohr P, Wilson C. Obesity-related behaviors in adolescent friendship networks. Social Networks. 2010; 32(3):161–167.
10. Wouters EJ, Larsen JK, Kremers SP, Dagnelie PC, Geenen R. Peer influence on snacking behavior in adolescence. Appetite. 2010; 55(1):11. [PubMed: 20211671]
11. Hagan, JF.; Shaw, JS.; Duncan, PM. Bright futures: Guidelines for health supervision of infants, children, and adolescents. American Academy of Pediatrics; Elk Grove Village, IL: 2008.
12. Ilich JZ, Brownbill RA. Nutrition Through the Life Span: Needs and Health Concerns in Critical Periods. Handbook of Stressful Transitions Across the Lifespan. 2010:625–641.
13. Larson NI, Neumark-Sztainer D, Story M. Weight control behaviors and dietary intake among adolescents and young adults: longitudinal findings from Project EAT. J Am Diet Assoc. 2009; 109(11):1869–1877. [PubMed: 19857628]
14. Peterson A. Adolescent development. Annual Review of Psychology. 1988; 39:583–607.
15. Daddis C. Influence of close friends on the boundaries of adolescent personal authority. J Res Adol. 2008; 18(1):75–98.
16. 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(4):667–675. [PubMed: 17329656]
17. Niemeier HM, Raynor HA, Lloyd-Richardson EE, Rogers ML, Wing RR. Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. J Adolesc Health. 2006; 39(6):842–849. [PubMed: 17116514]
18. Neumark-Sztainer D, Wall MM, Larson N, Story M, Fulkerson JA, Eisenberg ME, Hannan PJ. Secular trends in weight status and weight-related attitudes and behaviors in adolescents from 1999 to 2010. Prev Med. 2012; 54(1):77–81. [PubMed: 22024221]
19. Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. Health behavior and health education: Theory, research, and practice. 2008; 4:465–486.
20. Bandura, A. Social foundations of thought and action: A social cognitive theory. Prentice-Hall, Inc; 1986.
21. Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents. J Am Diet Assoc Aug. 1999; 99(8):929-+.
22. Neumark-Sztainer D, Croll J, Story M, Hannan PJ, French SA, Perry C. Ethnic/racial differences in weight-related concerns and behaviors among adolescent girls and boys - Findings from Project EAT. J Psychosom Res. 2002; 53(5):963–974. [PubMed: 12445586]
23. Borradaile KE, Foster GD, May H, Karpyn A, Sherman S, Grundy K, Nachmani J, Vander Veur S, Boruch RF. Associations between the Youth/Adolescent Questionnaire, the Youth/Adolescent Activity Questionnaire, and body mass index z score in low-income inner-city fourth through sixth grade children. Am J Clin Nutr. 2008; 87(6):1650–1655. [PubMed: 18541552]
24. Rockett HRH, Breitenbach M, Frazier AL, Witschi J, Wolf AM, Field AE, Colditz GA. Validation of a youth/adolescent food frequency questionnaire. Prev Med. 1997; 26(6):808–816. [PubMed: 9388792]
25. Trogdon JG, Nonnemaker J, Pais J. Peer effects in adolescent overweight. J Health Econ. 2008; 27(5):1388–1399. [PubMed: 18565605]
26. Hutchinson DM, Rapee RM. Do friends share similar body image and eating problems? The role of social networks and peer influences in early adolescence. Behav Res Ther. 2007; 45(7):1557–1577. [PubMed: 17258173]
27. Sirard JR, Bruening M, Wall MM, Eisenberg ME, Kim SK, Neumark-Sztainer D. Physical Activity and Screen Time in Adolescents and Their Friends. Prev Med. 2013; 44(1):48–55.
28. Lohman, T.; Roche, AF.; Martorell, R. Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics Books; 1988.
29. Toschke AM, Kurth BM, von Kries R. The choice of cutoffs for obesity and the effect of those values on risk factor estimation. Am J Clin Nutrit. 2008; 87(2):292–294. [PubMed: 18258616]

