Improving rural health disparities: Understanding and addressing intake of added sugars and sugar-sweetened beverages among adults and adolescents

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

In

Human Nutrition, Foods and Exercise

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March 22nd, 2019
Blacksburg, VA

Keywords: Rural health disparities, sugar-sweetened beverages, added sugars, adolescents, caregivers
Improving rural health disparities: Understanding and addressing intake of added sugars and sugar-sweetened beverages among adults and adolescents

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ABSTRACT

Around 46.2 million Americans living in rural areas are disproportionately burdened by health disparities. Likewise, obesity and obesity-associated diseases (e.g., diabetes, cardiovascular disease) are much higher for rural residents when compared to their urban counterparts. There is a high need to understand and address the nutritional determinants of these health inequities among adults and adolescents. One area of concern in rural dietary habits pertains to added sugars and more specifically, sugar-sweetened beverages (SSB).

Excessive added sugars and SSB intake have been strongly linked to many of the nutrition and chronic disease disparities impacting rural residents. Moreover, studies conducted in rural populations have found high consumptions of these in both adults and adolescents. There is an opportunity to better understand added sugars and SSB patterns in rural populations to inform the development of culturally relevant, multi-level interventions that address high consumption.

Study #1 is a cross-sectional study that explores top food and beverage sources of added sugars in the diet of adults (n = 301) living in rural areas of Southwest Virginia. Study #2 uses a nationally representative sample of adolescents (n = 1,560) from the Family Life, Activity, Sun, Health and Eating (FLASHE) study sponsored by the National Cancer Institute, to explore factors across the levels of the socioecological model associated with adolescent SSB intake. Study #3 utilizes focus groups and a pilot trial to understand language preferences, acceptability and use of SMS aimed at
caregivers to reduce SSB intake in both caregivers and adolescents living in rural areas of Southwest Virginia (n = 33). Collectively, these three studies offer recommendations and culturally relevant strategies for future large-scale trials aimed at reducing SSB intake among adolescents and caregivers in rural communities and ultimately reducing rural health disparities.
Improving rural health disparities: Understanding and addressing intake of added sugars and sugar-sweetened beverages among adults and adolescents

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GENERAL AUDIENCE ABSTRACT

Rural populations in the United States are at higher risk for being diagnosed with and dying from preventable and obesity-associated diseases like heart disease and cancer. Excessive added sugars and sugary drink (i.e. sodas, sweet tea/coffee, energy drinks, sweetened fruit drinks, sports drinks) intake have been strongly linked to many of the chronic diseases afflicting rural residents. Moreover, studies conducted in rural populations have found high consumptions of these, in both adults and adolescents. There is a great need to better understand added sugars and sugary drink patterns in rural populations so that we can develop programs to reduce consumption that are also culturally well received. Study #1 in this dissertation explores top food and beverage sources of added sugars in the diet of 301 adults living in rural areas of Southwest Virginia. Study #2 uses a nationally representative sample of 1,560 adolescents to explain why adolescent SSB intake might be higher. Study #3 aims to understand language preferences, acceptability and use of a text message program to reduce sugary drink intake in both caregivers and adolescents living in rural areas of Southwest Virginia. Collectively, these three studies offer recommendations and culturally relevant strategies for future large scale trials aimed at reducing sugary drink intake among adolescents and caregivers in rural communities and ultimately improving rural health.
ACKNOWLEDGEMENTS

All the efforts that went into this dissertation could not have been possible without the advice, support, and encouragement of many people (and animal, I didn’t forget you Chloe!) listed below. If you are mentioned here, you are now required to read this entire dissertation (fine, just reading the abstracts will do).

To my advisor, Dr. Zoellner: Thank you for taking a chance on me, that random girl that decided to show up to your community advisory board meeting in Danville, Virginia. I am so grateful for the opportunities you have provided me to be involved in such high-quality research. I have learned so much from you, not only about community-based research but also how to be a great advisor. You have challenged me to think and write more critically and helped me realize where my passions lie within this field. As I continue to advance in my career, your efforts to ensure my success here will never be forgotten.

To my dissertation committee members Dr. Valisa Hedrick, Dr. Samantha Harden, and Dr. Madlyn Frisard: Thank you for providing valuable advice that helped guide my research in the right direction and for always being there when I needed. I know I have emailed some of you too many times (*cough* Dr. Hedrick), thank you for putting up with my questions!

To my lab partners and friends, Dr. Kathleen Porter, Donna Brock, Dr. Natalie Kruzliakova, Katie Perzynski, Erin Hecht, Annie Loyd, and Brittany McCormick: I am so glad that I have met all of you through this experience. I have learned so much from each and every one of you. I would not have made it this far without your contributions and encouragement, none of the projects in this dissertation would have been possible.

To my parents: Abbu and Ammi, I owe all my successes to you. There will never be enough words to express my gratitude. You both have sacrificed so much to provide me with the opportunities and environment to get the best education, even though it was hard for you to let your daughter go far away. Thank you for supporting my dreams and ambitions, both emotionally and financially. I hope I have made you proud.

To my brothers and sisters, Aamir, Nabiha, Shireen, Shahbaaz, Younus, and Taha: You guys are my biggest cheerleaders. Even though we live far away from each other, you all have always been there for me, through thick and thin. Thank for listening to me talk about my research all the time, all the face-time calls, and all the trips out to visit me. I am so lucky to have you guys in my corner.

To my beautiful nieces and nephew, Laila, Zahra and Qasim: I can always count on your stories and smiles to brighten my day, no matter how stressful.
To my loving grandparents, both alive and those that have passed: I can feel your guidance and unceasing prayers for my success in everything that I do, and for that I am so grateful.

To my kitty-love, Chloe: You were the only one who stayed up with me late nights, cuddled up next to me on the couch as I wrote this dissertation. Thank you for your soft fur, purrs, and comfort during this whole process.

To my husband, Jonathan: My love, I cannot thank you enough. Jon, you have done everything to make sure this dissertation and my PhD degree became a reality. From the very first moment I mentioned I wanted to do my PhD, you were my biggest supporter. From making sure that there is a hot dinner on the table every night to reviewing and providing thoughtful feedback on my writing, you have always been there. You have worked so hard and carried our little family on your back so that I can pursue my career. This dissertation and PhD degree is as much yours as it is mine.

And finally, to my baby girl, Nyla: My darling Nyla, you are and will always be my source of love and inspiration. At my lowest points during this degree, it was you over everyone else that got me through, and pushed me to keep going. And if you are older now and wondering: the answer is yes. You, and by genetic association, your future sibling(s) are also required to read mama’s dissertation.

