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Does weight status influence weight-related beliefs and the consumption of sugar-sweetened beverages and fast food purchases in adolescents?

Mary O Hearst^a, Keryn E Pasch^b, Jayne A Fulkerson^c, and Leslie A Lytle^a

^aDivision of Epidemiology and Community Health, University of Minnesota

^bMichael & Susan Dell Center for Advancement of Healthy Living, Austin, Texas

^cSchool of Nursing, University of Minnesota

Abstract

Objective—To determine if weight status affects the relationship between weight-related beliefs and consumption of sugar-sweetened beverages (SSB) and fast and convenience store food purchases (FCFP).

Design—Observational, cross-sectional.

Setting—Twin Cities Metropolitan area, Minnesota, USA.

Methods—Body composition and psychosocial survey were obtained for 345 adolescents. General Linear Models tested adjusted (age and sex) associations between weight-related beliefs and consumption of SSB and FCFP. Significant associations were tested for moderation by weight status.

Results—SSB was positively related to perceptions that people worry too much about their weight ($\beta = 0.103$, $p = 0.016$), with no moderation present. FCFP were positively associated to perceived barriers to maintaining a healthy weight ($\beta = 0.042$, $p = 0.004$) with a subsequent significant interaction by weight status. Stratified models showed a significant association between perceived barriers to a healthy weight and FCFP for overweight adolescents ($\beta = 0.345$, $p = 0.022$).

Conclusions—Addressing perceived barriers to a healthy diet may lead to important risk reduction.

Keywords

adolescence; fast food; perceived barriers; sugar-sweetened beverage; weight status

The purchasing of fast foods, convenience foods (FCFP) and consumption of sugar-sweetened beverages (SSB) has steadily increased over time, contributing to the rising rates of obesity among adolescents¹⁻³ and causing nutritional deficits in adolescents⁴⁻⁹. Fast food consumption in particular is significantly and positively associated with higher consumption of total energy, total fat, saturated fat, and carbohydrates¹⁰ contributing to severe health-related consequences⁵.

The average adolescent visits a fast food restaurant two times per week⁵. Food purchased away from home is typically higher in fat and energy^{7, 8}. Adolescents who consumed fast food three or more times per week consume 40 percent more calories and 10 percent more fat compared to those who reported never eating at a fast food restaurant⁵. They are also less likely to consume vegetables, fruits and juices, milk and legumes^{5, 7, 8}.

Among 12–17-year-olds, 20 percent of the total mean energy intake comes from added sweeteners, with over one-third consumed from soft drinks¹¹. From 1978–98, there was a 48 percent increase in the number of children consuming soft drinks on any given day¹². The increase in soft drink consumption does not result in a decrease in calories from other food sources^{9, 13} but does reduce the intake of milk and juice. Nutritionally, replacement of milk with SSB can reduce calcium intake in adolescent diets increasing the risk of bone fracture or developing osteoporosis later in life^{4-6, 10}. Poor dietary habits may also cluster as eating at fast food restaurants is associated with more SSB consumption^{8, 12, 14}.

There are several potential reasons why adolescents consume excess SSB and FCFP. From a psychosocial perspective, consumption is related to emotional rewards of certain types of foods (i.e. chocolate when bored), normative preferences, perception of one's own ability to eat healthily and the use of unhealthy foods in socially-rewarding ways (fast food as a 'treat')¹⁵, attitudes and behavioral beliefs¹⁶; and parental modeling^{17, 18}. The available literature on the attitudes that help explain the consumption of SSB and FCFP is limited to narrowly-defined attitudes and beliefs related to a given behavior, such as attitudes and beliefs of fast food as it relates directly to fast food consumption¹⁶ without addressing how such relationships may differ by weight status. Since research shows that overweight adolescents and adults tend to underestimate their caloric intake compared to normal weight individuals^{19, 20}, it is plausible that attitudes regarding maintaining a healthy weight may differ by the weight status of adolescents and affect consumption patterns. For example, one study found that fast food consumption was significantly and positively associated with perceived barriers of healthy eating⁵, but there is little known about whether or not perceived barriers vary by weight status. These differences may be important to understand as public health approaches are likely reaching both healthy weight and at-risk or overweight adolescents.

