

EVALUATING MULTI-LEVEL FACTORS INFLUENCING ADOLESCENT
SUGAR SWEETENED BEVERAGE CONSUMPTION

A Dissertation Presented

By

CHRISTINA F. GRIECCI

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This work was undertaken in the Graduate School of Biomedical Sciences
Clinical and Population Health Research Program

Under the mentorship of

Stephenie Lemon Ph.D., Thesis Advisor

Milagros Rosal Ph.D., Member of Committee

Lori Pbert Ph.D., Member of Committee

Kate Lapane Ph.D., Member of Committee

Laura Hayman Ph.D., External Member of Committee

Sharina Person Ph.D., Chair of Committee

Kendall Knight, Ph.D.,
Interim Dean of the Graduate School of Biomedical Sciences

March 30, 2018

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ABSTRACT

Background: Sugar sweetened beverages (SSBs) comprise the largest source of added sugars in US adolescents' diets. SSB consumption is pervasive in US culture and is a critical risk factor for weight gain and obesity in adolescents. This thesis evaluates multi-level factors that influence adolescent SSB consumption.

Methods: The first two aims of this thesis utilized data from the cross sectional, internet based Family Life, Activity, Sun, Health and Eating (FLASHE) study to: 1) examine availability of SSBs in multiple settings (home, school, neighborhood) and adolescent SSB consumption, 2) examine the associations between perceptions of parenting practices and adolescent SSB consumption. The third aim used focus group discussions to understand adolescents' perceptions about SSBs.

Results: We found that SSB availability in the home was an important predictor of adolescent SSB consumption, regardless of SSB availability in other settings. Also, parenting practices that facilitate adolescent SSB consumption are associated with higher adolescent SSB consumption, but discussing/negotiating SSB behaviors is not associated with adolescent SSB consumption. Adolescents' described their attitudes, reinforcements, knowledge, and sources of influence around SSBs which are multifactorial and complex.

Conclusions: This thesis identified potential targets for addressing adolescent SSB consumption through availability of SSBs at home, parenting practices, and adolescent perceptions around SSBs. These are important modifiable factors in the adolescents' sociocultural environment that should be targeted in future dietary interventions to influence adolescent SSB consumption.

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LIST OF ABBREVIATIONS

SSBs - Sugar Sweetened Beverages

US – United States

FLASHE - Family Life, Activity, Sun, Health and Eating Study

NCI – National Cancer Institute

CVD – Cardiovascular Disease

BMI – Body Mass Index

CDC – Center of Disease Control

OR – Odds Ratio

CI – Confidence Intervals

PREFACE

CHAPTER II of this dissertation is under review as:

Haughton CF, MPH; Waring ME, PhD; Wang ML, ScD; Rosal MC, PhD; Pbert L, PhD; Lemon SC, PhD. Home Matters: Adolescents drink more sugar sweetened beverages when they are available at home.

CHAPTER III of this dissertation is under preparation as:

Haughton CF, MPH; Pbert L, PhD; Waring ME, PhD; Rosal MC, PhD; Lemon SC, PhD. Parenting practices are associated with higher adolescent sugar sweetened beverage consumption.

CHAPTER IV of this dissertation is under preparation as:

Haughton CF, MPH; Sreedhara M, MPH; Pbert L, PhD; Rosal MC, PhD; Waring ME, PhD; Lemon SC, PhD. Exploring perceptions of sugar sweetened beverages among a diverse sample of adolescents: a qualitative study.

CHAPTER I: INTRODUCTION

Sugar Sweetened Beverage Consumption in the United States

Sugar sweetened beverage (SSB) consumption has increased by 300% in the past 20 years and is the largest source of added sugar and calories in adolescent diets in the United States.^{1,2} Consumption of SSBs rose by a startling 38.5 gallons per person per year between 1950 and 2000.³ Although national trends in SSB consumption has seen small declines in recent years,^{4,5} adolescents continue to consume more SSBs than recommended with consumption estimated at 224 calories per day (10%-15% of total daily calories).² SSBs are beverages that contain added caloric sweeteners, provide no nutritional value, and are often readily available in large portions.⁶ SSBs include sodas, fruit-ades, sports drinks, energy and vitamin water drinks, sweetened iced tea and lemonade, shakes, and tea and coffee drinks with added sugars or syrup.⁶ Evidence strongly supports the role of limiting intake of these SSBs in promoting energy balance and healthy dietary habits. There are numerous national recommendations for limiting consumption of calories from added sugars. The 2015 Dietary Guidelines for Americans recommends less than 10% of your daily calories should come from added sugars and to limit or avoid consumption of SSBs.⁷ Reducing SSB consumption is a critical strategy to promote optimal health among adolescents.

Health Impact of Sugar Sweetened Beverage Consumption

SSBs have been associated with several health problems and are pervasive in the US culture. SSB consumption is a critical risk factor for weight gain, overweight, and obesity in adolescents.⁸ Multiple systematic reviews have found positive associations

between SSB intake and weight gain among children and adolescents.⁸⁻¹⁰ Evidence also suggests that the consumption of SSBs has increased in parallel to overweight and obesity trends.¹¹ The percentage of overweight youth has increased by almost 50% in the last two decades with one in three adolescents being overweight/obese.¹² Obesity during adolescence is a major public health concern given that obese youth are at higher risk of being obese adults¹³ and developing comorbidities, such as diabetes, cardiovascular diseases, and some cancers.¹⁴⁻¹⁶

Cardiovascular disease (CVD) and cancer are the top two leading causes of death in the US.¹⁷ SSBs and obesity have been associated with both diseases.¹⁸⁻²⁰ Obesity prevention and weight control through dietary behaviors, particularly SSB consumption, are important for prevention. First, 41.5% of the US are projected to have some form of CVD.²¹ The American Heart Association and a 2012 NHLBI expert panel set forth CVD prevention guidelines specifically for children addressing overweight and obesity in youth, as well as, obesogenic dietary behaviors.²² Recent studies found that adults who consumed SSBs had higher incidence of hypertension, hypertriglyceridemia and low high-density lipoprotein cholesterol compared to infrequent or nonconsumers of SSBs.^{23,24} Among adolescents, an analysis of the National Health and Nutrition Examination Survey data found a positive association between SSB intake and blood pressure in adolescents.²⁵ Second, over one third (39.6%) of the US population is expected to be diagnosed with cancer during their lifetime^{26,27} and new cancer cases are expected to increase nearly 45% by 2030.²⁸ The American Cancer Society has set forth cancer prevention guidelines promoting healthy body weight through diet and activity behaviors.²⁹ Obesity increases the

risk of common cancers, including colorectal, post-menopausal breast and endometrial cancers, among others.³⁰⁻³³ It is estimated that 20 percent of cancer cases are preventable due to obesity.²⁰ Replacing SSB's with lower calorie options such as water or low-calorie beverages can be efficacious in reducing body weight.³⁴⁻³⁶ Thus, reducing SSB consumption is essential for addressing adolescent obesity and therefore chronic disease prevention efforts.

Adolescence is Critical Period for Development of Healthy Eating Habits

Adolescence is an important period to address obesogenic behaviors as it is a period of growing autonomy and development and increased susceptibility to adipose tissue influencing obesity risk.^{37,38} Adolescence is also a critical period for weight gain because of the naturally occurring metabolic changes due to puberty which results in body composition changes including the location and quantity of body fat, physical fitness, insulin sensitivity and greater susceptibility of adipose tissue.^{38,39} In addition to physical changes, considerable psychological changes occur during this time. Adolescence brings an increasing regulation of one's own behavior and decision making which occurs as youth mature and develop a sense of self and seek more independence.³⁷ This period is also marked by changes in diet such as more control over food choices resulting in increased intake of energy dense foods.⁴⁰ Identifying opportunities and strategies to reduce SSB consumption during adolescence may be critical as these behaviors often persist into adulthood.^{41,42}

Multilevel Risk Factors for Adolescent SSB Consumption

Understanding multi-level risk factors that influence SSB consumption among adolescents is limited and important for addressing the public health issue of obesity and related chronic disease. Utilizing a social ecological framework helps in understanding SSB consumption among adolescents. The social ecological model posits that health behaviors are affected by multiple levels of influence, including inter-personal, home, school, and neighborhood.⁴³ The model also considers the connections between people and their environments.⁴³ The evidence is limited for identifying SSB consumption risk factors across the multiple environments in which adolescents may have access to. This framework is used to explore multiple environmental influences and fill this knowledge gap.

Neighborhood and School Environments Shape Adolescent SSB Consumption

Evidence shows associations between the local environment and dietary behaviors among youth. The physical availability of SSBs in these environments, including neighborhood and school, may be an important contributor to poor dietary habits and the risk of obesity and obesity related health consequences.

The neighborhood environment has found to be related to obesity, dietary practices, and health outcomes.⁴⁴⁻⁴⁷ Despite the growth in research on neighborhood environmental characteristics and their influence on youth diets, much remains to be learned, as few have examined the relationship between neighborhood food availability on dietary behavior in adolescents, specifically SSBs.⁴⁸⁻⁵³ Studies have generally shown that less healthy food environments are associated with poor diet quality and a higher prevalence of obesity compared to healthier food environments.^{44,50} In the local environment, greater exposure to fast-food restaurants and convenience stores is associated with unhealthier dietary

practices or overconsumption while availability of supermarkets and large grocery stores are associated with healthier diets among adolescents.^{44,54-57} Most studies to date assessed fast food and fruits and vegetables, but the limited available evidence on SSBs indicates that neighborhood access to SSBs impacts consumption.⁵⁵⁻⁵⁷ Findings from one study, indicate adolescents who live and go to school in areas with more fast food restaurants and convenience stores than healthier food outlets such as grocery stores are more likely to consume soda than teens who live and go to school in areas with healthier food environments.⁵⁸ Neighborhood factors that influence adolescent dietary behaviors, particularly availability of SSBs, need to be better understood to develop effective strategies to reduce SSB consumption.

School food environments are another important location affecting dietary behaviors in adolescents. The school environment plays a role in adolescent food choice and energy intake, including SSB consumption.⁵⁹⁻⁶¹ In the US, research has shown that students are exposed to a wide variety of less healthful food and beverages while at school^{62,63} and are consuming high amounts of less healthful food while at school; including SSBs and energy dense foods.^{45,62} Furthermore, studies have found that the availability of particular food or beverages at school is associated with consumption of those same items.^{59,64} Students that purchased SSBs at school were more likely to be higher consumers.⁶⁵ Vending machines in schools are also a potential source to purchase SSBs. The number of vending machines in schools was associated with student purchases of soft drinks and in schools where soft drink machines were turned off during lunch time, adolescents purchased fewer soft drinks.^{60,66} Availability of SSB's in school environments

through vending machines or a la carte options results in greater student SSB consumption than schools without these options.⁶⁷ Findings highlight the need for further research that focuses on the complex relationships between availability of SSBs in multiple environments, including their neighborhood and school, in order to develop multilevel prevention approaches that address SSB consumption among adolescents.

Parents and the Home Environment Shape Adolescent SSB Behaviors

Parents are the primary source of health-related information for adolescents and therefore can have an influence over their teen's exposure to information related to health behaviors, including nutrition and weight.^{68,69} However, it is unknown to what extent parents' influence extends to actual behavior, as adolescence is a time of increasing autonomy. Parental influence has only recently become a focus of prevention efforts, with few studies aiming to understand the impact of parents on teen obesity and on SSB consumption specifically. Because parents can act as role models, set food rules and control what foods are available in the home, they influence adolescents' dietary habits.⁶⁹⁻⁷¹

Given that adolescents consume 54% of their total daily calories at home, SSB availability in homes is a critical factor in adolescent consumption and warrants study.⁷² Studies that have examined the association of food and beverage availability in the home on consumption have demonstrated positive findings; though only a few are specific to SSBs.^{65,73-77} However, with increased autonomy, adolescents have access to SSBs in other settings, particularly schools and local neighborhoods. The impact of parents efforts to reduce availability of SSB in the home may be minimized when adolescents have

widespread SSB availability in other environments. No study to date has assessed these associations.

In addition to SSB availability in the home, parents and their parenting practices play an important role in shaping their adolescent's environment and dietary behaviors. Parenting practices can influence adolescent behaviors based on the parent's presence and involvement in the daily life and routines of their child. Parenting practices differ from parenting style and are defined as specific behaviors that parents use to socialize their children.⁷⁸ Recent attention has been drawn to food related parenting practices that consist of a wide range of behaviors parents use to influence their child's dietary intake.^{78,79} Adolescents in homes with stricter parenting practices or authoritative parenting styles are less likely to drink SSBs.⁸⁰⁻⁸² However, SSB specific parenting practices, such as efforts to reduce access and rule setting, have not been studied. Reporting of parenting practices can be parent or child informed and therefore provide unique perspectives on their relationship and the home environment. Although, existing research on parenting practices and dietary behaviors has been largely unidirectional focusing on parent reports.⁸³ Little is known about how adolescents perceive parenting practices and how those perceptions may influence SSB consumption behaviors. It is important to understand how adolescents interpret and respond to parenting practices around SSBs as well as how parents perceive they are engaging in these parenting practices to inform the development of effective interventions targeting parent food related practices for adolescents. In addition, it is unknown whether parenting practices matter if parents are not modeling the desired SSB behaviors. Parent dietary intake is associated with adolescent consumption.⁶⁹

Understanding the impact of parental and adolescent perceptions on parenting practices and the effect of parental SSB consumption will add a new dimension in understanding effective obesity prevention methods.