I cannot wait to see what the future holds, bring it on!
Attributes

Manuscript 2:

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Dr. Jamie Zoellner is an associate professor in the Department of Public Health Sciences at the University of Virginia. She assisted in conceptualization of the study, data interpretation, and reviewed the manuscript content.
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS .................................................................................................................................................. iii

ATTRIBUTES........................................................................................................................................................................ v

TABLE OF CONTENTS .......................................................................................................................................................... vi

LIST OF TABLES ................................................................................................................................................................. viii

LIST OF FIGURES ............................................................................................................................................................... ix

CHAPTER 1: INTRODUCTION ................................................................................................................................................ 1
- Overview ............................................................................................................................................................................ 2
- Rural Health Disparities in the United States .................................................................................................................. 2
- Added Sugars: Health Risks, Recommendations, and Intake Statistics ......................................................................... 5
- Sugar-Sweetened Beverages: Health Risks, Recommendations, and Intake Statistics .............................................. 9
- Reducing Added Sugars and SSB Consumption to Improve Rural Health ................................................................. 11
- Implications of this Dissertation ....................................................................................................................................... 13
- Figure .................................................................................................................................................................................. 14
- References .......................................................................................................................................................................... 15

CHAPTER 2: MANUSCRIPT 1 Food and Beverage Sources of Added Sugars in the Diets of Rural Adults Residing in Southwest Virginia .................................................................................................................... 24
- Abstract ................................................................................................................................................................................ 25
- Introduction ....................................................................................................................................................................... 26
- Methodology ..................................................................................................................................................................... 28
- Results .................................................................................................................................................................................. 31
- Discussion .......................................................................................................................................................................... 33
- Tables .................................................................................................................................................................................. 38
- References .......................................................................................................................................................................... 42

CHAPTER 3: MANUSCRIPT 2 Using a socioecological approach to identify factors associated with adolescent sugar-sweetened beverage intake ......................................................................................... 48
- Abstract ................................................................................................................................................................................ 49
- Introduction ....................................................................................................................................................................... 51
- Methodology ..................................................................................................................................................................... 52
- Results .................................................................................................................................................................................. 56
- Discussion .......................................................................................................................................................................... 59
- Conclusions ........................................................................................................................................................................ 62
- Tables .................................................................................................................................................................................. 63
- References .......................................................................................................................................................................... 69

CHAPTER 4: MANUSCRIPT 3 Development and testing of mobile phone short message service (SMS) messages to reduce sugar-sweetened beverage intake in rural caregivers and adolescents: A mixed-methods study ......................................................................................... 73
- Abstract ................................................................................................................................................................................ 74
- Introduction ....................................................................................................................................................................... 76
Methodology .................................................................................................................. 78
Results ......................................................................................................................... 85
Discussion ................................................................................................................... 91
Tables and Figures ...................................................................................................... 97
References .................................................................................................................... 113

CHAPTER 5: GENERAL CONCLUSIONS ......................................................................... 119
Synthesizing the Data: Important Findings and Implications .................................. 120
Looking Ahead: Guidance for Future Research ......................................................... 123
Final Considerations .................................................................................................... 127
References .................................................................................................................... 128

APPENDICES ............................................................................................................... 132
Appendix A: Screening script and survey (Manuscript 3) ........................................... 133
Appendix B: Informed consent (Manuscript 3) ............................................................ 137
Appendix C: Focus group script (Manuscript 3) .......................................................... 140
Appendix D: Pre-post caregiver surveys (Manuscript 3) ............................................. 144
Appendix E: Full list of messages tested in focus groups (Manuscript 3) ............... 163
Appendix F: SMS intervention flow and logic diagram (Manuscript 3) .................... 168
Appendix G: Follow-up interview script (Manuscript 3) ............................................ 171
LIST OF TABLES

Table 2.1 Differences in added sugars and added sugars as a percentage of total energy by demographics (n=301)..................................................................................................................................................38

Table 2.2 Top sources of added sugars by food categories.........................................................39

Table 2.3 Top sources of added sugars by soda type.................................................................41

Table 3.1 Adolescent sugar-sweetened beverage (SSB) intake by demographics
(n=1,560)..................................................................................................................................................63

Table 3.2 Adolescent sugar-sweetened beverage (SSB) intake by intrapersonal, interpersonal and home environment factors (n=1,560).................................64

Table 3.3 Step-wise regression model to predict adolescent sugar-sweetened beverage (SSB) intake using factors across the socioecological model
(n=1,560)..................................................................................................................................................68

Table 4.1 Example educational and strategy messages used in testing phases..........97

Table 4.2 Primary themes from semi-structured focus group discussion with representative quotes .........................................................................................................................99

Table 4.3 SMS response rates and changes in consumption category and personalized strategy choices..................................................................................................................106

Table 4.4 SSB related behavior change from SMS assessment and pre-post survey (n = 29).................................................................................................................................107
LIST OF FIGURES

**Figure 1.1** Factors influencing adolescent sugar-sweetened beverage intake across the socioecological model.................................................................14

**Figure 4.1** Overall study design........................................................................109

**Figure 4.2** Flow diagram for SMS-based assessment........................................110

**Figure 4.3** Audience preferences for educational and personalized strategy messages..................................................................................................111

**Figure 4.4** Tone of voice preferences for educational and personalized strategy messages ................................................................................................112
Overview

The overall focus of this dissertation is to provide essential preliminary data to guide interventions for reducing added sugars and sugar-sweetened beverage (SSB) intake in rural populations that are contributing to health disparities disproportionately affecting this region. This dissertation takes the reader through exploring where added sugars intake is coming from, what factors might be associated with adolescent SSB intake, and lastly how SSB behaviors can be changed in caregiver and adolescents in rural Southwest Virginia. This chapter starts by providing some foundational information into the determinants and description of rural health disparities. Then it will look at how these disparities relate to the excessive intake of added sugars and SSB in rural areas. Additionally, this chapter will look at how using multi-level approaches can be utilized to tackle the issues of reducing SSB consumption.

Rural Health Disparities in the United States

Around 46.2 million Americans live in rural areas, making up 15% of the population and covering 72% of land in the United States (U.S.).\(^1\) The demographic composition of this area consists of mostly White (77.8%), followed by Hispanic (9.3%), Black (8.2%), Native American (1.9%), and Asian individuals (1.0%).\(^2\) Other notable population characteristics of this rural area include a lower median household income, lower number of adults with post-secondary education, and higher number of children in poverty.\(^3\)

Rural Americans disproportionately experience health disparities as compared to urban areas and the overall population. Studies have found that rural residents have higher mortality, higher rates of chronic diseases, poorer health behaviors, and overall poor health outcomes.\(^4-6\) These health inequalities are determined by a combination of what has been called the “triad of rural health disparities” which consists of cultural factors, poor economy, and geographical
The interwoven effects of these factors contribute to the poor access, availability and utilization of health treatment and preventative services leading to the poor health behavior and health status of rural inhabitants compared to their urban counterparts.\textsuperscript{7,8}

\textit{Determinants of Rural Health Status}

Culture, which includes religion and spirituality, plays a major role in the health of rural populations influencing health related perceptions and health seeking behaviors.\textsuperscript{7} For example, in one study, Doutith and colleagues found that rural residents felt shame reporting to their providers their health issues because they looked at them more as neighbors and friends.\textsuperscript{9} There is a high need in this area to design culturally appropriate interventions. Thus, any efforts to improve the health of rural areas must consider how that particular culture will hinder or promote health improvement.