The purpose of this study was to understand the rationale for patterns of adolescent consumption of SSB and FCFP. This study adds to the literature by exploring the psychosocial factors of weight-related behavioral beliefs, perceived barriers to weight control, evaluation of behavioral outcomes, and weight-related attitudes as related to SSB and FCFP. The second unique aspect of this study was that it tested whether or not any observed association differed by weight status of adolescents. This study hypothesized that adolescents who have more negative weight-related attitudes, negative opinions and increased perceived barriers to weight control would consume more SSB and have increased FCFP than adolescents with less negative attitudes, opinions, and perceived barriers. Finally, we hypothesized that the observed relationship differed for adolescents who are overweight or at risk of being overweight from adolescents who are at a healthy weight.

Methods

The Identifying Determinants of Eating and Activity (IDEA) is funded from the National Cancer Institute's Transdisciplinary Research in Energetics and Cancer (TREC)²¹. IDEA is a longitudinal cohort study that follows adolescents (ages 10–16 at baseline) and one significant adult (usually a parent) over 24 months, using three yearly data collection periods. Participants were recruited in 2006–7 from the Twin Cities metropolitan area. For recruitment details and exclusion criteria, see Lytle²². For the present study, an additional

exclusion criteria was being less than the fifteenth percentile for weight ($n = 4$). The University of Minnesota human subjects review committee approved all recruitment, consent and measurement protocols.

Measures

Data for this study came from the first of three years of the larger study. Data included direct measurement of height and weight and a self-report student survey instrument. Trained clinic staff measured the height of each adolescent using a Shorr height board (Irwin Shorr, Olney, MD), and weight and body composition using a Tanita scale. The Tanita is a bioelectrical impedance device that assesses body weight, lean and fat mass (Tanita TBF-300A Body Composition Analyzer, Arlington Heights, IL). Additionally, adolescents were asked to complete a survey about perceptions and behaviors related to energy balance, including beverage intake, fast food and convenience food purchases and perceptions and behaviors relating to weight and activity. Psychosocial factors related to energy balance were informed by the Theory of Planned Behavior (TPB), Social Cognitive Theory (SCT), and empirical evidence²².

SSB consumption was measured with the following questions: (1) 'How often do you drink regular soda or pop, not including diet soda pop?'; (2) 'How often do you drink sports drinks (such as Gatorade, Powerade, etc.)?'; (3) 'How often do you drink other sweetened beverages (such as sweetened teas, juice drinks, punch or lemonade)?'; and (4) 'How often do you drink coffee drinks such as lattes, mochas, Frappuccinos, and Macchiatos (not including regular coffee)?'. The response categories were: never, once per month, 2–3 times per month, 1–2 times per week, 3–4 times per week, 5–6 times per week, once per day, 2 times per day, 3 or more times per day. Daily SSB consumption was calculated using the midpoint of the response categories, converted to a weekly amount (i.e. once per month became 0.25 times per week), summed across the four items to obtain a weekly total, and divided by seven to get a *daily* rate. This brief screener of SSB consumption was a reliable measure of intake ($Kappa > 0.60$) with acceptable criterion validity, in particular in a categorical manner of low, moderate and high consumption [blinded for review].

FCFP were measured by asking: (1) 'In the past month, how many times did you buy food at a restaurant where food is ordered at a counter or at a drive-through window (there is no waiter/waitress)?'; and (2) 'In the past month, how many times did you buy food at a convenience store, gas station, hardware store, or a vending machine, outside of school?'. The original categories were identical to the SSB categories and were similarly recoded for average weekly purchases. Purchases from fast food restaurants and convenience stores were summed for an average *weekly* FCFP. The reliability of this brief questionnaire for fast food consumption was strong with $Kappa > 0.60$ for typical quick food venues. However, criterion validity is difficult to confirm due to the infrequent purchasing of fast food during the recall period²³. There is no reliability or validity testing for the convenience food item. Both SSB and FCFP variables had skewed distributions and residuals and was thus log transformed to conform to statistical test assumptions.