Adolescent Perceptions about Sugar Sweetened Beverages

Adolescents who perceive SSBs as healthy drinks report higher consumption of SSBs.⁸⁴ Understanding perceptions about SSBs and where adolescents obtain their knowledge about them will be helpful in addressing SSB behaviors and how to intervene with correct health information. Adolescents receive information about health and dietary behaviors from many different outlets including their parents, peers, and the media. It can become difficult for adolescents to understand these, often conflicting, messages in constructing a set of beliefs and practices around obesity and SSB behaviors. There is also an increasing sense of independence during adolescence and a motivation for control over food choices often leading to an increase in energy-dense, nutrient-poor foods among adolescents.⁸⁵ A broad range of factors influence adolescent dietary behaviors and their food choices including preferences, cravings, appeal, availability, convenience, cost, habits, and social influences.⁸⁶⁻⁹⁰ There is a gap in understanding what specifically impacts their attitudes and motivation to choose different types of SSBs. This study aims to fill these gaps by qualitatively exploring adolescents' knowledge, attitudes, and reinforcements, and sources of influence that impact SSB consumption.

Specific Aims

This dissertation takes a multi-level approach to evaluate how adolescents, parents, the home and the environment impact adolescent SSB consumption. A secondary analysis

of data from the Family Life, Activity, Sun, Health and Eating (FLASHE) study, a cross sectional, internet based study sponsored by the National Cancer Institute, was conducted. A qualitative analysis using focus group discussions among youth in Worcester, MA, was also conducted. The specific aims of this dissertation were as follows:

Aim 1: To examine the association between adolescent self-report of the availability of SSBs in their home and SSB consumption and whether the association between adolescent self-report about the availability of SSBs in their home and their SSB consumption is moderated by perceived neighborhood and school neighborhood SSB availability.

Aim 2: To examine the associations between adolescent and parent report of parenting practices related to SSBs/junk food and adolescent SSB consumption and whether the association between parenting practices related to SSBs/junk food and adolescent SSB consumption is moderated by parental SSB consumption behavior.

Aim 3: To gain understanding of adolescents' attitudes and knowledge about SSBs, how they receive messages about SSBs, and motivations for SSB consumption through qualitative focus group discussions.

**CHAPTER II:
HOME MATTERS: ADOLESCENTS DRINK MORE SUGAR SWEETENED
BEVERAGES WHEN THEY ARE AVAILABLE AT HOME**

ABSTRACT

Objectives: Sugar sweetened beverages (SSBs) comprise the largest source of added sugars in US adolescents' diets. Availability of SSBs across various environments (e.g., home, school, school neighborhood) can influence adolescents' SSB consumption. This study aimed to examine the association between SSB availability at home and SSB consumption, and whether this association was consistent across school and school neighborhood SSB availability.

Study Design: Secondary analyses were conducted using data from the 2014 Family Life, Activity, Sun, Health and Eating (FLASHE) study of 1,494 adolescents (12-17 years old). Ordinal logistic regression analyses were conducted to examine the association between SSB availability in the home and adolescents' frequency of SSB consumption (non-daily <1, daily 1-<2, daily ≥ 2), adjusting for adolescent age, sex, race, BMI, parent marital status, and housing insecurity. Stratified ordinal logistic regression analyses were used to examine the association by school and school neighborhood SSB availability.

Results: A third (32.6%) of adolescents were non-daily consumers of SSBs, 33.9% consumed 1-<2 SSBs daily, and 33.5% consumed ≥ 2 SSBs daily. Almost half (44.4%) reported that SSBs were often or always available in their home. Frequency of SSB availability at home was associated with greater SSB consumption (OR: 3.17[CI:3.16-3.18] for rarely/sometimes available at home; OR: 7.34[CI:7.32-7.37] often/always

available at home). Similar associations were found regardless of availability of SSBs at the adolescent's school or school neighborhood.

Conclusions: SSB availability in the home was an important predictor of adolescent SSB consumption, regardless of SSB availability in other settings, and may be a key target for obesity prevention efforts.

INTRODUCTION

Sugar sweetened beverage (SSB) consumption has increased by 300% over the past three decades and constitutes the largest source of added sugar in US adolescents' diets.^{2,4} SSBs, which include sodas, fruit drinks and sport drinks, contain added caloric sweeteners, are energy dense, and provide little to no nutritional value.⁶ Studies point to increased SSB intake as a major contributor to the rising prevalence of overweight and obesity^{91,92} with one third of US adolescents being overweight or obese.¹² Despite recent national declines in SSB consumption, adolescents remain the highest consumers among all youth age groups.⁴ The 2015 Dietary Guidelines for Americans recommends that less than 10% of total daily calories should come from added sugars and to limit the consumption of beverages with any added sugars.⁷ The American Academy of Pediatrics supports these guidelines and recommends that pediatric practices and clinicians advise removing all SSBs from youths' diets.^{93,94} However, almost two-thirds of adolescents consume at least one SSB on a given day,⁹⁵ with SSBs estimated to constitute 15% of their total daily calories.⁹⁶ Thus, understanding determinants and reducing adolescent SSB consumption remain national priorities for public health and obesity prevention efforts.⁹⁷

Adolescence is an important developmental period in which to target SSB consumption, as eating habits and weight-related behaviors developed during adolescence tend to persist into adulthood.⁹⁸ Adolescence is also a period of growing autonomy, marked by increasing regulation of the individual's own behavior and decision making,³⁷ leading to more control over dietary choices.⁴⁰ Identifying opportunities and strategies to reduce SSB consumption during adolescence may be critical to address the elevated levels of SSB consumption and related obesity among this age group. The availability and accessibility of SSBs in adolescents' environment can influence their decisions and subsequent consumption.⁷¹ Approximately 54% of calories from added sugars in beverages are consumed at home,⁷² suggesting that the availability of SSBs in the home environment might be an important determinant of SSB consumption. Studies demonstrate that availability of SSBs at home is positively associated with SSB consumption among children and adolescents.^{69,73,74,76,99–101} However, the association of SSB availability across different environmental settings with adolescent SSB consumption is not well understood.

The aim of this study was to examine the association between availability of SSBs at home and adolescent SSB consumption, and whether this association was consistent across school and school neighborhood SSB availability. We hypothesized that home SSB availability would be positively associated with self-reported SSB consumption, and that the association between home availability of SSBs and SSB consumption would be attenuated by SSB availability in school and/or SSB availability in the school neighborhood.

METHODS

Data Source

We conducted a secondary analysis of data from the Family Life, Activity, Sun, Health and Eating (FLASHE) study. FLASHE is a cross-sectional, internet-based study of parent-adolescent dyads sponsored by the National Cancer Institute (NCI) in 2014.¹⁰² Data are publically available and include parent and adolescent self-reported lifestyle behaviors that relate to cancer risk (diet, physical activity, sun safety, tobacco use). The FLASHE sample was selected from the Ipsos' Consumer Opinion Panel which is a web based panel of about 700,000 participants. The sample was selected to match US population distributions of sex, income, age, household size, and region. Eligible parents were at least 18 years old, a parent or legal guardian to an eligible adolescent and living with the adolescent at least 50 percent of the time. Eligible adolescents were 12–17 years. Parental consent was completed online via email invitation and once completed, the adolescent was asked to complete assent online via email invitation. Each enrolled dyad completed four online surveys consisting of multiple questionnaires about their diet and physical activity behaviors. The parent completed two surveys (one on diet and one on physical activity) and the adolescent completed two surveys (one on diet and one on physical activity) over a six-month time period. Details on the FLASHE study have been reported elsewhere.^{102,103}

Measures

Adolescent Reported Sugar Sweetened Beverage (SSB) Consumption: Adolescent SSB consumption was measured by questions adapted from a validated dietary screener survey to capture usual consumption.^{104,105} Participants recall of what and how often they drank different beverages during the past week was captured through five questions about

SSBs with the following response options: “I did not drink –beverage- during the past 7 days”, “1 – 3 times in the past 7 days”, “4 – 6 times in the past 7 days”, “1 time per day”, “2 times per day”, “3 or more times per day”. The NCI dietary screener methods for converting frequency responses to daily frequency was used to calculate total SSB consumption from the questions that asked about SSBs (sweetened fruit drinks/teas; fruit juices; soda; energy drinks; and sports drinks). We categorized SSB consumption as: non-daily SSB consumption (<1 SSB consumed daily), daily SSB consumption (1-<2 SSB consumed daily) and heavier daily SSB consumption (≥ 2 SSB consumed daily).

Adolescent Reported Household SSB Availability: The availability of SSBs in the home was assessed from a single survey item: “How often are the following foods and drinks available in your home?”^{105,106} The question that asked about “sugary drinks like regular soda, sports drinks, fruit drinks, sweetened teas and other drinks with added sugar” was used to determine household SSB availability. Self-reported adolescent responses ranged from “never” to “always” on a 5-point Likert scale. We collapsed household SSB availability as never, rarely/sometimes, and often/always.

Adolescent Reported School SSB Availability: The availability of SSBs at school was assessed using two questions adapted from the *Active Where? Study Adolescent Survey*.¹⁰⁷ Adolescents answered yes or no to the questions “Are there vending machines at your school?” and “If Yes, then do they sell sodas, salty snacks and/or candy?” We categorized school SSB availability as either the presence or absence of vending machines that sell sodas, salty snacks, and/or candy at school.

Adolescent Reported School Neighborhood SSB Availability: The availability of SSBs in the neighborhood was assessed by an adapted survey that asked adolescents to “Think about the local area around your school, within a 10-15-minute walk in any direction. Do you have any of the following in walking distance from school?”¹⁰⁸ Responses of either “yes” or “no” were given to each of the following four store types: convenience store/corner store/small grocery store/bodega, supermarket/mid-size grocery store, fast food restaurant, and non-fast food restaurant. The four responses were tallied to determine the total number of stores available in their school neighborhood. We dichotomized school neighborhood SSB availability as having zero stores or at least one store available within walking distance of school.

Covariates: Adolescents and parents self-reported their own age, sex, race/ethnicity and body mass index (BMI). We classified adolescent age into two groups (12-14 and 15-17) to capture differences in autonomy of early and late adolescence¹⁰⁹ and parent age into three groups (18-34, 35-44, and 45+). Race/ethnicity was categorized as reported in the FLASHE dataset and included categories for Hispanic, Black/African American, White, or Other. BMI was calculated from self-reported height and weight and categorized into underweight, normal weight, overweight, and obese per percentile cutoffs based on CDC BMI percentiles among adults and adolescents.^{110,111} Additional parental factors examined include education (high school or less, some college, 4-year college), marital status (married/coupled, divorces/widowed/separated, never married) and housing insecurity as a monetary proxy determined by how often they were worried or stressed about having enough money to pay for rent/mortgage (never, almost never, sometimes, fairly/very

often). In each stratified analysis (school and school neighborhood), SSB availability in the other location was controlled for in the model.

Analysis

Appropriate analysis weights were applied in all analyses to reduce sampling bias in individual-level analyses and to account for the survey design that aims to yield a sample similar to the general US population on key demographics.^{103,112} Descriptive statistics of all variables were computed. Given that the SSB consumption variable represented ordered values, ordinal logistic regression models estimated associations. Ordinal logistic regression analysis was conducted to estimate the association between the measures of SSB availability in the home and adolescent SSB consumption behaviors. Additional ordinal logistic regression analyses were conducted to determine whether the association between the measures of SSB availability in the home and adolescent SSB consumption behaviors were consistent when stratified separately by school SSB availability and school neighborhood SSB availability. The proportional odds assumptions were tested and met for all final models. Models were initially tested with an alternative categorization of SSB consumption that included a “no SSB consumption” group but this did not meet proportional odds assumptions resulting in the three category SSB consumption outcome that was used in all study analyses. We decided a priori to include key adolescent demographics (age, sex, race, BMI) in adjusted regression models based on previous research.^{113–115} Additional variables were assessed and included in the model if there was a 10% change in association. All models controlled for adolescent age, sex, race, BMI, parent marital status, and housing insecurity. The main model examining the association

between SSB availability at home and adolescent SSB consumption was adjusted for SSB availability at school and in the school neighborhood. Models stratified by SSB availability at school were adjusted for SSB availability in the school neighborhood, and models stratified by school neighborhood availability were adjusted for SSB availability at school. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). Analyses were conducted in Stata version 13.1 (Stata Corp, College Station, TX).

RESULTS

Among the 1,737 adolescents in FLASHE, 1,632 had complete data for both SSB consumption and SSB availability variables. We excluded 138 participants due to missing data on covariates, resulting in a sample of 1,494 adolescents. A third (32.6%) were non-daily consumers of SSBs, 33.9% were daily consumers of 1 - <2 SSBs and 33.5% were daily consumers of ≥ 2 SSBs. The sample (Table 2.1) was almost evenly distributed across sex and age groups with the majority having a normal BMI (68.5%) and self-identified race as white (55.2%). Most participants had parents that were married or coupled (77.6%), and half of parents (46.6%) had completed 4 years of college.

Almost half (44.4%) of adolescents reported that SSBs were often/always available in their home. Adolescents for whom SSBs were rarely/sometimes available at home had 3 times the odds of higher SSB consumption than those whom SSBs were never available at home (OR: 3.12 [CI: 3.11-3.13]), and adolescents for whom SSBs were often/always available had 7 times the odds of higher SSB consumption than those whom SSBs were never available at home (OR: 7.05 [CI: 7.02- 7.07]; Table 2.2).

Half (51.9%) of adolescents reported that SSBs were available at school and 80.6% reported that SSBs were available in their school neighborhood; 42% reported that SSBs were available both at and near school and 11% reported that SSBs were not available at school or in their school neighborhood. Figure 2.1 describes adolescents' daily SSB consumption according to their SSB availability at home, stratified by SSB availability at school and in the school neighborhood environments. Among adolescents who reported SSBs were never available in their home, two-thirds were non-daily SSB consumers, while 10% or less were daily ≥ 2 SSBs consumers. Among adolescents that report SSBs were often/always available in their home, approximately 20% were non-daily SSB consumers while approximately 40% were daily ≥ 2 SSBs consumers. These percentages were similar across all stratum categories.