When it comes to rural economy, unemployment status and poverty are higher than in urban areas, both that have been linked to health disparities.\textsuperscript{3,10} These issues combined with the uninsured status of rural citizens leads to reduced health care utilization for fear of high medical costs.\textsuperscript{4} Rural communities also lack resources that makes it difficult to implement health and wellness programs that have only been tested in urban settings.

The untouched landscapes found in these rural areas may unfortunately be contributing to poor health care access, reduced health care availability, and unhealthy environments. Poor infrastructure in these areas can make transportation to health services and physical activity an issue.\textsuperscript{11} Additionally, there are healthcare workforce shortages in the area leading to reduced health care availability and access to preventive services.\textsuperscript{11} The compounded effects of the “triad” worsens the health disparities in rural areas and must be taken into consideration when developing interventions.
Disparities in Health and Health Behaviors

The 2014 Rural-Urban Chartbook has documented many of the disparities affecting rural residents.\textsuperscript{4} Compared to urban settings, rural populations have higher overall mortality rates, associated with several chronic diseases. Additionally they are at greater risk of dying from the top five leading causes of death in the U.S., including cardiovascular disease, cancer, chronic obstructive pulmonary disease and stroke.\textsuperscript{4,6} O’Connor and colleagues used the Centers for Disease Control and Prevention’s (CDC’s) 2008 Behavioral Risk Factor Surveillance System (BRFSS) data, and found that the crude prevalence rate was 8.6% higher for diabetes and 38.8% higher for cardiovascular disease for rural residents compared to urban residents.\textsuperscript{6} Both of these chronic diseases have been strongly linked with obesity, which rural residents are also experiencing in disproportionately high rates. In a recent study by Lundeen and colleagues, it was found that compared to urban/metro areas, adult obesity rates were 19% higher in rural areas.\textsuperscript{5} Similarly, obesity rates were significantly higher in rural children ages 2-18 years.\textsuperscript{12} When looking at obesity rates in rural minorities, the disparities were even more pronounced in racial/ethnic minority populations for both adults and children.\textsuperscript{12,13}

These high rates of obesity and obesity-related diseases could partly be explained by the disparities in health behaviors predominantly related to nutrition and physical activity. For instance, physical inactivity has been found to be higher in rural areas.\textsuperscript{14} Casey and colleagues found that obese rural adults perceived that the communities they were living in were not supportive of physical activity because of the poor quality of sidewalks and safety issues due to traffic.\textsuperscript{15} In addition to physical activity, rural residents have poor diets that may contribute to their high rates of obesity and chronic diseases. Some studies have found that rural adults are less likely to consume fruits and veggies and rural children tend to eat more junk food for reasons
such as accessibility to retail food environments and the price perception of food.\textsuperscript{16-18} One area of concern in rural dietary habits pertains to added sugars and even more specifically, SSB. Studies conducted in rural populations have found high consumptions of both,\textsuperscript{19-21} though much more research is needed to understand rural dietary patterns specific to added sugars and SSB consumption.

**Added Sugars: Health Risks, Recommendations, and Intake Statistics**

*Associated Health Risks*

Added sugars are defined as any sugar in food that is added during the processing phase and are not naturally occurring. Therefore, sugars naturally found in fruits, vegetables, and dairy for example would not be considered added sugars.\textsuperscript{22} Added sugars can be found in a variety of foods such as baked goods, desserts, cold cereals, and SSB. These added sugars can come in many different forms including high fructose corn syrup, cane syrup/sugar, honey and maple syrup.\textsuperscript{22} These types of sugars have been become a public health nutrition priority due to the high amounts consumed and their relationship to disease.\textsuperscript{23}

Added sugars intake has been identified as a determinant of body weight status and obesity in both adults and children. A systematic review of meta-analyses of randomized control trials commissioned by the WHO found that body weight was significantly reduced (0.80 kg, 95\% confidence interval [CI] 0.39–1.21; \( P < 0.001 \)) with decreased added sugars intake. This analysis also found that where added sugars intake increased, weight also increased by 0.75 kg (95\% confidence interval [CI] 0.30–1.19; \( P = 0.001 \)).\textsuperscript{24}

Added sugars have also been linked to obesity-associated chronic diseases such as type 2 diabetes and cardiovascular disease. Yang and colleagues found that adults whose added sugars intake contributed to about 17\% to 21\% of total calories had a 38\% higher risk of cardiovascular
disease mortality.\textsuperscript{25} This risk was doubled when the percentage of total calories was greater than 21\% (compared to an intake of 8.0\% of total calories or less).\textsuperscript{25} The American Heart Association (AHA) has released a scientific statement around intake of added sugars in children and cardiovascular health. This statement concluded added sugars are strongly associated with increased risk for cardiovascular disease risk due to intermediary factors such as increased energy intake, increased adiposity and dyslipidemia.\textsuperscript{26} Through similar mediation effects of overweight and obesity, type 2 diabetes has also been associated with added sugars intake.\textsuperscript{27}

In addition to obesity and obesity-related chronic diseases, the WHO commissioned another systematic review to address the relationship between added sugars intake and dental caries in adults and children. This review found that the risk of dental caries was lower when energy from added sugars was restricted to under 10\%, however when energy was restricted to less than 5\%, there was significant dose-response relationship.\textsuperscript{28}

Finally, there have been several epidemiologic studies that have found increased added sugars intake is positively correlated with unhealthy diet patterns and higher total calorie intake.\textsuperscript{29} Yang and colleagues also found a relationship in the amount of added sugars consumed and the number of calories from the sugar/sweets/beverage group.\textsuperscript{25} Not only is there an association with increase in calories, but added sugars have been linked to nutritionally lacking diets due to the displacement of nutrients and nutrient-dense food in children’s diet.\textsuperscript{30}

\textit{Recommendations}

These health concerns have led several different organizations to put forth recommendations around added sugars, which vary slightly. The 2015-2020 Dietary Guidelines for Americans and the WHO both recommend limiting calories from added sugars to 10\% or less of daily intake, which accounts to about an average of 100 calories per day.\textsuperscript{23,31} The AHA calls
for limiting added sugars to half the allowable discretionary calories, translating to about 100
calories (6 teaspoons) from added sugars for women and children, and 150 calories (9 teaspoons)
of added sugars for men.\textsuperscript{26,32} The National Academy of Science, Engineering and Medicine
(formerly known as Institute of Medicine) are more liberal in their recommendations for the
Dietary Reference Intakes, suggesting to limit added sugars to less than 25\% of the energy
requirement.\textsuperscript{33} The United States Department of Agriculture’s consumer version of dietary
guidelines, MyPlate, also provides a statement to choose foods with less added sugars, although
no specific amount is stated.\textsuperscript{34}