Three scales and one item were used as predictors of consumption of SSB and FCFP. The seven-item outcome expectation scale ($\alpha = 0.80$) assessed how weight impacts appearance, energy, self- and other-perception, which were measured using items such as: 'Having a healthy weight as a teen will help me be healthier adult'. The seven-item evaluation/value scale ($\alpha = 0.65$) assessed how much a healthy weight and lifestyle is valued and the belief that behavioral performance is associated with certain attributes or outcomes. Examples of items included in the evaluation/value scale are: 'How I look is important to me'. The eight-item perceived barriers scale ($\alpha = 0.86$) assessed the perceived barriers to maintaining a healthy weight and included items such as: 'It is difficult

to maintain a healthy weight'. Finally, a single item of 'I think people worry too much about their weight' was used to express weight attitudes. Response categories ranged from 1 (strongly disagree) to 5 (strongly agree). Outcome expectations and evaluation/values scales were recoded to range from -2 (strongly disagree) to 2 (strongly agree).

Body mass index (BMI) percentile was calculated using objectively measured height and weight and percentiles derived from data from the Centers for Disease Control and Prevention²⁴. BMI was dichotomized with students who were either overweight or at risk of becoming overweight (BMI > 85th percentile) coded as 1 and normal weight students coded as 0. Twenty percent of the students in our sample were classified as overweight or at risk of becoming overweight (herein referred to as overweight).

Analytic approach

Using SAS v.9.1 of the SAS System for Windows²⁵, study sample characteristics and analytic variable mean values (age, sex, mean daily SSB consumption and weekly FCFP, for each item individually, and summed quantities and scales) were calculated and mean differences by weight status were tested using an *F*-test, with $p < 0.05$ as criteria for statistical significance. First, associations between outcome expectancies, values, barriers and opinions of a healthy weight for the summed and log transformed daily SSB consumption and weekly FCFP categories were assessed for both crude models and models adjusted for age and sex using PROC GLM in SAS v9.1²⁵. If the adjusted association was not significant ($p < 0.05$), no further modeling was conducted. Second, if the adjusted model was statistically significant, weight status was added as a moderator. Given the small sample size ($n = 349$) with a relatively small proportion being in the overweight category (20 percent), a statistically-significant interaction term, a priori level of $p < 0.20$, led to a stratified analysis for those models. Models were run using both the log-transformed dependent variable and summed dependent variables. If findings were consistent between transformed and untransformed data, then untransformed summed measures were reported for ease of interpretation.

Results

Our study sample included 345 adolescents, mean age of 15.4 years, and 51 percent females. The sample was predominantly white (93.4 percent), lived in two-parent households (79.9 percent) and had well-educated parents (35.9 percent college graduate, 28.3 percent professionally trained). Table 1 provides a description of the overall study population and unadjusted mean values for age, sex, SSB consumption, FCFP, and scales stratified by weight category. Significant differences were noted for the outcome expectations scale and the perceived barriers to weight control scale. In both cases, the overweight adolescents perceived more barriers and that their weight status impacted their appearance, energy, and self- and other-perception more than healthy weight adolescents. No other significant differences were found by weight status.

Both log-transformed and summed dependent variables were used in unadjusted and adjusted models to assess the association between weight-related opinions and SSB consumption and FCFP. Findings were consistent across log-transformed and untransformed data^a, therefore summed dependent variables are reported here. Unadjusted regression models yielded only one significant association. As perception of weight-related barriers

^aAdjusted log transformed analysis of perceived barriers predicting FCFP was not significant, but at the trend level ($p = 0.08$). An interaction term was added, yielding a significant effect modification ($p < 0.20$). Stratified analysis by weight status revealed a significant association between perceived barriers and FCFP for overweight youth, but no significant association for normal weight youth, consistent with findings above.

increased, daily SSB consumption increased ($p = 0.002$). No other significant unadjusted association between attitudes and daily SSB consumption were present.