In stratified multivariable ordinal regression models, adolescents with more frequent availability of SSBs in the home were more likely to report greater SSB consumption compared to adolescents for whom SSBs were never available in their home regardless of SSB availability at school and in their school neighborhood (Table 2.3). When SSBs were available at school, adolescent SSB consumption was higher among those with more frequent availability of SSBs in the home: never available (ref), rarely/sometimes available (OR: 3.26 [CI: 3.25-3.28]), often/always available (OR: 7.21 [CI: 7.18- 7.25]). When SSBs were not available at school, adolescent SSB consumption was higher among those with more frequent availability of SSBs in the home: never available (ref), rarely/sometimes available (OR: 3.04 [CI: 3.02-3.05]), often/always available (OR: 7.19 [CI: 7.15- 7.22]). When SSBs were available in the school neighborhood, adolescent SSB

consumption was higher among those with more frequent availability of SSBs in the home: never available (ref), rarely/sometimes available (OR: 3.23 [CI: 3.22-3.26]), often/always available (OR: 7.67 [CI: 7.64- 7.70]). When SSBs were not available in the school neighborhood, adolescent SSB consumption was higher among those with more frequent availability of SSBs in the home: never available (ref), rarely/sometimes available (OR: 3.18 [CI: 3.15-3.20]), often/always available (OR: 6.29 [CI: 7.24- 7.34]).

DISCUSSION

In this study, adolescents with more frequent availability of SSBs at home reported higher SSB consumption. These findings are consistent with previous studies that demonstrated positive associations between SSB availability in the home environment and dietary behaviors, including SSB consumption.^{71,116} There is a growing body of evidence that the local environment may be an important determinant of dietary behaviors and obesity.^{44,117} Studies have generally shown an association between living in a neighborhood in close proximity to certain types of food outlets and the availability of healthy food options, dietary quality, dietary intake, and risk of overweight.^{50,57,118,119} However, there is a gap in understanding how SSB availability in various food environmental settings (home, school, neighborhoods) are linked with adolescent SSB consumption.^{117,120,121} In contrast with our hypotheses, our results indicate that the association between availability of SSBs in adolescents' home and self-reported SSB consumption did not differ by availability of SSBs in adolescents' school and school neighborhood.

Given the increasing autonomy and independence associated with adolescence, in addition to the opportunities for adolescents to make their own decisions about drink choices in environments outside the home, parents may believe they have limited influence on their child's SSB consumption. Parents may be concerned that, even if they limit SSB availability at home, their adolescent will consume them elsewhere. However, more than half of adolescents' calories are consumed at home¹²² and findings from this study emphasizes that the home does matter. The study results highlight the important role parents continue to play in adolescent's SSB consumption through the drinks they make available in the home. Numerous studies demonstrate that the home food environment can either facilitate or inhibit healthful eating.^{69,73-76,100,101} The present study adds to the literature with the finding that availability of SSBs in the home remains a critical factor that is positively associated with adolescent SSB consumption, regardless of SSB availability in other key food environment settings. Thus, parents can be empowered to make small changes in the home to reduce SSB availability and to promote healthier diets for their adolescents.

Our findings have implications for pediatric clinical practice. Pediatric providers have the opportunity to facilitate discussions with adolescents and parents about obesity prevention and the importance of healthy dietary choices during this critical period of development. The American Academy of Pediatrics supports the pediatric provider's role in primary prevention of obesity among youth.⁹⁴ The guidelines recommend providers encourage families to limit SSBs at home and to focus on family-based approaches for obesity prevention. The findings of this study support this approach and highlight the

critical role SSB availability in the home plays in SSB consumption of adolescents, even when they are exposed to environments outside the home where SSBs are readily available. Pediatric providers can share this message with parents to highlight the key role they play as parents and support their efforts to improve their home's dietary environment by eliminating or cutting back on purchasing SSBs.

There are additional ways parents may influence adolescent SSB consumption away from the home that this study does not capture. First, this study does not explore family norms around SSB consumption, such as, adolescent purchasing behaviors and their freedom to venture to environments outside the home that may impact their decisions to consume SSBs. Second, parental modeling of behaviors related to SSB consumption, such as parents' own SSB consumption or limiting the availability of SSBs at home, may be internalized by adolescents and potentially influence their beverage choices away from the home. Thus, parental influence on adolescent SSB consumption may extend further than consumption taking place in the home. Future studies can further explore the role parents may have on adolescent SSB consumption through parental modeling, parenting practices, and evolving youth independence.^{74,76,81}

Study findings should be considered in light of the following limitations. Compared to the national US population, a higher percentage of study participants were of healthy weight, had married parents, and parents with 4 years of college.⁷⁴ This may limit the generalizability of the results as SSB consumption may differ among the adolescents not well represented in FLASHE. Further examination of the associations in this study with more ethnically diverse populations is needed. This study was cross-sectional and causal

inferences are not possible. Regarding the primary outcome of interest (SSB consumption), there is potential for recall or social desirability bias in self-reporting. Individuals tend to underreport their consumption of foods that are perceived to be unhealthy by underestimating quantity consumed or omitting them altogether.^{123–125} This study captured multiple types of SSBs but the study survey did not capture coffee-based drinks to include in daily SSB consumption behaviors. However, the reporting of SSB consumption in this study among adolescents is similar to other national SSB consumption estimates.¹²⁴ Though the SSB consumption measure has limitations, it provides a reasonable estimate of consumption and is a feasible option for large-scale studies, given the cost and participant burden of gold standard dietary assessments. Another limitation is that the school availability measure captures both sugary drinks and junk food in vending machines. The impact of this may be minimal, though, as soda is the most common offering in school vending machines and 71% of children's purchases from school vending machines are sodas and other sugary drinks.¹²⁵ Policies around competitive foods (vending machines) in schools only apply during school hours, allowing opportunities for students to purchase SSBs before and after school.¹²⁶

CONCLUSION

This study found that, despite the availability of SSBs in school and school neighborhood environments, the home food environment remains an important determinant of adolescent SSB consumption and hence for obesity prevention efforts. Parents can play a critical role in reducing adolescent SSB consumption by limiting or cutting back on the availability of SSBs in the home. Pediatric providers are well positioned

to reinforce these recommendations and to support patients and their families in meeting these guidelines.

Table 2.1. Characteristics of adolescents 12-17 years old by daily sugar sweetened beverage (SSB) consumption (n=1,494) presented as weighted percentages in the FLASHE study, 2014.

	Total	Non-Daily SSB Consumption (<1 per day)	Daily SSB Consumption (1-<2 per day)	Daily SSB Consumption (≥2 per day)
Unweighted n	1494	476	519	499
Weighted n	22,781,104	7,427,122	7,712,569	7,641,412
Adolescent Characteristics				
Age (years)				
12-14	49.8%	50.5%	48.9%	50.0%
15-17	50.2%	49.5%	51.1%	50.0%
Sex				
Female	48.8%	55.5%	52.0%	39.0%
Male	51.2%	44.5%	48.0%	61.0%
Race/Ethnicity				
White	55.2%	56.6%	58.9%	50.2%
Black	13.5%	10.7%	13.0%	16.7%
Hispanic	15.9%	14.0%	17.5%	16.1%
Other	15.4%	18.7%	10.6%	17.0%
BMI				
Underweight (<5)	4.3%	5.5%	3.8%	3.6%
Normal (≥5 - < 85)	68.5%	68.0%	68.6%	69.0%
Overweight (≥ 85 - < 95)	14.8%	15.7%	13.8%	14.8%
Obese (≥ 95)	12.4%	10.8%	13.8%	12.6%
Parent Characteristics				
Age (years)				
18-34	11.8%	9.7%	12.0%	13.6%
35-44	43.8%	42.7%	44.6%	44.1%
45+	44.4%	47.6%	43.3%	42.3%
Sex				
Female	73.5%	75.6%	75.5%	69.3%
Male	26.5%	24.4%	24.5%	30.7%
Marital Status				
Married/Coupled	77.6%	79.5%	77.8%	75.4%
Divorced/Widow/Separated	12.1%	10.6%	12.0%	13.6%
Never Married	10.4%	9.9%	10.2%	11.0%
Education				
High school or less	18.4%	17.4%	17.7%	20.1%
Some college	35.0%	35.1%	38.5%	31.6%
4-year college	46.6%	47.5%	43.9%	48.4%
Housing Insecurity				
Never	37.1%	38.0%	37.8%	35.6%
Almost Never	21.3%	23.2%	21.5%	19.2%
Sometimes	22.4%	19.7%	22.3%	25.0%
Fairly /Very Often	19.2%	19.2%	18.4%	20.2%

*All reported percentages are weighted percentages.

Table 2.2. Multivariable ordinal logistic regression model (n=1,494) of the association between SSB availability in the home and adolescents (12-17yo) SSB consumption behaviors in the FLASHE study, 2014.

	Non-Daily SSB Consumption (<1 per day)	Daily SSB Consumption (1-<2 per day)	Daily SSB Consumption (≥2 per day)	SSB Consumption	
	n(weighted %)	n(weighted %)	n(weighted %)	Crude OR (95% CI)	Adjusted* OR (95% CI)
SSBs Availability at Home					
Never	68 (65.7%)	28 (26.0%)	10 (8.3%)	Ref	Ref
Rarely/Sometimes	277 (38.6%)	252 (33.3%)	196 (28.1%)	3.28 (3.27-3.29)	3.17 (3.16-3.18)
Often/Always	131 (20.4%)	239 (35.7%)	293 (43.9%)	7.20 (7.18-7.23)	7.34 (7.32-7.37)

*SSB consumption outcome categories: non-daily <1, daily 1-2, daily ≥2

**Model adjusted for school SSB availability, school neighborhood SSB availability, adolescent age, sex, race, BMI, parent marital status and housing insecurity.

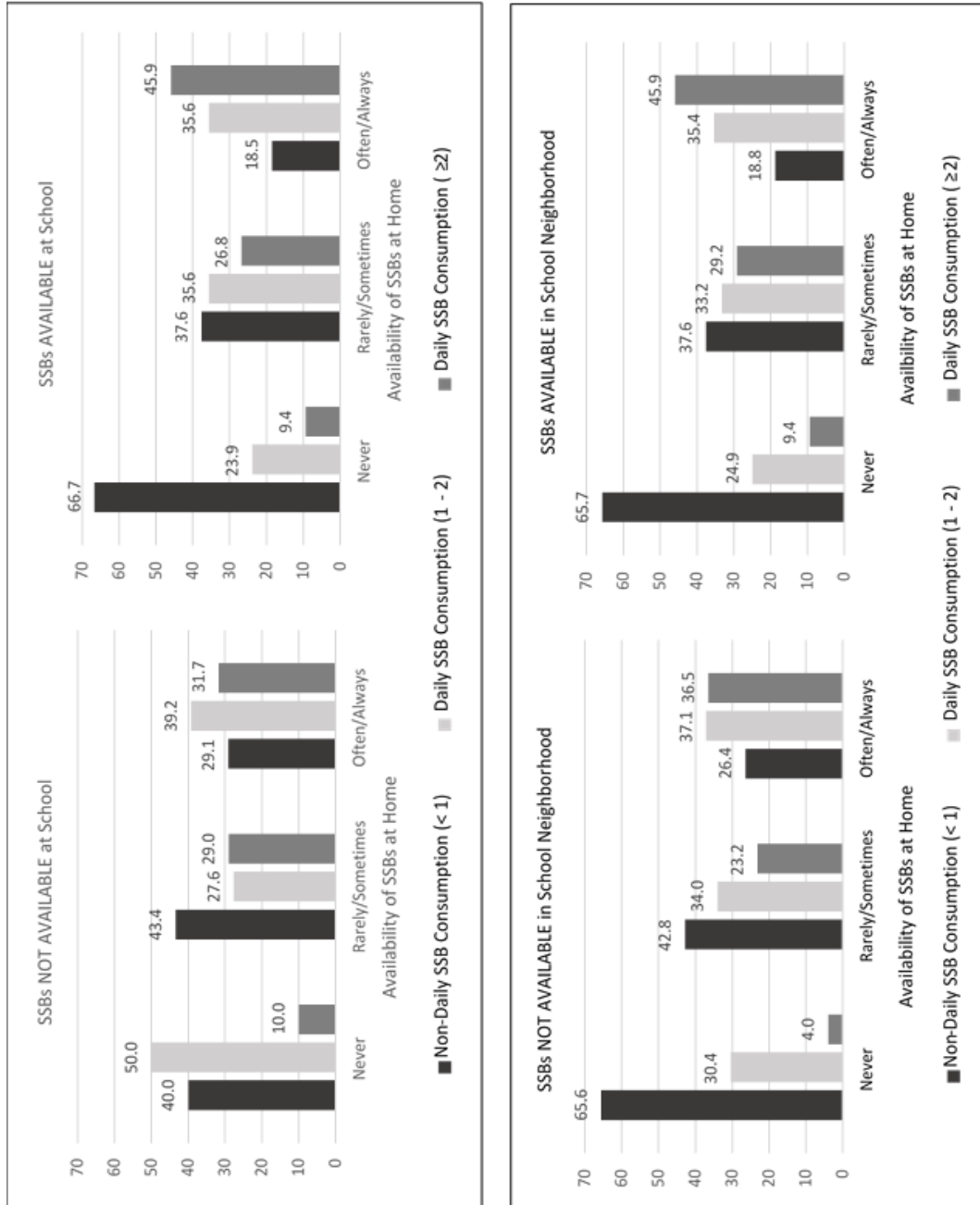
Table 2.3. Multivariable ordinal logistic regression models predicting adolescent's (12-17yo) SSB consumption (non-daily <1, daily 1- <2, daily \geq 2) stratified by availability of SSBs in school and the local school neighborhood in the FLASHE study, 2014.