\textit{National and Rural Intake Statistics}

Even with the recommendations and evidence on health risks, it is alarming that over
75\% of children and adults in the U.S. are still overconsuming added sugars according to all
guidelines.\textsuperscript{35} Although more improvements need to be made, there have been some positive
trends in national added sugars intake in the past few years.\textsuperscript{22} Powell and colleagues found that
intake of added sugars had slightly decreased then stabilized over the years 2003-2004 and 2009-
2010.\textsuperscript{36} In this study, children were higher consumers with 17\% of their calories coming from
added sugars, compared to adults who consumed 14\% from added sugars.\textsuperscript{36} Several studies have
looked at differences within different age groups for children and found that adolescents were the
highest consuming group.\textsuperscript{30,37} In a recent study by Rodriguez and colleagues, they found that
adolescents were consuming 94 grams of added sugars per day, which was roughly 17.9\% of
their mean energy intake.\textsuperscript{37}

Added sugars make up 11\% food calories and 38\% of beverage calories for children and
about 8\% of food calories and 37\% of beverage calories for adults.\textsuperscript{36} Several studies have
identified food sources that contribute to these high intakes of food and beverage calories.\textsuperscript{30,38,39}
SSB were unanimously the top contributor for beverage and total added sugars calories for adults and children, providing on average of 173 calories per day.\textsuperscript{39} Top contributors within solid foods varied by study partly due to the way food groups were divided, but in general included sweetened grain desserts, candy/sweets, cold cereals, and dairy desserts.\textsuperscript{30,38,39} Other contributors of beverage calories also varied depending on age and socioeconomic status.\textsuperscript{38} For example, Slining and colleagues found that flavored/sweetened milks were part of the top contributors in low income families. Furthermore, flavored/sweetened coffees and teas were in the top contributors to beverage choices for children in middle income families.\textsuperscript{38}

There has been no national level analysis to date that has explored total added sugars consumption in rural populations compared to urban populations. However, the few regional studies examining rural children’s diet are able to provide a glimpse into intake patterns.\textsuperscript{40,41} For example, in a study with rural Native American and White children living in Oklahoma, it was found that added sugars from soft drinks, candy, fruit drinks, and cakes/cookies accounted for almost 13\% of the children’s energy intake. These are higher than the recommended amounts.\textsuperscript{41} Increased added sugars intake has also been associated with lower educational status and family income, which are characteristics of rural populations.\textsuperscript{42} It has been hypothesized that areas of lower socioeconomic status, such as most rural regions, have increased consumption of energy dense foods like added sugars due to their cost-effective nature.\textsuperscript{43} One economic analysis of food costs found that added sugars provided calories at a much lower cost compared to healthier food options like lean meat, fish, fresh vegetables, or fruit. These are less expensive options due to their ease of production, processing, transportation, and storage.\textsuperscript{43} Understanding the amounts and sources of added sugars in rural diets can aid in providing effective nutrition education where dietary behaviors are specifically defined.
Sugar-Sweetened Beverages: Health Risks, Recommendations, and Intake Statistics

Associated Health Risks

Within added sugars, SSB are also a high priority in improving public health due to the high consumption rates that have been linked with many health conditions. SSB are defined as any beverage that contains sugar, either in natural form or syrup (such as high fructose corn syrup). These include soda, fruit drinks, sports drinks, and energy drinks. Although 100% fruit juices have similar amounts of sugar, they are not always be considered part of the SSB category due to the other vitamins and minerals they provide.

There is strong evidence in the form of meta-analyses and systematic reviews that link the high consumption of SSB to obesity, type 2 diabetes mellitus, and cardiovascular diseases. In a meta-analysis analyzing prospective studies, it was found that high consumption of SSB increased the odds ratio for being overweight or obese by 1.55 (1.32 to 1.82) compared with those who had lower intakes. In a similar study design, Imamura and colleagues found that drinking SSB increased the incidence of type 2 diabetes by 18% for every increase in one serving per day. Few other prospective cohort studies have found relationships between SSB and several obesity-related cancers such as colorectal, postmenopausal breast, gastric, pancreatic and prostate. SSB may also contribute to poor dental health in children and adults. The high sugar content feeds bacteria in the mouth, in turn causing dental carries while the acidity of some SSB like soft drinks, contributes to the erosion of the enamel surface.

Recommendations

Even given these health risks, no specific recommendations have been put forth for SSB since they are considered a subset of foods with added sugars. Based on added sugars recommendations, one SSB may put a person at or above the limit for the day. A 12-fluid ounce
soda for example, has on average 150 calories solely from added sugars. Given the contribution of SSB to the added sugars intake crisis in the U.S., organizations like WHO, AHA, CDC and others are increasingly calling for the reduction in SSB consumption.

National and Rural Intake Statistics

Similar to added sugars, SSB consumption has begun to decline in the recent years, but remains above recommended amounts for all population subgroups, especially for racial and ethnic minorities and low-income populations. Around 63% of children ranging from 2 to 19 years old consume at least one SSB per day equating to the consumption on average of 143 calories from SSB. When looking at adult data, 50% consume some SSB per day, that is contributing around 138 calories per day. It is not surprising given data on added sugars that adolescents are also the highest consumers of SSB compared to all other age groups. Adolescent boys consume on average 232 kcals/day from SSB while girls consume around 162 kcals/day. There is a great need to address SSB consumption in adolescents, particularly in areas with high incidences of SSB associated diseases, such as rural areas.

In an analysis of the 1999-2006 National Health and Nutrition Examination Survey, rural adults had significantly higher SSB consumption compared to urban adults. Additionally, rurality status has been associated with an increased likelihood of drinking more than three cans or glasses of SSB per day. In a cross-sectional study targeting Appalachia adults living in rural southwest Virginia, it was found that they were consuming 457 kcals/day on average from SSB, which is three times higher than the national adult intake of 138 kcals/day.

Children living in rural areas may also have higher SSB consumption rates. A comprehensive report on third graders in Ohio reported that 50% of children residing in Appalachia were drinking greater than one SSB per day, and this was significantly higher than
their urban counterparts. In a pilot study testing an intervention to reduce SSB consumption in rural Appalachian high schools, it was reported that 63% of students had SSB at least three times per week, consuming on average 2.32 servings of SSB per day at baseline. This data was not compared to other age groups or urban adolescents, however does reflect a high intake that mirrors national intake statistics.

Reducing Added Sugars and SSB Consumption to Improve Rural Health

Looking through a Socioecological Lens

Consumption of added sugars and SSB has caught the attention of researchers, policy makers, and community stakeholders working to address health disparities particularly in rural populations. The next steps are to understand the different levels of influencer on SSB intake for creating and implementing effective interventions. The socioecological model (SEM) is an approach to understanding health behaviors that recognizes the complexity of most public health challenges. This model explores the combination of strategies across intrapersonal, interpersonal, environmental and policy levels, in order to improve health behaviors.