Adjusted associations (controlling for age and gender) between attitude scales and SSB consumption and FCFP purchases are shown in Table 2. Consumption of SSB was positively related to the perception that people worry too much about their weight ($\beta = 0.103$, $p = 0.016$). FCFP purchases were positively associated to perceived barriers to maintaining a healthy weight ($\beta = 0.042$, $p = 0.004$). No other associations were statistically significant.

Interaction terms were added to the statistically-significant models to determine if the observed associations were moderated by weight status. See Table 2 for p -values of interaction term. Using the a priori p -value of $p < 0.20$, there was a significant interaction between BMI status and FCFP ($p = 0.166$). Stratified models found that, for adolescents who are overweight, as the perceived barriers to maintaining a healthy weight increased, weekly purchases of FCFP also increased. There was no significant relationship for healthy weight adolescents, although the trend was in the right direction. No interaction effect was found between weight status and consumption of SSB.

Discussion

The purpose of this study was to determine if weight-related attitudes, opinions and barriers were associated with the consumption of SSB and FCFP by adolescents and if these associations were moderated by weight status. Although we found a significant association between weight attitudes and sugar-sweetened beverages, there was no effect modification by weight status. This suggests that, regardless of weight status, adolescents in our sample who believe that people worry too much about their weight consume more daily SSB. This may be reflective of individual disregard for weight as a relevant issue, lack of knowledge regarding SSB nutrition, may reflect a sense of defiance or rebellion or perhaps is reflective of measurement error as the independent variable is measured by only one item. No other significant associations were found for daily SSB consumption. Our sample reported a relatively low intake of SSB and this low intake may help explain the lack of association with any other variables examined.

Our finding of a significant positive association between perceived barriers to maintaining a healthy weight and FCFP purchases is consistent with other published research⁵. In addition, we found that the statistically-significant relationship is largely due to overweight adolescents who report higher perceived barriers to weight control also purchasing more FCFP on a weekly basis. This relationship was not significant for healthy weight adolescents, although the trend was positive. The items comprising the perceived barriers included items such as perceived difficulty and effort in weight control, cost, lack of skills, feelings of deprivation and time constraints. One interesting parallel is a study by Saba et al in which they found no differences in attitudes or beliefs in the choice of food containing fat between overweight and normal weight adolescents, but did report that habit was a strong predictor of consumption of high-fat foods¹⁶.

The association between being overweight, fast food consumption and perception of barriers suggests that adolescents may turn to fast food because they perceive that healthier foods are more costly²⁶⁻⁹, less convenient or may take excessive time to prepare^{26, 30, 31}. None of these studies focus on differences between normal weight and overweight adolescents and all the pricing studies were conducted in the school environment. There is some evidence of purchasing behavior related to the low cost of fast food compared to fruits and beverages among adults and how it varies by income levels³², but further intervention studies would be

informative. Cost and convenience factors have been studied in low income and minority populations largely as it reflects community access to healthy, low cost food options³³⁻⁵, but these studies do not directly apply to this largely well-educated, suburban, white sample. It is possible that simply the extensive availability and social consumption patterns support consumption of SSB and FCFP³⁶, particularly for overweight adolescents. In any regard, these findings suggest that educational approaches that help adolescents reduce perceived barriers to eating more healthy foods may be warranted, especially among those adolescents who are overweight.

This study provided the first look of its kind on the use of weight status as a moderator of weight-related attitudes, perceived barriers and opinions of a healthy weight and SSB consumption and FCFP patterns. Our FCFP measure adds to the literature as it accounted for not only fast food restaurants, but also other types of population-level, non-vending food locations.