	SSBs Not Available in School (n=726)		SSBs Available in School (n=768)	
	SSB Consumption		SSB Consumption	
	Adjusted OR	95% CI	Adjusted OR	95% CI
SSBs Availability at Home				
Never	Ref	Ref	Ref	Ref
Rarely/Sometimes	3.07	3.06-3.09	3.19	3.18-3.21
Often/Always	7.39	7.36-7.43	7.08	7.05-7.12
	SSBs Not Available in School Neighborhood (n=303)		SSBs Available in School Neighborhood (n=1191)	
	SSB Consumption		SSB Consumption	
	Adjusted OR	95% CI	Adjusted OR	95% CI
SSBs Availability at Home				
Never	Ref	Ref	Ref	Ref
Rarely/Sometimes	3.15	3.13-3.17	3.24	3.23-3.25
Often/Always	6.20	6.15-6.25	7.69	7.66-7.72

*SSB Availability in School Model adjusted for school neighborhood SSB availability, adolescent age, sex, race, BMI, parent marital status and housing insecurity.

**SSB Availability in School Neighborhood Model adjusted for school SSB availability, adolescent age, sex, race, BMI, parent marital status and housing insecurity.

Figure 2.1. Daily SSB consumption according to SSB availability at home, stratified by SSB availability in the school and local school neighborhood environment among US adolescents aged 12-17 years using weighted percentages in the FLASHE study, 2014.



**CHAPTER III:
PARENTING PRACTICES ARE ASSOCIATED WITH HIGHER ADOLESCENT
SUGAR SWEETENED BEVERAGE CONSUMPTION**

ABSTRACT

BACKGROUND: Two out of three adolescents in the United States consume sugar sweetened beverages (SSBs) daily and consume more than the recommended amount of added sugars. Parent behavior and their parenting practices can potentially play an important role in shaping their child's environment and dietary behaviors. This study examined the associations between adolescent and parent report of four SSB/junk food-related parenting practices and adolescent SSB consumption and evaluated whether parent SSB consumption behaviors modified these associations.

METHODS: This study was a cross sectional analysis of 1,522 adolescents (12-17 years) and their parents in the Family Life, Activity, Sun, Health and Eating study. Path analysis examined the associations of parent and adolescent perceptions of four SSB/junk food-related parenting practices (emotional regulation, parent purchasing behavior, shared decision-making, and restriction) and adolescent SSB consumption. In a second path analysis, models were stratified by parent SSB consumption to examine effect modification.

RESULTS: Higher parent SSB consumption was associated with higher adolescent SSB consumption in each model. Emotional regulation, parent purchases, and restriction were associated with higher adolescent SSB consumption. Parent SSB consumption moderated the association (non-daily consumers; daily consumers): Emotional regulation

($\beta=0.10, 95\%CI=0.02-0.18$; $\beta=0.18, 95\%CI=0.10-0.27$); parent purchases ($\beta=0.16, 95\%CI=0.09-0.24$; $\beta=0.05, 95\%CI=-0.03-0.14$); restriction ($\beta=0.04, 95\%CI=-0.03-0.12$; $\beta=0.13, 95\%CI=0.05-0.21$).

CONCLUSION: Parenting practices that facilitate adolescent SSB consumption are associated with higher adolescent SSB consumption, but discussing/negotiating SSB behaviors is not associated with adolescent SSB consumption. Parental behavior and SSB/junk food-related parenting practices are important modifiable factors that may influence adolescent SSB consumption.

INTRODUCTION

One third of adolescents in the United States (U.S.) are overweight or obese.¹² Childhood obesity is a major public health problem and a top health concern among U.S. parents.¹²⁷ The intake of excess calories from added sugar has been associated with weight gain among youth.¹²⁸ Two out of three teenagers in the U.S. consume sugar sweetened beverages (SSBs) daily,¹²⁹ including sodas, fruit drinks, energy drink, sports drinks and other drinks with added sugars and no nutritional value.¹³⁰ Despite the declines seen in average SSB consumption among youth in recent years, adolescents still consume more SSBs than recommended, exceeding the recommended amount of added sugars in their diets.^{7,130} Reducing SSB consumption may decrease the prevalence of obesity and obesity-related conditions.¹¹

Parents impact adolescent dietary intake as they are the primary source of health related information for their children⁶⁸ and have influence over the home food

environment.⁶⁹ Parents can act as role models, set food rules, and control what foods are available in the home.^{69,71} Research exploring the association between availability of healthy and unhealthy dietary options in the home and adolescent consumption has found that the availability of sugary drinks or fruit and vegetables in the home is positively associated with adolescent consumption, respectively.^{71,116,131} The availability of SSBs in the home is associated with adolescent SSB consumption regardless of SSBs being available to adolescents in other settings like the school or local school neighborhood [manuscript under review]. Given that adolescence is a time of increasing autonomy,¹³² it is an important developmental period in which to address dietary behaviors for SSB consumption because the behavioral patterns established during adolescence track into adulthood.¹³³

Parents and their parenting practices also play a potentially important role in shaping their adolescent's environment and dietary behaviors.¹³⁴ Parenting practices can influence adolescent behaviors based on the parent's presence and involvement in the daily life and routines of their child. Parenting practices differ from parenting style and are defined as specific behaviors that parents use to socialize their children.⁷⁸ Recent attention has been drawn to food related parenting practices that consist of a wide range of behaviors parents use to influence their child's dietary intake.^{78,135} Although the majority of research has included samples of young children and/or has examined general parenting practices,¹³⁶ the two most common food related parenting practices studied among parents of adolescents are pressure to eat certain foods and restriction of certain foods.¹³⁷ These studies conducted among adolescents have been contradictory, with some studies finding

these controlling parenting practices to be associated with higher weight status and greater SSB consumption^{81,138,139} while another study has found restrictive parenting practices to be associated with healthier diets and less soft drink consumption.¹⁴⁰ There is a gap in understanding an array of SSB food related parenting practices among adolescents. The present study will add to the literature of food related parenting practices and SSB consumption among adolescents by examining multiple food related parenting practices specifically for SSBs around availability, rules, monitoring and negotiation.¹⁴¹

Additionally, existing research on parenting practices and dietary behaviors has been largely unidirectional focusing on parent reports.⁸³ Little is known about how adolescents perceive parenting practices and how those perceptions may influence SSB consumption behaviors. Investigating parent and adolescent report of parenting practices may help to understand the complex relationship between parenting and adolescent dietary behaviors such as SSB consumption. As adolescents become more independent, the impact of parenting practices may diminish or parent perceptions may become less congruent with adolescent perceptions and thus not be a good indicator. It is important to understand how adolescents interpret and respond to parenting practices around SSBs as well as how parents perceive they are engaging in these parenting practices to inform the development of effective interventions targeting parent food related practices for adolescents.

In addition, it is unknown whether parenting practices matter if parents are not modeling the desired SSB behaviors. Parent dietary intake is associated with adolescent consumption.⁶⁹ Understanding the impact of parental and adolescent perceptions of parenting practices in families where parents consume SSBs more or less frequently will

add a new dimension in examining potential effective targets for obesity prevention initiatives.

The aim of this study is to examine the associations between both adolescent and parent report of four different SSB/junk food-related parenting practices – emotional regulation, parent purchasing behavior, shared decision-making, and restriction – and adolescent SSB consumption. The study will further evaluate this association by stratifying by parent SSB consumption behaviors to examine whether the association between parenting practices and adolescent SSB consumption differs by parental intake of SSBs.

METHODS

We conducted a cross sectional analysis of the Family Life, Activity, Sun, Health and Eating (FLASHE) study. FLASHE is an Internet-based study sponsored by the National Cancer Institute that collected data from parent- adolescent dyads on lifestyle factors for cancer prevention, such as nutrition and activity behaviors. Complete details about the FLASHE study design and methodology have been published elsewhere.^{102,103} Briefly, the sample for FLASHE was selected from the 700,000 members of the Ipsos' Consumer Opinion Panel to match the US population on key demographics. Out of the 5,027 eligible parent- adolescent dyads, 1,945 dyads were enrolled in the study if the adolescent was 12-17 years old and the parent was the adolescent's legal guardian and lived with the adolescent at least 50% of the time. Parents provided consent online via email invitation and adolescents provided assent online via email invitation. In 2014, parent-adolescent dyads completed four online surveys; each member of the dyad completed two surveys.

MEASURES

Adolescent Sugar Sweetened Beverage Consumption - Five questions adapted from a validated dietary screener to capture participants' typical weekly SSB consumption behaviors assessed adolescent SSB consumption.¹⁴² The five questions asked how often during the past week the participant drank each of the following SSBs: sodas, sports drinks, energy drinks, fruit drinks, and juices. Responses about weekly SSB consumption (I did not drink any, 1-3 times in past 7 days, 4-6 times in past 7 days, 1 time per day, 2 times per day, 3+ times per day) were converted to daily drink consumption using the NCI dietary screener frequency conversion calculations.¹⁴² Daily SSB consumption of all five SSB drink categories were summed to create a continuous variable representing the average number of SSBs consumed by the adolescent per day.

Parent Sugar Sweetened Beverage Consumption – Parent weekly SSB consumption was assessed in the same way as adolescents' consumption.¹⁴² After converting to daily consumption, parent SSB consumption was categorized into a dichotomous variable: non-daily SSB consumption (<1 SSB consumed daily on average) or daily SSB consumption (>= 1 SSB consumed daily on average).

Adolescent Perception of Parenting Practices – Adolescent perception of parenting practices was assessed from survey items modified from the Comprehensive Feeding Practice Questionnaire, Parent Feeding Style Questionnaire and the Child Feeding Questionnaire through cognitive testing.^{135,143,144} Adolescents responded to statements regarding what their parents say and do when it comes to eating junk food or drinking sugary drinks. We defined the four different parenting practices captured in this study as:

(1) emotional regulation, (2) parent purchasing behavior, (3) shared decision making, and (4) restriction. Each question asked the adolescent how much they disagree or agree with statements regarding what parents say and do when it comes to their adolescent eating junk food or drinking sugary drinks. Emotional regulation was assessed by asking if their parents let them have junk food or sugary drinks to make the adolescent feel better when they are having a bad day. Parent purchasing behavior was assessed by asking if parents do not buy a lot of junk food or sugary drinks for their adolescent. This was reverse coded so that higher scores reflect buying junk food or sugary drinks. Shared decision-making was assessed from an item asking if the adolescent and their parent decide together how much junk food or sugary drinks the adolescent can have. Restriction was assessed from an item asking if their parent has to make sure the adolescent does not consume too much junk food or sugary drinks. The response for each question was answered on a scale from 1 (strongly disagree) to 5 (strongly agree).

Parent Perception of Parenting Practices – Parent perceptions of the four parenting practices were assessed from the same survey items as adolescent perceptions [^{135,143,144}], and variables were coded to be comparable to adolescent perception of parenting practices.

Potential confounders - Potential confounders included adolescent and parent demographic characteristics.¹⁴⁵ Adolescent demographics used in the analysis included adolescent sex, age (12-14, 15-17), race (Black, White, Hispanic, Other) and body mass index (BMI) determined from adolescent's self-reported height and weight and classified into categories based on CDC's BMI percentiles (underweight (<5%ile), normal weight ($\geq 5\%$ ile - < 85%ile), Overweight ($\geq 85\%$ ile - < 9 %ile), obese (≥ 95 %ile)). Parent

demographics included parent sex, and parent marital status (married/coupled, divorced/widowed/separated, never married).

ANALYSIS

Descriptive statistics were calculated to describe the demographics of the analytic sample. Path analysis techniques were used to examine the associations of perceptions of parenting practices and adolescent SSB consumption behaviors, adjusted for adolescent sex, adolescent age, adolescent race, adolescent weight status, parent sex, and parent marital status. Inclusion of these variables was determined a priori based on associations in previous literature.¹⁴⁵ We examined one path model for each of the four parenting practices. Path analysis is an extension of multiple regression where several regression relationships can be estimated simultaneously.¹⁴⁶ This method provides a way to examine both adolescent and parent perceptions of parenting practices on adolescent SSB consumption. We conducted two sets of path analysis. In the first path analysis, parent SSB consumption was included in the model. In the second path analysis, models were stratified by parent SSB consumption. Missing data were addressed by using full information maximum likelihood. Path models were evaluated in terms of how well the model fits the data in terms of the magnitude, direction, and significance of the estimated path coefficients as well as measures of overall fit.¹⁴⁷ Model comparative fit index (CFI) ≥ 0.90 , and root mean square error of approximation (RMSEA) ≤ 0.05 indicated good model fit.¹⁴⁷ Parent and adolescent agreement, both agreeing/strongly agreeing or both disagreeing/strongly disagreeing, was calculated for their perceptions on each parenting practice being implemented. Graphs were created using predicted values of adolescent SSB consumption

from the path analysis equations. The graphs examined associations between perceptions of parenting practices and adolescent SSB consumption at two categories of parent SSB consumption (daily consumers vs non-daily consumers). Data were analyzed using Stata 13.1 (Stata Corp, College Station, TX).

RESULTS

The final sample included 1,522 parent-adolescent dyads with complete information on main variables and covariates after excluding dyads missing dietary surveys (n=202), missing parenting surveys (n=30), and missing covariates (n=94). The majority of the adolescents in the sample were normal weight (68.0%), white (63.7%) and had married parents (77.6%). Adolescents with parents who do not consume SSBs daily were more likely to be white (70.0% vs. 57.0%), have female parent respondents (81.0% vs. 66.9%) and have married parents (81.1% vs. 73.9%) compared to adolescents with parents who consume SSBs daily (Table 3.1). Adolescent age, sex, and weight status did not differ by parent SSB consumption. Parent and adolescent perceptions of the four parenting practice variables were positively correlated (range: 0.43-0.56). Agreement between parent and adolescent perceptions of parenting practices were greater than 50%: emotional regulation (67%), parent purchases (60%), shared decision making (55%), restriction (59%).