30. An, W. The Sage Handbook of Social Network Analysis. 2011. Models and methods to identify peer effects.
31. Brener ND, Merlo C, Eaton D, Kann L, Park S, Blanck HM. Beverage Consumption Among High School Students-United States, 2010 (Reprinted from MMWR, vol 60, pg 778–780, 2011). JAMA. 2011; 306(4):369–371.
32. Nelson MC, Neumark-Sztainer D, Hannan PJ, Story M. Five-Year Longitudinal and Secular Shifts in Adolescent Beverage Intake: Findings from Project EAT (Eating Among Teens)-II. J Am Diet Assoc. 2009; 109(2):308–312. [PubMed: 19167959]
33. de la Haye K, Robins G, Mohr P, Wilson C. Homophily and Contagion as Explanations for Weight Similarities Among Adolescent Friends. J Adolesc Health. 2011; 49(4):421–427. [PubMed: 21939874]
34. Bulcroft RA, Carmody DC, Bulcroft KA. Patterns of parental independence giving to adolescents: Variations by race, age, and gender of child. J Marriage Fam. 1996; 58(4):866–883.
35. Bagozzi RP, Wong N, Abe S, Bergami M. Cultural and situational contingencies and the theory of reasoned action: Application to fast food restaurant consumption. J Consum Psych. 2000; 9(2):97–106.
36. Christakis NA, Fowler JH. Social contagion theory: examining dynamic social networks and human behavior. Stat Med. 2012

J Nutr Educ Behav. Author manuscript; available in PMC 2016 February 08.

Table 1

EAT (Eating and Activity among Teens)-2010 participant demographics and prevalence of key behavioral variables by school-level[1]

	All (n=2124)	Middle school (n=1114)	High school (n=1010)	*P*-value
Age (years) *(Mean ± SD)*[2]	14.2± 1.9	12.6± 0.8	15.9± 1.3	<0.001
Gender *%(n)*[3]				0.336
Girls	46.2 (982)	54.8 (610)	52.7 (532)	
Boys	53.8 (1143)	45.2 (504)	47.3 (478)	
Body mass index percentile *(Mean ± SD)*[2]	68.9± 28.0	70.2± 27.8	67.42± 28.2	0.019
Weight status *%(n)*[3]				0.083
Underweight (<15th percentile)	6.1 (129)	6.1 (67)	7.2 (72)	
Normal weight (≥15th percentile, <85th percentile)	53.6 (1132)	52.3 (575)	55.7 (555)	
Overweight/obese (≥85th percentile)	39.9 (838)	41.6 (458)	38.1 (380)	
Obese (≥95th percentile)	22.0 (462)	24.4 (269)	19.4 (193)	
Race/ethnicity group *%(n)*[3]	20.2 (423)			<0.001
White	26.6 (557)	18.7 (207)	21.8 (219)	
African American/Black	17.7 (370)	23.5 (261)	30.2 (304)	
Latino/Hispanic	19.4 (405)	16.1 (179)	19.3 (194)	
Asian American	16.1 (336)	21.3 (237)	17.1 (172)	
Mixed/Other		20.4 (226)	11.6 (117)	
US-born status *%(n)*[3]				<0.001
US-born	83.2 (1742)	87.0 (967)	79.0 (796)	
Foreign-born	16.8 (352)	13.0 (145)	21.0 (211)	
Socioeconomic status *%(n)*[3]				0.063
Low	29.6 (468)	36.7 (392)	40.7 (404)	
Low-middle	25.5 (236)	22.9 (244)	20.7 (206)	
Middle	34.8 (183)	19.1 (204)	15.6 (155)	
Upper-middle	6.9 (140)	14.0 (149)	13.8 (137)	
High	3.2 (72)	7.3 (78)	9.2 (91)	
Nutrition-related behaviors*(Mean ± SD)*[2]				
Regular soda intake (servings/week)	2.5 ±3.6	2.4±3.7	2.5±3.5	0.661

	All (n=2124)	Middle school (n=1114)	High school (n=1010)	*P*-value
Sports drink intake (servings/week)	1.9±3.1	1.9±3.2	1.9±3.0	0.961
Energy drink intake (servings/week)	0.7±2.0	0.8±2.3	0.6±1.7	0.015
All fast food restaurant use (times/week)	3.7± 4.3	3.7 ± 5.0	3.9 ± 4.3	0.714
Burger and fries fast food restaurant use (times/week)	0.9± 1.1	0.9 ± 1.3	0.9 ± 1.2	0.180
Mexican fast food restaurant use (times/week)	0.5 ± 1.0	0.4 ± 1.1	0.5 ± 1.0	0.212
Fried chicken fast food restaurant use (times/week)	0.6 ± 1.3	0.7 ± 1.5	0.6 ± 1.2	0.187
Sandwich fast food restaurant use (times/week)	0.7 ± 1.2	0.8 ± 1.4	0.8 ± 1.2	0.954
Pizza fast food restaurant use (times/week)	0.9 ± 1.3	0.9 ± 1.4	0.9 ± 1.3	0.979

[1]Results are presented by school level due to the significant interaction in the associations between friends' and adolescents' behaviors

[2]Bivariate continuous models examined with t-tests

[3]Bivariate models with categorical variables examined with chi-square tests

J Nutr Educ Behav. Author manuscript; available in PMC 2016 February 08.