This study had limitations. First, our study had a lower prevalence of overweight adolescents and a lower intake of SSB and FCFP compared to national averages. Second, SSB intake and FCFP purchases may be underreported due to the self-report nature of both the SSB and FCFP measures. The associations may be stronger in populations with a higher prevalence of overweight and higher SSB consumption. Additionally, we do not know the specific foods purchased at FCFP. It is possible, but unlikely, that all food purchases were low-fat, included fruits or vegetables or were low calorie. The evaluation/values scale internal consistency was $\alpha = 0.65$. While still within a reasonable range, a lower alpha increases the error variance in the model, reducing the ability to detect a difference if one is present³⁷, therefore our analyses with this scale may have lacked the power to detect an association. And our assessment of opinions of a healthy weight was one item and may not adequately reflect the construct. We did not include home, school or environmental data as a factor influencing access to SSB and FCFP. The participants in this study come from well-educated, suburban and largely white families, which limited generalizability of findings. Finally, use of observational studies limits causal inference; hence we were able to report associations, but not causation.

Future studies should focus on understanding the perceived barriers to healthy weight in overweight adolescents using longitudinal and multilevel data. The second and third years of data collection for this study will enhance and expand these findings. It will be important to explore the social and environmental context related to perceived barriers and to SSB and FCFP. Little is known about perceived barriers to weight control and actual barriers, or how these associations may differ by age as middle school adolescents perceptions, attitudes and consumption patterns may differ from high school adolescents. Understanding such differences is important for establishing appropriate intervention points. Finally, intervention studies aimed at addressing cost and convenience barriers through fast and convenience store food venues will be an important expansion to vending literature. Additionally, skill building interventions for food selection and/or preparation among this age group may also be an avenue to reduce perceived barriers to a healthy weight.

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TABLE 1

Mean values of select characteristics of the study sample by healthy weight and overweight or at risk for being overweight

	Total sample <i>N</i> = 345	Healthy weight (<i>n</i> = 276)	Overweight or at risk (<i>n</i> = 69)
Age	15.42	15.47	15.22
Female %	51.0%	50.7%	52.2%
Regular soda (frequency per day)	0.26	0.25	0.27
Sugar sport drinks (frequency per day)	0.22	0.22	0.22
Other sugar sweetened beverages (frequency per day)	0.38	0.40	0.36
Coffee drinks (frequency per day)	0.08	0.07	0.09
Total sugar sweetened beverages per day	0.94	0.94	0.94
Fast food (times per week)	0.89	0.85	1.08
Other convenience food (times per week)	0.55	0.53	0.64
Fast food and convenience store food purchases per week	1.44	1.38	1.72
Outcome expectations scale *	1.28	1.00	2.38
Evaluation/values scale	8.71	8.78	8.42
Perceived barriers to weight control scale **	16.45	15.37	20.77
People worry too much about weight	3.24	3.28	3.09

* Significantly different $p < 0.05$;

** significantly different $p < 0.01$

† Includes convenience store, gas station, hardware store or vending machine food items

TABLE 2

Main effect of attitudes, outcome expectations and perceived barriers and consumption of sugar sweetened beverages or fast food or convenience store food purchase with interaction by weight status

Main effect	B coefficient	p-value	Interaction by weight status (p-value)
Sugar sweetened beverages			
Outcome expectations	0.005	0.586	
Evaluation/values	0.020	0.193	
Perceived barriers	0.005	0.528	
Opinions on healthy weight	0.103	0.016	0.652
Fast food and convenience store purchases*			
Outcome expectations	-0.005	0.717	
Evaluation/values	0.007	0.788	
Perceived barriers	0.042	0.004	0.141
Opinions on healthy weight	0.044	0.518	

* Includes convenience store, gas station, hardware store or vending machine food items; covariates included: age, gender and weight status; *p*-value for interaction significant at $p < 0.20$

TABLE 3

Stratified analysis of perceived barriers to weight control and fast and convenience store food purchases by weight status of adolescents

	Normal weight	<i>p</i> -value	Overweight	<i>p</i> -value
Fast food and all convenience store purchases [*]				
Perceived barriers	0.072	0.073	0.345	0.022

* Includes convenience store, gas station, hardware store or vending machine food items; covariates included: age and gender; overweight defined as > 85th percentile BMI