All four path models examining the associations of perceptions of the four food related parenting practices and adolescent SSB consumption behaviors demonstrated good model fit and were just identified models (emotional regulation CFI=1.00, RMSEA =0.00; parent purchases CFI=1.00, RMSEA =0.00; restriction CFI=1.00, RMSEA =0.00; shared

decision making CFI=1.00, RMSEA =0.00). The emotional regulation path model demonstrated that both adolescent ($\beta= 0.14$, 95%CI= 0.08-0.20) and parent ($\beta=0.06$, 95%CI= 0.008-0.12) perceptions of allowing the adolescent to consume junk food/SSBs to make them feel better was positively associated with adolescent SSB consumption behaviors (Figure 3.1). The parent purchases path model found that only parent perception of buying a lot of junk food/SSBs for their adolescent was positively associated with adolescent SSB consumption ($\beta=0.09$, 95%CI=0.04-0.14; Figure 3.1). The restriction path model found that only adolescent perception of their parent making sure they don't consume too much junk food/SSNs was associated with adolescent SSB consumption ($\beta=0.09$, 95%CI=0.03-0.14; Figure 3.1). There was no association found in the shared decision-making model between adolescent or parent perception of deciding together how much junk food/SSBs the adolescent can have and adolescent SSB consumption behaviors (Figure 3.1). Parent SSB consumption was associated with adolescent SSB consumption in all four path models ($\beta= 0.23-0.25$, $p<0.001$; Figure 3.1).

48.1% of adolescents had parents who reported consuming 1+ SSB daily and these adolescents consumed an average of 2.26 SSBs daily. 51.9% of adolescents had parents who reported consuming <1 SSB daily and these adolescents consumed an average of 1.35 SSBs daily. Adolescents whose parents consume SSBs daily had greater predicted daily SSB consumption than adolescents whose parents do not consume SSBs daily (Figure 3.2). For further analysis, all four path models examining the associations of perceptions of the four SSB/junk food-related parenting practices and adolescent SSB consumption behaviors were stratified by parent SSB consumption. Among adolescent whose parents did not

consume SSBs daily, adolescent perceptions of emotional regulation were positively associated with adolescent SSB consumption ($\beta=0.10$, 95%CI=0.02-0.18; Table 3.2) and parent perceptions of parent purchases were positively associated with adolescent SSB consumption ($\beta=0.16$, 95%CI=0.09-0.24; Table 3.2). Among adolescents whose parents consume SSBs daily, adolescent perceptions of emotional regulation were positively associated with adolescent SSB consumption ($\beta=0.18$, 95%CI=0.10-0.27; Table 3.2) and adolescent perceptions of restriction were positively associated with adolescent SSB consumption ($\beta=0.13$, 95%CI=0.05-0.21; Table 3.2).

DISCUSSION

This study found that adolescents whose parents consumed SSBs daily had higher daily SSB consumption than adolescents whose parents did not consume SSBs daily. This study also found that specific parenting practices, namely emotional regulation, parent purchases, and restriction – are associated with higher adolescent SSB consumption. Neither adolescent nor parent perceptions of discussing/negotiating SSB behaviors together via shared decision-making was associated with adolescent SSB consumption. Together, these results emphasize the importance of not only parenting practices, but also parental behavior (i.e., modeling), in shaping adolescent SSB consumption.

We observed that parent SSB consumption was the largest driver of adolescent SSB consumption. This finding is consistent with other studies of parents influencing dietary intake from modeling their healthful or unhealthful food/beverage choices, and indicates that parental modeling is an important aspect of adolescent dietary behaviors.^{71,99,136} This

shows there is a need for future research to continue to include parental modeling behaviors in current intervention efforts to improve adolescent dietary patterns.

In this study, we investigated both parent and adolescent perceptions of SSB/junk food parenting practices in recognition of adolescents' growing autonomy and increased independence in which the impact of parenting practices may diminish or may become less congruent with parent perceptions. Specifically, it is important to consider if the message parents are trying to send via parenting practices are being received by their adolescent. In this study, agreement between parent and adolescent perceptions of the parenting practice was greater than 50% for all four practices (67% emotional regulation; 60% parent purchases; 55% shared decision making; 59% restriction).

Emotional regulation defined in this study is a practice in which parents use SSBs/junk food for mood enhancement; that is to cheer up an adolescent when they are having a bad day. We observed that adolescent (not parent) perceptions that their parents use SSBs/junk food to cheer them up was associated with adolescent SSB consumption, regardless of the SSB behaviors the parent models. This parenting practice of using SSBs/junk food to boost their child's mood is consistent with studies that examined the influence of food as a reward on unhealthy eating.¹⁴¹ When unhealthy items like SSBs are used as a reward this may increase a preference for the item. As adolescence is a period in adolescents' lives when emotional ups and downs occur, this parenting practice could reinforce bad moods if they think they can get SSBs/junk food out of it or can set them up to become accustomed to using SSBs/junk food to help them during life's hard moments. Parental use of unhealthy dietary items like SSBs to produce a boost in the adolescent's

mood when they are down may create an association for the adolescent between emotions and SSBs.^{70,136,141} Although, due to parents' perception not being significant it may be because they are not fully aware that they are practicing this behavior. Parents can help support their child through means that do not include food or SSBs, for example with material or activity rewards⁷⁰ or a discussion to understand the reasons for why the adolescent is feeling down.

Parents are often the main providers of foods/beverages for the home and this study found that when parents are buying a lot of SSB/junk food for their adolescent, their adolescents drink more SSBs. Previous studies provide evidence that availability of foods/drinks in the home is an important factor and influences dietary intake¹³⁶ and youth SSB intake^{99,77,80} and parental purchasing behavior contributes to availability and accessibility of SSBs in the home and subsequently on adolescents' SSB consumption. Interestingly, the relationship between parental purchasing behavior and adolescent SSB consumption was only observed, in this study, for the parents' perception of their purchases and not the adolescents' perception of their parents' purchases. For parents, recognition of who the drinks are being bought for and who is actually drinking the SSBs is important when making purchases for the home. In addition to modifying parent purchasing behaviors, communication about purchases may be one approach to reduce adolescent SSB consumption.

We also observed an association between perceptions of parental regulations for SSB/junk food and adolescent SSB consumption. This was observed only for adolescent perceptions of parental regulations, not parent perceptions. This finding suggests that how

adolescents interpret SSB limits set by their parents is impactful. In addition, this finding was observed only in the model restricted to parents who consume one or more SSB per day. This suggests that despite the strong association between parent and adolescent SSB consumption behaviors, parents who are regular SSB consumers who can instill regulations around SSB consumption that are clearly articulated and understood by the adolescent can limit their child's SSB consumption. Previous findings on the role of restrictive parenting practices for SSBs and youth consumption have been mixed, with some studies finding that restrictive parenting practices were associated with greater consumption of SSBs^{81,138,139} and another finding them to be associated with lower SSB consumption.¹⁴⁰ Given that adolescence is a time where established dietary behaviors can track into adulthood,⁹⁸ finding the balance of limiting unhealthy dietary items and fostering self-regulation is an important undertaking for parents.

We assessed the parenting practice of shared decision-making under the potential premise that allowing a discussion between parents and their adolescent about the amount or type of food/drink they should consume supports autonomy.¹⁴¹ However, this study found that negotiating or deciding together about rules around SSB/junk food consumption did not impact how much SSBs the adolescent consumed. In future studies this relationship could be explored further to understand what limits or rules were set and if adolescents followed did follow what was agreed upon. It may be that those who consume more SSBs had negotiated higher SSB limits or those who consume few SSBs may not need to negotiate limits because their current consumption is considered okay by their parents. In the current study, we do not have data on who (parent or adolescent) decide on how much

junk food or sugary drinks the adolescent can have in cases where the adolescent and/or parent reported that this decision-making was not shared. It may be that the lack of observed association with adolescent SSB consumption in this study can be explained by lower SSB consumption among adolescents whose parents limit SSB/junk food intake without involving the adolescent in this decision-making.

There are limitations of the current study that should be considered. The FLASHE study was a cross sectional survey and thus causality of the study results cannot be determined. The study sample was selected via convenience sampling of the Ipsos Consumer Opinion Panel, resulting in a sample that is predominately composed of adolescents with parents that are white, educated, and married. Although the sample was national, the sociodemographics of the sample limits the generalizability of results. Future studies should include samples with greater racial/ethnic and socioeconomic diversity as most research on parenting has been conducted among white European-American, middle-class populations. Studies examining the cultural context of parenting in the US found that parents of different racial/ethnic identities have different parenting practices.¹⁴⁸ The FLASHE study collected all data via self-report from adolescents and their parents, and thus recall bias or social desirability bias may impact responses. The items assessing parenting practices asked about SSBs/junk food and thus reported parenting practices may represent practices around foods other than or in addition to SSBs. This should be considered when interpreting the findings of the study and future studies can tease out these items to further understand parenting practices specifically about SSBs.

In conclusion, this study identified potential targets for addressing adolescent SSB consumption through parenting practices. Though adolescence is a period of growing autonomy,¹³² parents still play a critical role in their children's SSB consumption via parental modeling of SSB consumption and SSB/junk food-related parenting practices. These both are important modifiable factors in the adolescents' sociocultural home environment that should be targeted in future dietary interventions to influence adolescent SSB consumption.

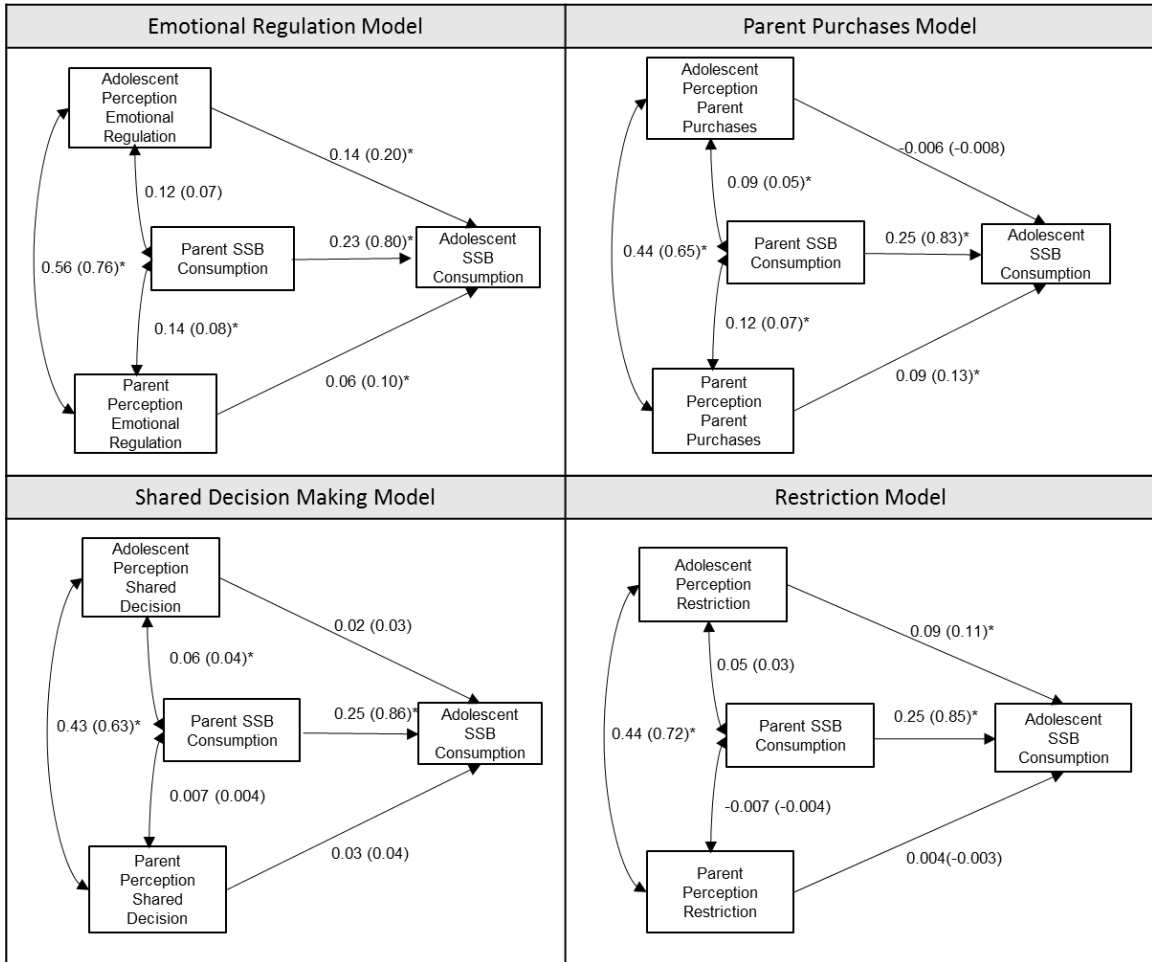
Take Home Points for Clinicians to Share with Parents:

- **Adolescents whose parents consumed SSBs daily had higher daily SSB consumption than adolescents whose parents did not consume SSBs daily.**
- **Parents that are unable to change their SSB consumption can still have an impact on adolescent SSB consumption through parenting practices.**
- **Parents may unknowingly give SSBs to their adolescent to help them get through a bad day but adolescents may pick up on this reward. Parents can use other ways to help their adolescent on a bad day, like taking a walk or talking about their day.**
- **Parents are often the main providers of foods/beverages for the home and adolescents whose parents are buying a lot of SSBs/junk food for their adolescent had higher daily SSB consumption than adolescents whose parents are not buying SSBs/junk food.**
- **Parents who are regular SSB consumers can limit their adolescents SSB consumption by instilling regulations around SSB consumption that are clearly articulated and understood by the adolescent.**

Table 3.1. Characteristics of adolescents 12-17 years old and their Parents (n=1,522) in the FLASHE study, 2014.