Research has identified some of the factors within each SEM level associated with high SSB intake (Figure 1.1), however more research in needed to look across the influence of these levels in relationship to one another. At the intrapersonal level, characteristics such as attitudes, subjective norms, and perceived behavioral control have been independently shown to be associated with adolescent intention to drink soda. At the interpersonal level, a person’s social group and networks may influence SSB behaviors. For example, factors such as permissive parenting practices, parental role modeling and peer SSB intake have all been associated with adolescent SSB intake. Environmental level factors take into consideration the home, school and larger social institutions that an individual belongs to as well the relationship
among the different community institutions. Some of these influencing factors include the media, fast food environments, and home and school availability of SSB. Finally, local, state and national laws may also influence SSB intake in rural areas. Examples of such factors include policies implemented at schools and SSB taxation.

Several systematic reviews have identified SSB intervention for adolescents that utilize the various levels across the SEM, however there are two outstanding gaps in these evidences. First few efforts have been cited in rural areas. In one review looking at 55 SSB interventions in children and adolescents, it was found that there were zero multilevel intervention implemented in rural areas. There is a need here to develop, test and implement multi-level strategies to create supportive environments that will promote reduced consumption of SSB, however barriers such as transportation and poverty make it difficult to access programs. One proposed strategy that has been cited is to target the school systems in rural areas, where adolescents can be easily reached. However, another systematic review of SSB interventions found that interventions that used home as a setting were more effective than school-based programs. This is likely because few school-based programs target the adolescent’s individual behaviors and intervene to change their social influence and their environment, such as parents and the home availability of SSB. This is the second gap in the evidence on current SSB interventions. Vezina-Im and colleagues conducted a systematic review of school-based SSB interventions, and found that only 6 out of 36 interventions targeted both the individual and the environment. In addition to programs in rural areas, there is a need to develop and test SSB reduction strategies that incorporate environmental level of influence on adolescent consumption, such as targeting parents to changing their parenting practices, purchasing behaviors, home environment and role modeling by reducing their own SSB intake.
**Implications of this Dissertation**

There is an opportunity to better understand added sugars and SSB patterns in rural populations to inform the development of more accessible, multi-level interventions that address high SSB consumption. This dissertation begins that process. Manuscript number one is a cross-sectional study that explores top sources of added sugars in the diet of adults in rural Southwest Virginia. Understanding the food and beverage sources of sugar can help create effective nutrition interventions where dietary behaviors are specifically described, though this is currently absent in the literature for rural populations. Manuscript two uses a nationally representative sample of adolescents to explore factors across the SEM that are associated with increased SSB intake.\textsuperscript{71} Findings from this manuscript provide recommendations for interventions aimed at adolescents, such as focusing on the home setting and incorporating their caregivers. These strategies can be used to create intervention components that address these multilevel factors. Manuscript three discusses the development and testing of SMS messages to understand language preferences and acceptability of text messages through focus groups and pilot testing with caregivers of adolescents living in rural areas of Southwest Virginia. The proposed study is part of the preliminary work needed for a future multi-level program to be delivered in middle schools to help reduce SSB consumption. Collectively, these three manuscripts will start the process towards improving rural health disparities through understanding intake of added sugars and SSB and addressing SSB intake through a unique modality to change SSB behaviors in adults and adolescents in Southwest Virginia.
Figure 1.1 Factors influencing adolescent sugar-sweetened beverage intake across the Socioecological Model

**Public Policy:**
policies implemented at schools and SSB taxation

**Organizational/Community:**
media, fast food environments, and home and school availability of SSBs

**Interpersonal:**
permissive parenting practices, parental role modeling and peer SSB intake

**Intrapersonal:**
characteristics such as attitudes, subjective norms, and perceived behavioral control
References


33. Dietary Reference Intakes Tables and Application.


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CHAPTER 2: MANUSCRIPT 1

Title: Food and Beverage Sources of Added Sugars in the Diets of Rural Adults Residing in Southwest Virginia
Abstract

Rural residents have been found to have high consumption of added sugars (AS) when compared to their urban counterparts, yet the top sources have not been explored. Excessive AS consumption is linked with weight gain, dental carries, heart disease and diabetes. Understanding AS intake in rural populations is imperative to address the health disparities affecting these areas. This objective of this study was to explore the top food and beverage sources of AS by food category and their contribution to total AS and energy intake. This study analyzed cross-sectional data collected at baseline from the Talking Health trial, that took place in eight rural counties across Southwest Virginia. The sample consisted of 301 participants, of which 93% were white, 81% were female, 49% were between the ages of 35-54, 43% had an income of $14,000 or less, 33% had low health literacy, and 32% had less than a college education. AS data was obtained from three 24-hour dietary recalls and proportions were obtained as grams and as percentage of total energy intake for each individual food category. Overall, AS contributed to 21% of total energy intake. The top sources of AS were soda, sweetened tea, grain desserts, sweetened coffee and frozen dairy desserts. Furthermore, liquid sources of AS contributed to almost 66% of all AS intake and 14% of total energy intake. Within liquid sources, soda contributed to almost 40% of all AS intake, and 8% of total energy intake. Cola and citrus favored drinks were the main types of sodas that this population was consuming. Results from this study can help inform food- and beverage-based dietary guidelines specific to rural populations. Furthermore, these findings should be used in the development and adaptation of evidence-based interventions for rural areas to reflect more culturally relevant dietary behaviors.
Introduction

Excessive added sugars (AS) consumption is a nutritional determinant that influences high chronic disease rates observed across the United States (U.S.). Specifically, increased consumption of AS is linked to weight gain, dental carries, cardiovascular disease, type 2 diabetes and some cancers.\textsuperscript{1-4} In areas that are disproportionately affected by these health disparities, such as rural regions,\textsuperscript{5} understanding and addressing AS consumption is imperative.