Table 2

Predicted prevalence of adolescent reported weekly sugar-sweetened beverage (SSB) and diet soda intake by friends' reported weekly SSB and diet soda intake

	Predicted probability of adolescent SSB/diet soda intake of 1 or more drinks per week[1]									
	All SSBs*		Regular soda[3]		Diet soda[3]		Sports drinks[2,3]		Energy drinks[3]	
		95% CI		95% CI		95% CI		95% CI		95% CI
Friend group										
Middle school										
1 or more SSBs	59.5%	55.4, 63.6	30.0%	24.6, 35.5	11.4%	5.7, 17.1	8.1%	6.7, 11.6	5.8%	3.3, 8.3
Less than 1 SSB	57.6%	51.7, 63.5	31.8%	28.9, 34.9	8.1%	6.4, 9.7	8.0%	6.4, 11.1	2.8%	1.8, 3.8
Risk difference	1.9%	−5.0, 8.9	−1.8%	−9.7, 6.0	3.3%	−1.8, 8.5	0.1%	−3.7, 4.1	3.0%	0.3, 5.7
P-value	0.589		0.646		0.202		0.934		**0.028**	
High school										
1 or more SSBs	62.8%	58.9, 66.8	40.3%	31.2, 48.6	2.2%	−0.4, 5.0	11.3%	9.7, 13.1	5.1%	0.4,10.7
Less than 1 SSB	56.5%	45.3, 68.0	33.6%	28.9, 38.2	8.3%	6.9, 9.6	5.1%	3.7, 6.1	1.4%	0.7, 2.0
Risk difference	6.3%	−6.2, 19.0	6.7%	−3.0, 16.5	−6.1%	−9.1, −2.1	6.2%	3.1, 8.6	3.7%	−1.9, 8.6
P-value	0.323		0.179		**<0.001**		**<0.001**		0.214	
Test for interaction	0.374		0.075		**0.043**		**0.031**		0.911	
Best friends										
Middle school										
1 or more SSBs	63.1%	59.3, 66.9	34.1%	29.6, 38.5	6.5%	2.6, 10.5	10.4%	7.9, 12.9	4.5%	3.3, 5.7
Less than 1 SSB	50.3%	42.0, 58.7	31.8%	29.1, 34.4	8.2%	7.0, 9.3	5.0%	2.1, 8.0	3.0%	3.6, 5.7
Risk difference	12.8%	4.3, 21.2	2.3%	−3.8, 8.3	−1.7%	−5.3, 2.1	5.4%	1.7, 9.6	1.5%	−0.2, 3.6
P-value	**0.003**		0.466		0.455		**0.005**		0.093	
High school										
1 or more SSBs	64.4	60.5, 68.4	43.0%	35.3, 50.6	7.1%	1.3, 13.0	9.8%	8.1, 11.6	2.1%	1.0, 3.9
Less than 1 SSB	62.4	50.4, 74.5	31.7%	26.0, 37.5	9.1%	7.3, 10.8	8.8%	3.9, 13.8	1.1%	0.5, 2.2
Risk difference	2.0	−11.6, 15.7	11.3%	0.2, 22.2	−2.0%	−8.6, 4.8	1.0%	−5.7, 6.6	1.0%	−0.4, 2.3
P-value	0.769		**0.046**		0.573		0.885		0.202	
Test for interaction	0.164		0.098		0.784		0.184		0.950	

[1] Generalized estimating equation logistic regression adjusted for race/ethnicity, socio-economic status, US-born status, gender, school level, and number of friends sampled

[2] Generalized estimating equation linear regression adjusted for race/ethnicity, socio-economic status, US-born status, gender, school level, number of friends sampled, and sports team participation (yes/no)

[3] Predicted prevalence tested comparing one or more SSBs per week vs. less than SSBs per week

[4] Bolded text indicates significant findings

* All SSBs measure is an aggregate measure of regular soda, sports drinks and energy drinks.