	Total (N=1,522)	Adolescents with parents who consume <1 SSB per day (N=790)	Adolescents with parents who consume ≥1 SSB per day (N=732)
Adolescent Age (years)			
12-14	773 (50.8)	408 (51.7)	365 (49.9)
15-17	749 (49.2)	382 (48.3)	367 (50.1)
Adolescent Sex			
Female	765 (50.3)	409 (51.8)	356 (48.6)
Male	757 (49.7)	381 (48.2)	376 (51.4)
Adolescent Race/Ethnicity			
White	970 (63.7)	553 (70.0)	417 (57.0)
Black	255 (16.8)	94 (11.9)	161 (22.0)
Hispanic	149 (9.8)	66 (8.3)	83 (11.3)
Other race/ethnicity	148 (9.7)	77 (9.8)	71 (9.7)
Adolescent Weight Status			
Underweight (<5)	65 (4.3)	34 (4.3)	31 (4.2)
Normal (≥5 - < 85)	1035 (68.0)	536 (67.9)	499 (68.2)
Overweight (≥ 85 - < 95)	232 (15.2)	123 (15.6)	109 (14.9)
Obese (≥ 95)	190 (12.5)	97 (12.3)	93 (12.7)
Parent Sex			
Female	1130 (74.2)	640 (81.0)	490 (66.9)
Male	392 (25.8)	150 (19.0)	242 (33.1)
Parent Marital Status			
Married/Coupled	1182 (77.6)	641 (81.1)	541 (73.9)
Divorced/Widow/Separated	190 (12.5)	93 (11.8)	97 (13.3)
Never Married	150 (9.9)	56 (7.1)	94 (12.8)

Figure 3.1. Path analysis model predicting adolescent daily SSB consumption from both adolescent and parent perceptions of four parenting practices and parent daily SSB consumption in the FLASHE study, 2014.



Standardized parameter estimates followed by unstandardized parameter estimates in parentheses

* parameter estimates were statistically significant (p ≤ 0.05)

Controlled for covariates: adolescent age, adolescent sex, adolescent race, parent sex, parent marital status

Table 3.2. Path analysis models predicting adolescent daily SSB consumption from both adolescent and parent perception of four parenting practices stratified by parent SSB consumption behaviors in the FLASHE study, 2014.

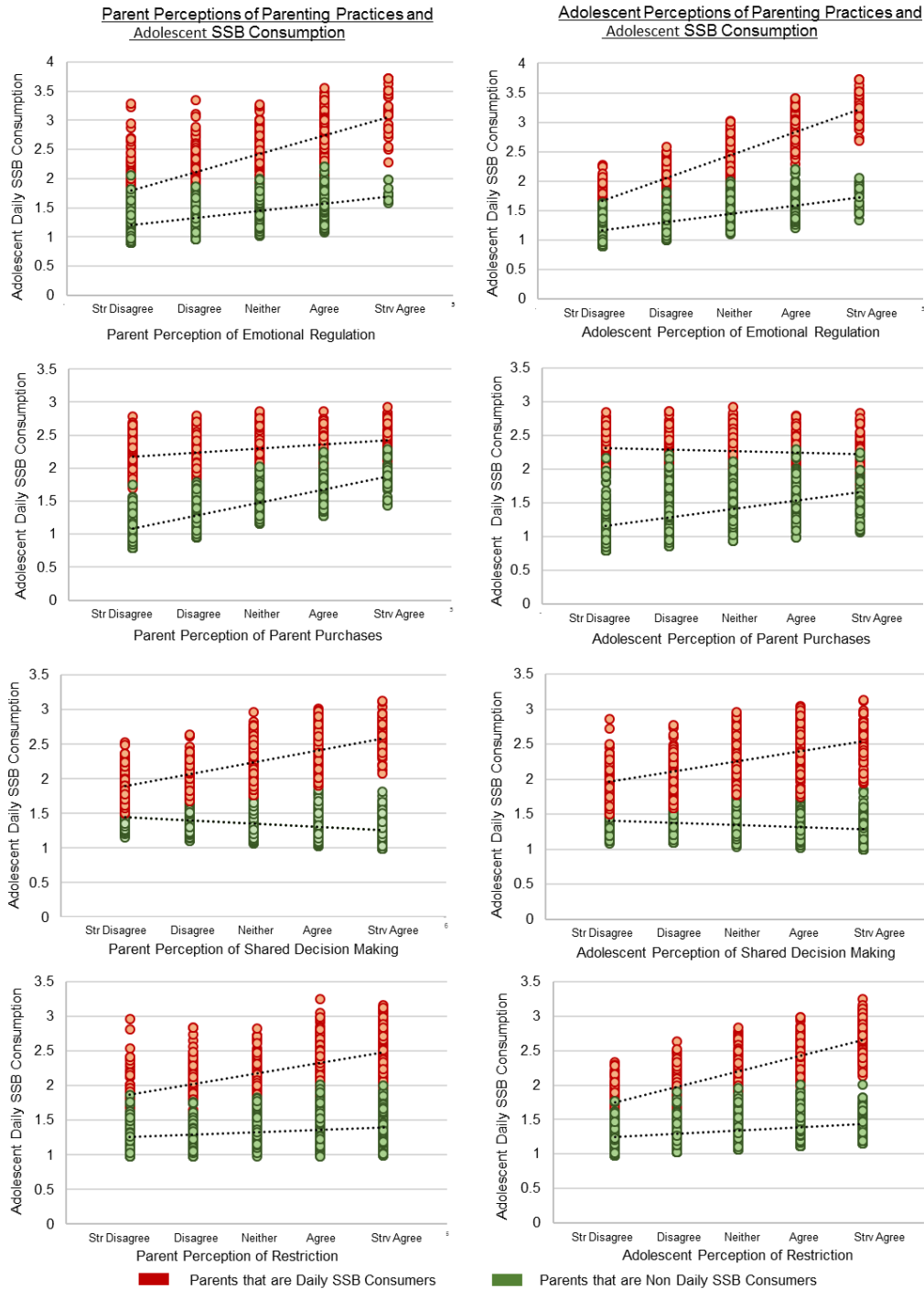
	Non Daily SSB (<1) Consuming Parents		Daily SSB (≥1) Consuming Parents	
	Standardized coefficients (unstandardized coefficients)	95% CI Standardized estimates	Standardized coefficients (unstandardized coefficients)	95% CI Standardized estimates
Emotional Regulation				
Adolescent Perception	0.10 (0.10)	0.02 – 0.18	0.18 (0.32)	0.10 – 0.27
Parent Perception	0.06 (0.07)	-0.02 – 0.13	0.07 (0.12)	-0.02 – 0.16
Parent Purchases				
Adolescent Perception	0.06 (0.06)	-0.01 – 0.13	-0.04(-0.06)	-0.12 – 0.4
Parent Perception	0.16 (0.16)	0.09 – 0.24	0.05 (0.09)	-0.03 – 0.14
Shared Decision Making				
Adolescent Perception	-0.03(-0.03)	-0.10 – 0.05	0.05(0.08)	-0.03 – 0.13
Parent Perception	-0.03(-0.03)	-0.11 – 0.04	0.08(0.14)	-.0001-0.16
Restriction				
Adolescent Perception	0.04(0.04)	-0.03 -0.12	0.13(0.20)	0.05-0.21
Parent Perception	-0.004(-0.003)	-0.08 – 0.07	0.05(0.08)	-0.03 – 0.13

Standardized parameter estimates followed by unstandardized parameter estimates in parentheses

Bolded parameter estimates were statistically significant ($p \leq 0.05$)

Controlled for covariates: adolescent age, adolescent sex, adolescent race, parent sex, parent marital status

Figure 3.2. Predicted adolescent daily SSB consumption predicted from adolescent and parent perceptions of parenting practices related to SSBs, stratified by parent SSB consumption in the FLASHE study, 2014.



**CHAPTER IV:
EXPLORING PERCEPTIONS OF SUGAR SWEETENED BEVERAGES
AMONG A DIVERSE SAMPLE OF ADOLESCENTS: A QUALITATIVE STUDY**

ABSTRACT

Background: Among adolescents, sugar sweetened beverages (SSBs) are the primary source of added dietary sugar and constitute 10-15% of total caloric intake. Multiple factors influence adolescent dietary behaviors and food choices. This study aimed to explore adolescents' attitudes and knowledge about SSBs, sources that influence SSB consumption and things that reinforce SSB consumption.

Methods: We conducted five focus groups with youth aged 12-14 years that attend one of the eight Youth Connect programs in Worcester, MA in 2016-2017. Groups were gender-specific to facilitate conversation of potentially sensitive issues of body image and health behaviors during adolescence. A semi-structured guide facilitated a discussion around SSBs. Audio-recorded data were transcribed and transcripts were double coded. The data were analyzed using content analysis.

Results: Discussions included 33 participants (16 boys and 17 girls). Participants were 12-14 years old, 27% identified as Hispanic, 24% black and 33% white. One third speaks more than one language at home and 63.6% consume SSBs daily. Qualitative analysis led to the identification of themes related to Attitudes, Knowledge, Reinforcements, and Sources of Influence. Despite being aware of SSBs and their health impacts, adolescents were not well informed about dietary recommendations around SSBs, they expressed independence

around their behaviors, strong feelings about drinking water, and were influenced by peers, celebrities via media sources, and adult SSB behaviors.

Conclusions: Adolescents' perceptions, knowledge, and actions around SSBs are multifactorial and complex. These findings can inform future public health messaging around obesogenic behaviors such as excess caloric intake from beverages.

INTRODUCTION

Sugar sweetened beverage (SSB) consumption among youth in the United States is a major public health problem, with national guidelines and recommendations having been set forth to reduce or prevent SSB consumption.^{6,7} Adolescents consume 10-15% of their total calories from SSBs,² more than the recommended amount of added sugars and SSBs, which are calorically dense drinks that lack nutritional value.⁶ Despite the recent national declines seen in SSB consumption rates, adolescents remain one of the highest consumers of SSBs⁴ and these rates are disproportionately higher among racial minority populations.¹⁴⁹ High consumption of SSBs is associated with weight gain and obesity,⁸⁻¹⁰ which is also more prevalent in racial minorities.¹² Furthermore, unhealthy dietary behaviors and weight status are risk factors for chronic disease, including certain cancers, diabetes, and cardiovascular disease.^{16,20} Reducing consumption of SSBs is not only a strategy for obesity prevention but for reducing racial disparities in obesity and associated chronic diseases.

Dietary behaviors and habits are believed to be shaped during childhood and adolescence.¹⁵⁰ The period of adolescence provides vital opportunities for prevention of

unhealthy behaviors, which often track into adulthood.¹³³ Adolescents experience increased independence and control over food choices, which often lead to an increase in consumption of energy-dense, nutrient-poor choices.⁸⁵ In order to reduce adolescents' SSB intake, it is important to understand the factors that influence choices from the adolescents' perspective.

A small body of research to date, primary observational studies, has identified a broad range of factors that influence adolescent dietary behaviors and their food choices. These include preferences, cravings, appeal, availability, convenience, cost, habits, and social influences.⁸⁶⁻⁹⁰ The majority of studies that qualitatively examined adolescents perspectives have focused on a single SSB, such as energy drinks or sport drinks,¹⁵¹⁻¹⁵³ or focused on the caffeine content in these SSBs and not perspectives around the sugar in these drinks.^{154,155} There is a lack of studies that have explored the adolescents' perspective around all SSBs qualitatively and none among a group of racially diverse adolescents in the United States. Thus, there remains a gap in understanding what specifically adolescents know about SSBs and reasons why they choose to drink different types of SSBs, particularly among diverse populations.

This study aims to fill these gaps by exploring adolescents' perceptions around SSBs. The study specifically sought to gain a better understanding of factors that influence adolescent SSB consumption, including their knowledge about SSBs, their attitudes about SSBs, things that reinforce behaviors for consuming SSBs, and sources that influence SSB consumption through messaging around SSBs. Better understanding of influential factors on adolescent SSB consumption may provide a basis for public health practitioners and

researchers to develop well-informed and effective interventions to reduce adolescent SSB intake.

METHODS

STUDY DESIGN

We conducted focus group discussions to investigate adolescents' perspectives on SSBs. Focus groups are a qualitative methodology that are used to collect data about beliefs, views, or perspectives on a specific topic through a semi-structured group interview process that is led by a group moderator.¹⁵⁶ Focus groups were conducted as they provide flexibility and the ability to explore attitudes and ascertain perspectives and experiences that questionnaires may not fully capture due to not asking the correct questions or unable to explore different points of view that provide a wealth of information. A priori, we planned to conduct a minimum of four focus groups (two with girls, two with boys). The University of Massachusetts Medical School Institutional Review Board approved this study.

SETTING

We recruited adolescents aged 12-14 years who attended one of the eight Youth Connect Worcester programs in Worcester, MA. Youth Connect Worcester is a coalition of community organizations that consists of local programs with a mission to provide neighborhood-based youth developmental opportunities to recreational, educational, and cultural activities to isolated and underserved Worcester youth. This local community-based agency currently serves 86% of middle school children in Worcester through at least one program: Boys & Girls Club, Friendly House Inc, Girls Inc., Worcester Youth Center,

YMCA, Y.O.U. Inc, and YWCA. The four groups were each held at different Youth Connect Worcester organizations.