AS are defined as any sugar in food that is artificially added during the processing, cooking or preparing phases.\textsuperscript{6,7} The 2015-2020 Dietary Guidelines for Americans and the World Health Organization recommend limiting calories from AS to 10\% or less of daily intake.\textsuperscript{2,8} Recent reports have found that AS intake in the U.S. is trending down, but remains well above this recommended amount.\textsuperscript{9} On average, Americans consume 308 calories of AS per day, which contributes to approximately 14\% of total energy intake.\textsuperscript{10} Though few studies have explored AS in rural areas, two studies have found that AS consumption is higher in rural regions, contributing around 21\% of total energy intake.\textsuperscript{11,12}

National level studies have found that the primary sources of AS in adults are from sugar-sweetened beverages (SSB), followed by grain-based desserts.\textsuperscript{10,13} Not only are SSB the top source of AS, but also the greatest single source of calories in the U.S. diet.\textsuperscript{14} However, unlike national level data, there are a lack of published studies focusing on food sources of total AS intake and their contribution to total energy intake in rural populations. Likewise, there are substantially fewer evidence-based interventions that target AS and SSB in rural communities when compared to other areas.\textsuperscript{15} Conducting analyses to understand food sources of AS is a foundational step to intervening on AS and SSB in rural settings.
Appalachia is a geographical area made up of mostly rural counties that has historically been a medically underserved region with longstanding rates of high poverty and reduced health care access. Deaths from diseases associated with excessive AS intake such as heart disease, cancer, and stroke have been found to be significantly higher in this area. AS and SSB intake has also been found to be a pervasive problem in this region. Studies from the Talking Health trial in Appalachian adults living in rural southwest Virginia have found that AS made up around 21% of total energy intake and 457 kcals/day were coming from SSB. Based on data from other studies, it can be hypothesized that a majority of these SSB calories are coming from soda, which have been linked to poor oral health in Appalachia. The excessive amounts of sugar and acid in soda contribute to high rates of dental carries and erosion. In Appalachia, this has been labeled “Mountain Dew Mouth” due to the idea that citrus flavored sodas are the most highly consumed soda type, although no known formal assessment exists. Understanding the amount and sources of SSB as well as other sources of AS in Appalachian diets can help increase the cultural relevancy and potential effectiveness of educational efforts where AS intake can be specifically defined.

In addition to identifying food sources of AS, there is a lack of research on differences in AS intake within rural demographic subgroups such as education status, income, race, and health literacy. Research has found that lower educational status and family income has been associated with increased AS intake. Exploring these factors within a rural population will shed light on further income and education disparities that may exist. Other demographic factors that have been linked to increased intake include lower health literacy and being racial minority. Finally, few studies exist on the relationship between health literacy and nutrition behaviors, particularly in rural adults. In a study with adults in rural lower Mississippi Delta, Zoellner and
colleagues found significantly higher SSB intake patterns among rural adults with lower health literacy skills, however the relationship with total AS and health literacy in rural adults has yet to be explored.²²

This study aims to characterize AS intake in rural Southwest Virginian adults considered part of the Central Appalachian region. This will be accomplished by exploring the top food and beverage sources of AS by category, specific food type, and their contribution to energy intake. Additionally, this study will analyze differences in AS intake across various demographic factors such as sex, age, race/ethnicity, education, income and health literacy.

Methodology

Study Design and Participants

This study is a secondary analysis of cross-sectional data collected at baseline from the Talking Health trial.²⁵ Talking Health was a randomized-controlled, community-based trial that occurred in eight rural counties across Southwest Virginia. These counties were federally designated as medically underserved, and have a rurality status of 6.1 ± 2.5 out of 9 on the Rural-Urban Continuum Codes (where 9 = very rural).²⁶ Talking Health evaluated the effectiveness of SIPsmartER, a behavioral intervention aimed at decreasing the consumption of SSB to less than 8 fl. oz., against a matched contact comparison group targeting physical activity called MoveMore. To be eligible, participants had to be >18 years of age, consume >200 calories of SSB per day, have access to a telephone, and have no physical activity limitations. Recruitment was done using both active (e.g., direct contact with participants at health departments, clinics and apartment complexes), and passive methods (e.g., newspaper ads, flyers, and targeted postcard mailings).²⁷ These strategies resulted in a generally representative sample of the region, with the exception of the underrepresentation of men.²⁶ This study took place between March
2012 to November 2014 and was approved by the Institutional Review Board at Virginia Tech.\textsuperscript{26} Written informed consent was obtained from all participants prior to data collection.

**Measures**

At baseline, data was collected on demographic characteristics and dietary intake (three 24-hr dietary recalls).

*Demographic Variables*

Data was collected on age, sex, race, income, education status, and health literacy. Age was reported on a continuous scale and recoded into four categories. Race was reported across five categories and categorized into White, Black, and other. Income was reported on 12 categories, starting at $<$5,000 to $>$55,000 and condensed into four categories. Education status was reported across six categories from no education to completion of graduate school and was collapsed into two categories. Health literacy was assessed using the interviewer administered Newest Vital Sign (NVS). The NVS is a validated six-item questionnaire that assesses health literacy using a nutrition facts label. Participants can receive a score on a scale of 0-6.\textsuperscript{28} For this study, scores were collapsed to represent low health literacy (0-3) and high health literacy (4-6). Categories were created and collapsed for comparison using guidance from previous literature.\textsuperscript{10,29}

*Dietary Intake*

Dietary information was extracted from the three-interviewer administered non-consecutive 24-hour dietary recalls over a 2-week period. Interviews were done by trained researchers supervised by a PhD-level Registered Dietitian. The first recall was taken at baseline...
and the following two were through unannounced telephone calls using multiple-pass method. Additionally, to capture a comprehensive picture of dietary intake across the week, recalls were taken for one weekend day and two weekdays. All of the participants completed at least one baseline 24-hour dietary recall, 90.7% completed two recalls, and 74.1% completed all three recalls. Dietary recalls were entered into a nutritional analysis software (Nutrition Data System for Research (NDS-R) 2011, University of Minnesota).

**Food Categories**

Food categories were defined using a combination of the Nutrition Coordinating Center (NCC) Food Group Identifier from the NDS-R system, and previous literature that examined dietary sources of nutrients on a national level. Some categories were collapsed or expanded for clarity of food groups that contained AS (e.g., sports drinks and sweetened fruit drinks were expanded to have unique identifiers). Categories hypothesized to be significant contributors (i.e., soda) were further expanded for analysis as well by flavor descriptors.

**Data Analyses**

To understand demographic differences in AS intake, data was extracted from NDSR and entered into SPSS 25.0 (IBM Corp., Armonk, NY) for further analysis. For total energy from all dietary sources (calories) and total AS (grams), variables were created by averaging amounts from the three days reported. Energy from AS was calculated by using the standard of four calories per gram of AS. This value was then divided by total energy to obtain an average percentage of energy intake from AS. Means and standard deviations for AS intake in grams and as a percentage of total energy intake were calculated. One-way ANOVAs were conducted to
identify significant bivariate correlations between AS intake and demographics variables. Post-hoc analyses were performed using the Tukey method.

To analyze top food sources of AS, data was extracted from the NDS-R Output File 02 (displays foods as whole versus at the ingredient level) and imported into Microsoft Excel (version 15.32). From here, data was summed across all participants and all available recalls to obtain total AS (grams) and total energy from all dietary sources (calories) from all foods. Next, the NCC Food Group ID was used to identify and sort each individual food category and AS (grams) for each of these categories was summed and reported as a proportion of total AS. Additionally, for each individual food category, the summed value for AS (grams) was converted to calories using four calories per gram standard. This value, total AS (calories) for each individual food category, was divided from the total energy (calories) from all foods, to obtain a proportion of total energy intake (calories). Following this, to determine top sources of AS, food categories were ranked based on their AS contribution to total AS and total energy intake.