J Nutr Educ Behav. Author manuscript; available in PMC 2016 February 08.

Table 3

Predicted prevalence of adolescent reported weekly fast food restaurant visits by friends' reported fast food restaurant visits

	Predicted probability of adolescent fast food restaurant visits[1,2]											
	All fast food restaurants[2]		Burger and fries restaurants[3]		Mexican restaurants[3]		Fried chicken restaurants[3]		Sandwich restaurants[3]		Pizza restaurants[3]	
		95% CI		95% CI		95% CI		95% CI		95% CI		95% CI
Friend group												
Middle school												
High fast food	69.5%	65.5, 73.4	75.4%	72.5, 78.3	44.5%	40.3, 48.7	52.3%	48.2, 56.3	59.2%	53.2, 65.2	68.8%	65.1, 72.4
Low fast food	75.3%	66.4, 84.1	65.3%	50.6, 79.9	38.4%	33.0, 43.8	42.1%	37.1, 47.1	58.5%	51.4, 65.6	71.0%	61.2, 80.7
Risk difference	−5.8%	−17.7, 6.2	10.1%	−6.5, 26.7	6.1%	−0.03, 12.5	10.2%	5.1, 15.2	0.7%	−11.5, 12.9	−2.2%	−12.9, 8.4
P-value	0.345		0.233		0.063		**<0.001**		0.915		0.685	
High school												
High fast food	78.4%	73.8, 83.0	78.8%	76.0, 81.6	54.6%	49.4, 59.9	53.2%	46.8, 59.5	72.3%	67.3, 77.0	74.6%	72.1, 77.1
Low fast food	69.3%	59.8, 78.9	67.1%	57.7, 76.6	47.1%	40.1, 54.1	43.1%	38.8, 47.5	56.8%	50.6, 63.0	74.9%	68.3, 81.6
Risk difference	9.1%	1.6, 16.6	11.7%	3.2, 20.1	7.5%	0.07, 12.3	10.1%	5.1–15.0	15.5%	7.6, 23.0	−0.03%	−6.6, 6.0
P-value	**0.018**		**0.007**		**0.030**		**<0.001**		**<0.001**		0.923	
Test for interaction	**0.007**		0.530		0.472		0.404		**0.003**		0.753	
Best friends												
Middle school												
High fast food	71.4%	69.0, 73.7	78.3%	74.3, 82.4	43.8%	36.1, 51.5	55.1%	44.3, 65.7	63.0%	57.7, 68.2	75.0%	70.3, 79.7
Low fast food	69.4%	61.1, 77.7	73.7%	70.0, 77.4	42.3%	37.3, 47.2	45.7%	42.6, 48.8	60.3%	55.6, 64.9	66.7%	62.7, 70.6
Risk difference	2.0%	−7.8, 11.9	5.1%	−1.4, 10.7	1.6%	−7.3, 10.4	9.4%	−0.5, 19.1	2.7%	−3.9, 9.3	8.3%	1.8, 14.8
P-value	0.690		0.131		0.728		0.063		0.430		**0.012**	
High school												
High fast food	80.2%	76.7, 83.8	84.8%	77.7, 91.9	67.2%	55.0, 79.4	63.6%	53.0, 75.2	75.3%	69.5–81.2	77.7%	74.3, 81.1
Low fast food	60.1%	47.3, 72.9	74.4%	69.7, 79.1	50.6%	45.6, 55.6	46.0%	41.4, 50.6	68.3%	63.7, 72.9	73.6%	69.5, 77.7
Risk difference	20.1%	8.9, 31.3	10.4%	−0.07, 21.5	16.6%	2.4, 30.6	17.6%	6.7, 28.6	7.0%	1.0, 13.1	4.1%	0.01, 8.1
P-value	**<0.001**		0.067		**0.021**		**0.002**		**0.021**		**0.046**	
Test for interaction	**0.018**		0.095		0.319		0.348		0.349		0.478	

[1] Generalized estimating equation logistic regression adjusted for race/ethnicity, gender, socio-economic status, US-born status, and number of friends sampled

[2]Predicted prevalence tested comparing three or more visits per week vs. less than three visits per week

[3]Predicted prevalence tested comparing one or more visits per week vs. less than one visit per week

[4]Bolded text indicates significant findings