PARTICIPANTS

Eligible participants were youth between the ages of 12-14 years old, English speaking, residents of Worcester, attended one of the eight Youth Connect Worcester programs and participant stated they were comfortable speaking and participating in the focus group discussions. Participants were recruited either in person at an information booth set up at one of the Youth Connect Worcester organizations or through posted flyers on information bulletins at the organizations. For those recruited at information booths, contact information of interested participants was collected, and each was given a study fact sheet and copies of the consent and assent forms to review at home with their parents/guardians. For those who responded to flyers posted at the organizations, the study was explained and a study fact sheet and consent and assent forms were emailed to the parent/guardian to review with interested participant. The parents/guardians of interested participants were contacted via telephone to further explain the study, assess eligibility, and schedule a focus group date. Written consent was obtained in person by the parent or legal guardian and then written assent was obtained in person by the participant prior to the start of the focus group discussion. A total of 33 youth (17 girls, 16 boys) participated in the focus group discussions.

DATA COLLECTION

Focus group discussions took place after school or on the weekends at Youth Connect organizations between November 2016 – September 2017. Focus groups were

stratified by gender to encourage participants to feel comfortable in sharing their thoughts and in light of potentially sensitive issues due to changes in body image and health behaviors during adolescence.^{157,158} Prior to the start of each session, participants completed an anonymous survey to collect demographic information and SSB intake behaviors. The same moderator (CH) conducted each focus group discussion using a semi-structured interview guide of open-ended questions allowing for flexibility in the discussion that emerged. The guide was developed by the researchers and aimed to understand adolescents' knowledge about SSBs (e.g., Has anyone ever heard of the phrase "sugar sweetened beverages"? How about "sugary drinks"? What comes to mind when you hear that?), attitudes around consuming SSBs (e.g., Tell me what you think about those sugary drinks/ sugar sweetened beverages? What do you think are some good things about these drinks? What do you think are some not so good things about these drinks?), things that reinforce behaviors for consuming SSBs (e.g., Why do you choose the drinks you just mentioned having on a normal day?), and sources that influence consumption through messages received about SSBs (e.g., Tell me about different people who you listen to when choosing what to drink. Where do you see, or get information from, when deciding what drinks to choose?). Core questions were followed up with prompts and probes for further information or clarity. All focus groups lasted approximately 45-60 minutes and were audio recorded. Participants received a \$20 gift card.

ANALYSIS

Audio-recordings were transcribed verbatim and reviewed to capture all conversations that occurred during the group discussion. Content analysis was conducted,

a conceptual framework was used to identify key constructs from the research questions that would be used to create initial coding categories.¹⁵⁹ The data were thoroughly examined to identify the repetitive topics that emerged under each key construct.¹⁵⁹ Through data immersion, additional codes were identified under each of the framework's key constructs. A final data codebook was created. Two researchers (CH, MS) independently coded the transcripts and discussed code discrepancies until consensus was reached. Inter-rater percent agreement of transcript coding was calculated (90.3%). Data were coded and managed using Atlas.ti software.¹⁶⁰ Gender differences were determined if a topic was mentioned in all of the focus groups of one gender and not mentioned in any of the focus groups from the other gender.

RESULTS

A total of five focus groups were conducted with 33 boys (n=16 in 3 groups) and girls (n=17 in 2 groups) (Table 4.1). Identified gender differences were noted under three of the four content areas: knowledge, SSB reinforcements, sources of influence.

KNOWLEDGE

In general, participants were knowledgeable about SSBs. They were able to define and identify "sugar sweetened beverages" or "sugary drinks" and state health risks associated with SSBs. All participants knew that sugar is bad for the body and mentioned numerous negative health impacts of consuming too much sugar, such as, making one fat or rotting teeth. Many participants also knew to utilize nutritional labels to identify which drinks were SSBs and which were not SSBs; however, no one expressed reading the labels

when making decisions on what to drink. There were also areas where participants had some misinformation about SSBs and lack of general nutritional knowledge.

First, the long-term health impact of sugar was not well articulated, very few participants mentioned how consuming too much sugar or SSBs can impact one's health later in life or chronic diseases one could develop as an adult. The health impact associated with sugar in all SSBs did not resonate with them the same way as health dangers associated with specific SSBs like energy drinks. The dangers about energy drinks the participants heard through online news stories, parents, or friends scared them and deterred them from consuming these specific drinks (Table 4.2).

Second, although the majority of participants knew about nutritional labels, health claims on the front of the drink label were found to be confusing to interpret and in identifying whether the drink was healthy, even though it contained sugar. Some claims on the labels about drinks having vitamins or containing natural ingredients had some participants question if that meant it was a healthy drink (Table 4.2).

Third, participants had little knowledge about the dietary recommendations for consuming sugar and SSBs. There were numerous opinions on how many SSBs is acceptable to drink on a given day, ranging from one a day, to drinking them every other day, to it depending on how much sugar was in each one. However, not a single participant said that you should never consume them. When asked how much sugar grams or total calories was too much to have in one drink, responses varied, but no one said that the best beverages to drink are those with zero calories or zero sugars. No participants were able to

correctly voice what is considered a lot of calories or how many calories one should be consuming in total on a given day (Table 4.2).

Fourth, it was an established view among all participants that water is healthy for you. Although, it was rarely mentioned as a favorite drink among participants and the majority of participants believed its main purpose was only for hydration (Table 4.2).

Gender differences in participant knowledge were observed when discussing the number of calories contained in various SSBs and concerns about water being sanitary. Among the boys, a handful in each focus group expressed that they were not concerned about the calories the drinks contained because they believed that any calories they consumed, they burned off from being active or being outside sweating in the hot summers. The girl focus groups did not discuss the concept of energy balance, or consuming and burning off calories. Throughout the discussions, girls expressed concerns over the cleanliness of water, majority believed water from a fountain or tap was not sanitary. Girl participants expressed that they only liked bottle water because they did not like the taste of water from other sources and had concerns of the water being clean or filtered. This concept did not emerge in the discussions conducted among boys.

ATTITUDES

Throughout the discussions, specific attitudes emerged about why participants chose to drink SSBs, with the two most common being the associations they have formed with SSBs and expressing independence/invincibility over their SSB choices. Participants mentioned consuming different drinks due to associations they have made with a specific

type of drink and a certain food, location, or mood. Participants associated certain foods with SSBs, such as pizza and soda. Seltzer water or “fizzy water” was mentioned in majority of the groups, in which there were mixed thoughts about liking it but a common viewpoint was that seltzer was a drink for adults and they liked it more than kids.

The concept of independence and/or invincibility regarding their drink choices was mentioned in each discussion (Table 4.2). The notion of invincibility that SSBs would not impact their health now was woven through participant comments during the group discussions. Participants felt they did not need to think about how much sugar they drink because they do not see it as currently affecting their day-to-day activities. They also expressed beliefs of independence, stating that it would be hard for teens to limit or stop drinking SSBs because they are going to continue to drink what they choose even if they hear otherwise.

SSB REINFORCEMENTS

Taste, visual appeal, and cost were consistently mentioned in each focus group as reasons why participants like and choose to drink SSBs. In general, participants liked the taste of SSBs, the colorful labels, and believed SSBs to be cheaper than healthier drinks such as water. When asked how much would be too much to spend on their favorite sugary drink, responses varied, but in general they liked to buy drinks that were \$1-2 and thought that \$4-5 was too much to spend. Additional factors that influenced their decisions was the popularity of certain drinks within their social environments. There were certain drinks mentioned in the discussions that participants stated as popular or trendy drinks at their school or amongst their social circles. Participants mentioned an excitement around a “fad”

drink that results in many people wanting to try the drink or be part of the conversation among their peers talking about the current popular drink. These “fad” drinks seem to be temporary until the next one comes along (Table 4.2). There were no consistent differences found in things that reinforced SSB consumption between genders.

SOURCES OF INFLUENCE

Participants reported that they received information that influence opinions or impact ideas they formulate about consuming SSBs from three main sources: peers, adults, and celebrities through media (Table 4.2). All participants mentioned that they notice SSB advertisements on TV, in stores, online and through social media or apps. Participants reported that the memorable commercials for adolescents are those that are funny or different. Those types of ads stand out and generate conversation about the commercial and the drink the commercial was promoting. There were a handful of popular mobile apps that participants identified using on their phones including Snapchat, Facebook, and YouTube. The majority of participants believed that if the image or promotion they see on these apps is sent from a person the adolescent likes then that might influence them to try that drink. In addition to ads, the actions of adults were noted as influential and confusing to adolescents. Majority of participants noticed when the behaviors of adults contradict the behaviors the adults expect the adolescents to engage in. Participants mentioned that adults attempt to restrict them from certain drinks because they are unhealthy but then the participants stated that they see those adults drinking the SSBs the adolescent was told not to drink.

Gender differences arose in how receptive participants were to advertisements. The majority of boys stated that if they see an ad they like then they were up for giving the drink a try to see if they liked it, while the girls were not as convinced by ads and did not express the same enthusiasm for trying the drink. However, the majority of girls stated that they would need people they know, like friends, claim the drink was good first before trying it, while boys would just try the drink.

DISCUSSION

Through five focus groups conducted among adolescents aged 12-14 in Worcester, MA we found areas where adolescents are misinformed about SSBs and identified areas that can be used to modify SSB consumption behavior under four factors of influence: knowledge, attitudes, reinforcements and influential sources. In this study, we found that adolescents are largely knowledgeable about identifying SSBs and their associated health impacts. However, adolescents were not well informed about dietary recommendations around SSBs and they held strong beliefs about the purpose of drinking water. We also found that adolescents have strong preferences for SSBs over non-SBBs with taste being the primary reason SSBs are consumed, they expressed a notion of invincibility and independence that resists changing their SSB behaviors and they were influenced by various sources including peers, adults, and celebrities through the media.

A consistent finding across all focus groups in this study was adolescents are well informed about some aspects of SSBS, specifically what they are and that they are unhealthy drink choices. They were able to accurately identify and define SSBs and utilized

nutritional labels to determine if the drinks contained sugar. However, areas to improve adolescent knowledge arose from these discussions.

Not a single adolescent knew the dietary guidelines about limiting consumption of added sugar or SSBs. National guidelines recommend that less than 10% of one's total daily calories should come from added sugars and that they should avoid consuming SSBs.⁷ Adolescents did not know the recommendations are to limit SSB consumption, or how many calories would be considered a lot for a single drink. In a study conducted among adults in the US, it found that less than one third of adults knew the national dietary recommendations and those who did know the recommendations consumed fewer SSBs per month than those who did not.¹⁶¹ This suggests that improving knowledge around dietary recommendations is needed and can help adolescents conceptualize what the calorie number in SSBs really means and potentially make them think about their drink choices.

In this study, the majority of participants discussed their beliefs that water was meant for hydration and not a preferred drink of choice. Girls, specifically, also stated their concerns about water not being sanitary and that they did not like to drink tap water or water from a fountain. These negative perceptions of tap water and water fountains among youth are not uncommon. Among low income, Latino middle school students in California, the majority (59%) believed water fountains to be unclean.¹⁶² Another study among teens, found 20% disagreed that their tap water was safe, 40% disagreed that school water fountains were clean and safe, and that negative water fountain perceptions were associated with SSB intake among Hispanic youth.¹⁶³ Addressing these attitudes around water is important because research suggests that daily energy consumption can be substantially

reduced if children replace SSB with plain water and greater plain water intake has been associated with lower SSB intake among youth^{89,164,165}. Changing how tap water is delivered, via fountains with visible filters, at schools so adolescents are reassured it's clean may be an approach to promote SSB consumption. Pricing interventions also may be helpful in encouraging students to switch from SSBs to water as cost was also mentioned as a driver for purchasing SSBs over water.

Adolescents in this study stated they do not consume energy drinks because of the health dangers associated with them but the dangers of other SSBs did not resonate the same way. These findings suggest that many youth know about the health effects of SSBs but do not think the potential long term health effects of these drinks apply to them. Interventions that provide more compelling messages about health impacts of SSBs may deter some from drinking SSBs. In a study on sports drinks among adolescents, most of the respondents had some understanding of the detrimental effects on health, although the majority of them were drinking them regularly despite this knowledge.¹⁶⁶

Adolescence is a period of growing autonomy and independence³⁷ and in this study, the concept of adolescents wanting to express their independence through their drink choices emerged. When talking about what might change their minds about drinking SSBs, a common response was nothing. Adolescents, in this study, expressed they are going to make their own decisions and they will not stop drinking SSBs because they like them. These statements also tied into the sentiment of invincibility that participants expressed in terms of not thinking the negative health impacts of SSBs apply to them because they do

not currently experience any health issues. Identifying influential sources that adolescents listen to might be a way to facilitate positive healthy drink choices.

Adolescents receive information about SSBs from many different sources that can influence the beliefs they formulate around SSBs; including celebrity advertisements, peers, and adults. The information and messages they receive and interpret from these sources can affect their own behaviors.¹⁶⁷⁻¹⁶⁹ In this study, most participants stated their schools did not allow students to bring sodas but that they see their teachers drinking sodas. They also mentioned seeing their parents drink sodas even though they tell their children that sodas are bad for them and do not allow them to drink them at home. These conflicting messages may impact adolescents in constructing a set of beliefs and practices around SSB behaviors. Parental health behaviors are associated with adolescent behaviors and thus, helping adults model positive behaviors may help reduce their child's SSB consumption.⁶⁹

Another finding is the influence of popular drinks within their social circles, and seeing pictures on social media of different people they like drinking different SSBs. When adolescents hear about these fad drinks or popular images on social media, they want to try the drink to be part of the social conversation among their peers. The spread of behaviors through social networks is an important area to target in interventions among adolescents. Interventions can try to understand these social connections and change social norms or try to start a new conversation about non-SSBs to spread through these channels.