Results

Participants and Demographic Differences in Added Sugars Intake

Participant characteristics and demographics differences in AS intake are shown in Table 2.1. The majority of the sample (n=301) was white (93%) and female (81%). Around 32% had less than a college education, 33% were categorized as having low health literacy, 49% were between the ages of 35-54, and 43% had an income of $14,000 or less. On average, participants consumed 108.75 grams of AS which contributed to around 21% of total energy intake.

Significant differences in intake were found for the sex and income variables (p<0.05). Male participants consumed significantly more AS in grams when compared to females (p=0.044), but the amount was not significant when considering AS as a percentage of total energy intake.
energy intake. Participants who had an income of $35,000-54,999 consumed significantly lower amounts of AS in grams when compared to all other income groups. When comparing income categories by the contribution of AS to total energy intake, those who had an income of $14,999 had similar contribution to those who made $15,000-34,999, but had a significantly higher percentage than those who made $35,000 or more (p=0.002). There were no significant differences in AS intake by age, race/ethnicity, education level, or health literacy status categories.

**Top Sources of Added Sugars**

All sources of AS by food categories are ranked in Table 2.2. Soda was the top source of AS, making up almost 40% of AS grams and 8% of total energy intake. These proportions are three times higher than the second largest source of AS, sweetened tea. Sweetened tea accounted for around 13% of AS and 3% of total energy intake. Following these two liquid sources, grain desserts was the third highest overall source and the top solid food source of AS. Grain desserts, which included all types of cookies, cakes, brownies, pies etc., accounted for around 7% of AS and 1.5% of total energy intake. Sweetened coffee and frozen dairy desserts rounded out the top five food sources, respectively.

The top liquid sources of AS (i.e., SSB) were soda, sweetened tea, sweetened coffee, sweetened fruit drinks, sports drinks, energy drinks, sweetened milk, specially formulated drinks (e.g., carnation instant breakfast), cocktails, and sweetened milk alternatives (Table 2.2). Together these liquid sources made up around 66% of AS foods and almost 14% of total energy intake. These liquid sources are about double the amount contributed by solid food sources, which was 34% and 7%, respectively for AS and total energy intake.
Top Sources of Added Sugars by Soda Types

Eight different soda types emerged from the analysis of dietary recalls, and are reported in table 2.3. The top source contributing to AS from the soda food category was cola (e.g., Coke and Pepsi), followed closely by citrus flavored sodas (e.g., Mountain Dew and Mello Yello). Together, cola and citrus flavored sodas accounted for almost 26% of AS and 5.5% of total energy intake, which was double the contribution compared to all other soda types combined. Dr. Pepper, lemon-lime flavored (e.g., Sprite, 7-up, Sierra Mist), unknown types (e.g., reported soda without a flavor descriptor), fruit flavored drinks (e.g., grape and orange sodas), ginger ale, root beer, and cream soda, accounted for 13% of AS and less than 3% of total energy intake.

Discussion

This is the first known study to identify the top food and beverage sources of AS in the diets of rural adults and examine their relative contributions to AS and energy intake. This analysis highlights a high need to reduce overall AS intake in rural diets. Results from this study indicate this can be achieved through reducing consumption of SSB, due the high proportion consumed relative to other food sources. Therefore, efforts that aim to reduce AS intake and that strive to make significant impacts on rural health should focus on SSB intake, with a strong message to reduce sodas.

These results should be interpreted while keeping in mind that one of the inclusion criteria for the Talking Health trial was that participants had to consume greater than 200 calories of SSB per day.\textsuperscript{26} Although this inclusion criteria may be leading to the over representation of AS intake due to higher amounts of SSB reported, analyzing this dataset for this study provides the opportunity to understand the AS intake of a sample that would highly benefit from an
intervention to reduce consumption. Furthermore, this sample was fairly representative in terms of SSB intake as studies have found that this rural region consumes over three times the national average of SSB intake (457 vs. 138), which is similar to the average SSB intake in this sample.\textsuperscript{19,23}

Overall, this sample of rural adults consumed around 109 grams of AS which contributed to around 21% of total energy intake. Not only is this more than double the recommended amounts by the 2015-2020 Dietary Guidelines for Americans and the World Health Organization (10% of energy intake), but also 38% higher than the national contribution of AS to total energy intake (13%).\textsuperscript{7,9} Findings around the differences in AS intake by sex and income, were generally supported by findings from nationally representative samples.\textsuperscript{14,31} Similar disparities in AS intake in exist in rural men and those with lower income, therefore recruitment methods should focus on strategies to target these specific subgroups and increase their enrollment, engagement and retention in interventions that reduce AS intake. For example, analysis of the recruitment methods in the Talking Health trial found that using more active recruitments yielded more male participants compared to passive strategies.\textsuperscript{27}

Similar to national trends, SSB (and soda within this category) are the largest contributors of AS in this sample of rural adults.\textsuperscript{7} However, when looking at relative contributions, the substantially higher quantities of SSB in this rural sample is alarming. Ervin and colleagues found that in a national sample of adults, solid foods contributed to 67%, and SSB contributed to 33% of total AS intake.\textsuperscript{14} For rural adults, the relative contribution of AS from solids versus liquid is flipped compared to national data, with SSB contributing 66% and solid foods contributing 34% to AS intake. Additionally, when examining SSB intake in relationship to total energy intake, rural SSB contributed double the energy intake (~14%) compared to national
reports (7%). SSB is the only AS source that has been individually linked to various diseases such as obesity, heart disease, cancer and tooth decay. As SSB contributes to more half of AS intake in this rural population, reducing the consumption of this single food group may have significant health implications.

Within the SSB category, soda was by far the largest contributor, making up 40% and 8% of AS and total energy intake, respectively. On a national level, it was found that soda contributed to around 5% of total energy intake. Furthermore, soda consumption in this sample contributed to more energy intake than any single food category on a national level. This high soda intake is concerning for several reasons. First unlike other AS foods and some other SSB (e.g., sweetened milk or fortified fruit juices), soda consists of what has been termed “empty calories” due to absence of vitamins and minerals. Additionally, consuming soda has been found to have a lower satiety effect, therefore increasing the potential of the amount of sugar from liquid sources consumed compared to solid AS food sources. Finally, in addition to the diseases related to SSB, soda has further oral health implications as it has been linked with dental erosion and dental carries, which are highly prevalent issues in rural areas.