The main strength of this study is the in-depth information on diverse adolescents' perceptions and opinions around SSBs. The focus group design provides an opportunity to collect in depth exploration about adolescents' knowledge and attitudes. Study limitations

include that the data were collected from a single city in Massachusetts, which may hinder its generalizability to other populations, such as high income or suburban locations. However, this is also a strength because low-income youth have higher SSB consumption.¹² Additional limitations include the format of participant selection. Focus groups are self-selecting and thus those who chose not to participate may be different than those who choose to participate. Participants were not asked about their SSB consumption behaviors for inclusion in the study, thus may not be capturing responses from those that are highest SSB consumers. The group sizes varied from 4-9 participants that may influence the depth or variety of conversations generated within the groups. The moderator attempted to mitigate this by asking follow-up questions and encouraging everyone to share so one outspoken individual would not dominate a discussion.

In conclusion, adolescents identified a variety of perceptions in relation to their knowledge, attitudes, SSB reinforcements and influential sources. This study found that adolescent perceptions around SSBs are multi-dimensional and there is not a single factor in participants' perceptions about SSBs that can change consumption choices. Therefore, in order to change such a health behavior, addressing a wide range of factors is necessary. Potential modifiable determinants include having adults refrain from drinking SSBs in front of adolescents, providing filters on water fountains to increase its acceptability, changing the conversation about SSBs so non-SSBs sound appealing, increasing the cost of SSBs, and having dietary recommendations resonate with adolescents. These undertakings can be implemented by researchers, public health

advocates, school policies or health care professionals, to decrease SSB consumption and the subsequent risk of obesity among adolescents.

Table 4.1. Characteristics of qualitative focus group participants (5 groups, n=33) among adolescents in Worcester, MA.

	n	%
Sex		
Male	16	48
Female	17	52
Age		
12	12	36
13	14	43
14	7	21
Race/Ethnicity		
Non-Latino White	11	33
Non-Latino Black	8	24
Latino/Hispanic	9	27
Other	5	16
Language		
One Language (English)	22	67
Two Languages	11	33
Daily SSB Intake		
<1 SSB Daily	12	36
1-2 SSB Daily	8	24
>2 SSB Daily	13	40

Table 4.2. Themes and key quotes related to adolescents' knowledge, attitudes, and reinforcements for consuming sugar-sweetened beverages and influential sources on messaging around sugar-sweetened beverages from qualitative focus group discussions.

Themes Related to Adolescents Knowledge about SSBs	Representative Quotations
SSB Health Risks/ Impact	<p><i>"I think it slows down your cells in your head and when you go to class you're not as active as you are."</i> – Boy</p> <p><i>"If you have too much sugar, you get too much cholesterol, and too much cholesterol makes your lungs something... and then you have a heart attack"</i> – Boy</p> <p><i>"I don't drink those, they race your heart and people die from them. A teenager died from drinking too many energy drinks. I heard it on the radio on the way to school."</i> – Boy</p> <p><i>"I think my friend said, it's like scientifically proven that sugar doesn't like make you hyper."</i> – Girl</p> <p><i>"It's hard to digest so it makes it into fat"</i> – Girl</p>
Nutritional Information and Dietary Recommendations	<p><i>"Three per week, like have an even amount Monday, Wednesday, Friday and for the rest of the days have water."</i> – Boy</p> <p><i>"Calories... maybe like high 100's..."</i> – Girl</p> <p><i>"Yeah but if it says zero sugar, that means it has fake sugar"</i> – Girl</p> <p><i>"Sugar is unhealthy except if it's natural sugar"</i> – Boy</p> <p><i>"Sunny D is actually healthy; it has 100% vitamins. So y'all are wrong."</i> – Boy</p> <p><i>"It's fat free...it means it has less sugar."</i> – Girl</p>
Water is for Hydration and Cleanliness of Water	<p><i>"If I wanted to stay hydrated I would go with the water but if I wanted a good tasting drink I would go with the soda."</i> – Boy</p> <p><i>"I don't like water that much. I mean I'll drink it if I'm dehydrated and stuff."</i> – Girl</p> <p><i>"If I'm at someone's house and they give me tap water, I'll just leave it there and be like thanks. It's not personal towards them. I just can't drink water unless it's bottled and I open it myself and know it's filtered and everything."</i> – Girl</p> <p><i>"The water fountains at school, they're like dirty. The fountains are warm and they taste like metal too."</i> – Girl</p>
Themes Related to Adolescents Attitudes around Consuming SSBs	Representative Quotations
Drink Associations	<p><i>"Because our school has like two stores on the same street. I just get what I'm in the mood for like if I'm happy I get pineapple. If I need something to kinda pick me up I get cotton candy. (soda flavors)"</i> – Girl</p>

	<p><i>“We’re young and then when you grow up they tell you you need to control your sugar. When you’re younger you don’t think about it.”</i> – Boy</p>
Independence/Invincibility	<p><i>“No, I would never stop drinking the drinks I already drink because they’re addicting.” - Girl</i></p> <p><i>“Like teens you can’t stop them they’re gonna do what they want to do you know doesn’t matter.” – Girl</i></p> <p><i>“Some people say coffee stunts your growth and I don’t want that to happen. So some people say sugar does that but I’m tall and drink sugar so that doesn’t happen and isn’t true.”-Boy</i></p>
Themes Related to SSB Consumption Reinforcements among Adolescents	Representative Quotations
Taste	<p><i>“Because it’s kinda addicting, the taste. Yeah, you crave it and want more.” – Boy</i></p>
Cost	<p><i>“If like afterschool if we’re waiting for a bus to come here we all go to like the pizza place near our school or papa johns or corner store. When we go there they have the cheap drinks that I can get with my dollar.” – Girl</i></p> <p><i>“At school they were teaching us how healthier drinks are more expensive than junk foods and stuff like that.” – Boy</i></p>
Popularity of Drinks	<p><i>“Olde Time used to be really popular at our school too – it got so popular like kids always wanted it - like kids were like buying it and selling it (to each other) because they wanted it so badly.” - Girl</i></p>
Sources of Influence around SBS	Representative Quotations
Peers	<p><i>“Yeah and if they’re your friends, they’ll know ways to make you want something. If they say, oh yeah this drink is really good you should probably have it then you’re gonna.” – Girl</i></p>
Adults	<p><i>“My mom she was drinking coke and I’m like this is bad for you and she is like well it really tastes good. So yeah.” – Boy</i></p> <p><i>“The school says don’t drink soda but they are. My history teacher has one or two cokes a day. Yeah during class.” – Boy</i></p> <p><i>“My mom, she’s a nurse, and she says the house is a soda free zone but she brings soda home everyday, like my cousins bring soda like Pepsi and Coke and stuff over, and my mom says it’s a soda free zone but she drinks soda all the time” – Girl</i></p>
Celebrities in the Media	<p><i>“Like Gatorade and PowerAde like most people like most people who really like sports and see like famous athletes and all that drink it and they feel that it would make them as good as that person to if they were like to drink it.” - Boy</i></p>

“Well it depends on who’s doing it. Like if it’s a snap from someone you like then yes but not somebody you don’t like then no.”- Girl

“There’s this guy on youtube and if he said I drink this everyday then I’d probably want to try it.” – Boy

CHAPTER V: DISCUSSION AND CONCLUSIONS

Summary of Findings

The overall purpose of this dissertation was to use a multi-level approach to evaluate how adolescents, the home and the local environment influences adolescent SSB consumption. The socio-ecological model informed this dissertation by recognizing that there is not a single factor that influences behaviors but that health behaviors are influenced by multiple factors.⁴³ The primary goals of this dissertation were to: 1) examine the association of the availability of SSBs in different environments (home, school, school neighborhood) and adolescent SSB consumption; 2) examine perceptions of parenting practices related to SSBs/junk food and adolescent SSB consumption and whether parental SSB consumption moderated the association; 3) gain understanding of factors that influence adolescents' perceptions around SSBs through focus groups. To accomplish these aims, a secondary analysis of data from the Family Life, Activity, Sun, Health and Eating (FLASHE) study was conducted, as well as, a qualitative analysis using focus group discussions among youth in Worcester, MA.

The first aim of this dissertation found that, despite, the availability of SSBs in the school and school neighborhood environments, the home food environment remains an important determinant of adolescent SSB consumption and may be a key target for obesity prevention efforts. Due to the importance of the home environment, parents can play a critical role in reducing adolescent SSB consumption by limiting or cutting back on the availability of SSBs in the home.

The second aim of this dissertation found that specific parenting practices, namely emotional regulation, parent purchases, and restriction – are associated with higher adolescent SSB consumption. However, discussing/negotiating SSB behaviors is not associated with adolescent SSB consumption. Another finding was that adolescents whose parents consumed SSBs daily had higher daily SSB consumption than adolescents whose parents did not consume SSBs daily. This finding was consistent across all four parenting practices. These results emphasize the importance of not only parenting practices, but also parental behavior, in shaping adolescent SSB consumption.

The third aim of this dissertation found that adolescents aged 12-14 in Worcester, MA, are largely knowledgeable about identifying SSBs and their associated health impacts. They also have strong preferences for SSBs over non-SBBs with taste being the primary reason SSBs are consumed. However, adolescents in this study were not well informed about dietary recommendations around SSBs, they expressed this notion of invincibility and independence that resist changing their behaviors, they held strong feelings about the purpose of drinking water, and sources of influence included media, peers, and adults. These results identified areas adolescents are misinformed and can be used to modify behavior under four factors of influence: knowledge, attitudes, reinforcements and influential sources.

In summary, multiple factors influence adolescent SSB consumption and using the socio-ecological model, this dissertation identified specific influences in the local environment, household setting, intrapersonal factors, and individual perceptions that can be addressed to reduce adolescent SSB consumption.

Study Strengths and Limitations

The findings from this dissertation should be considered in light of the following limitations. The FLASHE study, used for the first two aims, was a cross sectional survey and thus causality of the study results cannot be determined. The study sample was selected via convenience sampling, resulting in a sample that is predominately composed of adolescents with parents that are white, educated, and married. Although the sample was national, the sociodemographics of the sample may limit the generalizability of the results as SSB consumption may differ among the adolescents not well represented in FLASHE. The FLASHE study also collected all data via self-report from adolescents and their parents, and thus recall bias or social desirability bias may impact responses. For the third qualitative aim, additional limitations should be considered when interpreting the findings of this dissertation. Focus groups are self-selecting and thus those who chose not to participate may be different than those who chose to participate. Participants were not asked about their SSB consumption behaviors for inclusion in the study, thus may not be capturing responses from those that are highest SSB consumers. The group sizes varied from 4-9 participants that may influence the depth or variety of conversations generated within the groups. Study strengths include using a nationally representative sample of adolescents and their parents. This survey allowed for innovative dyad analysis due to capturing perspectives of both parents and adolescents. The main strength of the qualitative aim of this study is the in-depth information on diverse adolescents' perceptions and opinions around SSBs. The focus group design provides an opportunity to collect a broad range of information that questionnaires do not capture.

Discussion and Future Research Directions

SSB consumption has increased by 300% in the past 20 years and is pervasive in US culture.^{1,2} Despite recent declines in national SSB consumption rates, adolescents continue to consume more SSBs than recommended with consumption estimated at 224 calories per day.^{1,2} High consumption of SSBs is associated with weight gain and obesity; furthermore, unhealthy dietary behaviors and weight status are risk factors for chronic disease.⁸⁻¹⁰ Numerous national recommendations for limiting consumption of calories from added sugars, specifically SSBs, have been set forth to support healthy dietary habits.⁷ Even with these efforts, there remains a need to understand multi-level risk factors that influence SSB consumption among adolescents for addressing the public health issue of obesity and related chronic disease. Reducing SSB consumption is a critical strategy to promote optimal health among adolescents. This study used the social ecological model to evaluate different levels of influence, including individual, inter-personal, home, school, and neighborhood environments.

The findings, from this study, highlight the important role parents play in supporting healthy dietary habits among their children. Adolescents may have access to SSBs in other environments, but the home environment remains a critical determinant of their SSB consumption behaviors. Future interventions around reducing adolescent SSB consumption need to include the parents. Parents are the main providers of foods and drinks in the home and the majority of one's daily calories are consumed at home.^{69,71} Supporting parents to help them create healthy home environments and promote positive dietary choices among their children are necessary. Not only is the availability of SSBs in the home

environment an important factor to consider but the sociocultural factors in the home are also important. Perceptions of parenting practices and parental modeling impact adolescent SSB consumption behaviors. Parent and adolescent communication can be challenging during the adolescence period⁸⁵ but is necessary so that both individuals understand the steps being taken to support healthy habits. Having clinicians talk to parents about their role in limiting adolescents SSB consumption is a potential strategy to help facilitate the conversation with their adolescent. The adolescent perspective is also critical to understand the dietary choices they make and to identify ways to modify those choices to promote healthy behaviors. The focus groups conducted in this study highlighted areas of misinformation or influences that could be targeted to modify perceptions or behaviors. Interventions that include an emphasis on social norms as well as education on key dietary knowledge like dietary recommendations and health impacts may be influential in reducing SSB consumption among adolescents. In addition, strategies to improve the perceptions around water are needed in order to promote and alternate drink when reducing consumption of sugary drinks.

Overall, there are multiple future directions for this research. Addressing multi-level risk factors that influence SSB consumption among adolescents is critical for reducing SSB consumption and, therefore, addressing the public health issue of obesity and obesity related disease. Next steps can include intervening at multiple levels across the socio-ecological model, such as, advancing understanding of how to intervene in adolescent dietary health in the clinical setting or inform AAP policy statements about SSB consumption behaviors and food environments. Additional steps include future

interventions that target aspects of the home's physical environment and parental interactions within the home environment. Furthermore, steps to modify perceptions around SSBs can be taken to reduce current SSB consumption behaviors. All together, this study provides insight into multiple future directions that can be pursued to reduce adolescent SSB consumption and improve adolescent dietary behaviors.

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