The results from this study emphasize the differences in AS intake patterns between rural areas and the U.S. as whole and the need to adapt food-based dietary guidelines to be more specific when working in rural areas. For example, within the soda category, this study identified cola and citrus flavored drinks to be the top contributors, which is only partially consistent with hypothesis that citrus-flavored drinks were the most commonly consumed in rural areas. Strategies to reduce SSB intake could be strengthened if educational materials used in clinical or research settings, public awareness campaigns, policies and other efforts focus on culturally relevant beverages, such as colas and citrus flavored drinks, and specific beverage patterns.
A few limitations should be considered while interpreting results. First, this study may have limited generalizability to other rural populations beyond the Appalachian region of rural southwest Virginia, but can be used as a guidance to conduct similar studies in other rural populations. Second, in terms of race, this sample was representative for the region\textsuperscript{26} but the lack of diversity within the study region is another potential limitation of generalizing the results. Given that studies have found that rural areas are becoming increasingly diverse, and experiencing greater health inequalities\textsuperscript{39} future research should aim to obtain samples with greater diversity to help understand the difference intakes of AS within these demographic subsets. Lastly, self-reported dietary recalls are prone to measurement error\textsuperscript{40} However, one of the strengths of this study was the use of the multiple pass method along with three dietary recalls obtained separately, which included two weekdays and one weekend day, for a more comprehensive representation of dietary intake\textsuperscript{30}

In conclusion, this study revealed several important differences in rural AS intake compared to national level data, while describing cultural preferences around beverage choice. These results suggest that this Appalachian sample is drinking larger amounts of SSB compared to national intake, which is reinforced from previous findings that have found rural areas are drinking SSB in excessive amounts\textsuperscript{11} These results also add to the literature with the findings around soda being the top source of AS and the disproportionate contribution of SSB to AS and total energy intake when compared to national level data. Public health efforts to reduce AS consumption in rural areas should focus on SSB intake and further emphasize reducing soda intake. Targeting this specific dietary behavior has the potential to reduce total AS consumption and significantly improve rural health outcomes. While AS and SSB have been the target of many evidence-based interventions\textsuperscript{41} few efforts have been successfully implemented in rural
areas. Talking Health is an example of such a trial that was able to significantly reduce SSB consumption in the SIPsmartER arm by 227 calories per day, compared to the match contact comparison of MoveMore, that reduced their intake by 53 calories per day. There is a high need to start adapting these evidence-based interventions into other rural areas. Results from this study can be used to inform and modify nutritional messages in added sugars and SSB interventions, to increase cultural relevancy and potentially the effectiveness of the intervention. Furthermore, future studies should explore how specific food and beverages choices changed as a result of incorporating specific food-based dietary recommendations.
### Table 2.1 Differences in added sugars and added sugars as a percentage of total energy by demographic characteristics (n=301)

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
<th>Added Sugars (g) m (SD)</th>
<th>F- Statistic (p- value)</th>
<th>% Total Energy</th>
<th>F- Statistic (p- value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56 (18.6%)</td>
<td>120.66 (89.73)</td>
<td>4.096 (0.044)</td>
<td>19.53 (11.50)</td>
<td>1.405 (0.237)</td>
</tr>
<tr>
<td>Female</td>
<td>245 (81.4%)</td>
<td>96.84 (76.97)</td>
<td></td>
<td>21.56 (11.76)</td>
<td></td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-34</td>
<td>96 (31.9%)</td>
<td>109.84 (94.98)</td>
<td>0.789 (0.501)</td>
<td>22.05 (12.06)</td>
<td>0.302 (0.824)</td>
</tr>
<tr>
<td>35-54</td>
<td>148 (49.2%)</td>
<td>99.77 (75.79)</td>
<td></td>
<td>20.87 (12.09)</td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td>50 (16.6%)</td>
<td>92.62 (61.98)</td>
<td></td>
<td>20.88 (10.64)</td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td>7 (2.3%)</td>
<td>77.34 (40.09)</td>
<td></td>
<td>19.00 (6.69)</td>
<td></td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>280 (93.0%)</td>
<td>102.27 (80.99)</td>
<td>0.316 (0.729)</td>
<td>21.37 (11.85)</td>
<td>0.873 (0.419)</td>
</tr>
<tr>
<td>Black</td>
<td>13 (4.3%)</td>
<td>87.4 (38.5)</td>
<td></td>
<td>20.92 (6.69)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>8 (2.7%)</td>
<td>88.69 (94.49)</td>
<td></td>
<td>15.82 (13.59)</td>
<td></td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤High School</td>
<td>96 (31.9%)</td>
<td>101.43 (79.58)</td>
<td>0.001 (0.981)</td>
<td>21.93 (12.43)</td>
<td>0.538 (0.464)</td>
</tr>
<tr>
<td>≥Some College</td>
<td>205 (68.1%)</td>
<td>101.2 (80.22)</td>
<td></td>
<td>20.86 (11.39)</td>
<td></td>
</tr>
<tr>
<td><strong>Income Category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤$14,999</td>
<td>129 (42.9%)</td>
<td>113.24 (101.3)a</td>
<td>3.042 (0.029)</td>
<td>23.67 (14.16)a</td>
<td>5.191 (0.002)</td>
</tr>
<tr>
<td>$15,000-$34,999</td>
<td>96 (31.9%)</td>
<td>102.61 (63.18)a</td>
<td></td>
<td>21.04 (9.21)a</td>
<td></td>
</tr>
<tr>
<td>$35,000-$54,999</td>
<td>39 (13.0%)</td>
<td>74.8 (49.45)b</td>
<td></td>
<td>16.35 (8.65)b</td>
<td></td>
</tr>
<tr>
<td>≥$55,000</td>
<td>37 (12.3%)</td>
<td>83.96 (44.62)a</td>
<td></td>
<td>18.13 (8.55)b</td>
<td></td>
</tr>
<tr>
<td><strong>Health Literacy (NVS)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>99 (32.9%)</td>
<td>96.02 (76.88)</td>
<td>0.635 (0.426)</td>
<td>21.23 (12.69)</td>
<td>0.001 (0.975)</td>
</tr>
<tr>
<td>High</td>
<td>202 (67.1%)</td>
<td>103.84 (81.38)</td>
<td></td>
<td>21.19 (11.26)</td>
<td></td>
</tr>
</tbody>
</table>

*a, b* Post-hoc analyses were done using the Tukey method. Values that do not share the same superscript letter are significantly different from each other (p<0.05)
<table>
<thead>
<tr>
<th>Rank</th>
<th>Food Category</th>
<th>Liquid vs. Solid</th>
<th>% Added Sugars</th>
<th>% Total Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soda (e.g., cola, citrus flavored, root beer)</td>
<td>Liquid</td>
<td>39.59%</td>
<td>8.34%</td>
</tr>
<tr>
<td>2</td>
<td>Sweetened tea (e.g., sweet tea, hot tea with sugar packets)</td>
<td>Liquid</td>
<td>12.94%</td>
<td>2.73%</td>
</tr>
<tr>
<td>3</td>
<td>Grain desserts (e.g., cookies, cakes, brownies)</td>
<td>Solid</td>
<td>6.87%</td>
<td>1.46%</td>
</tr>
<tr>
<td>4</td>
<td>Sweetened coffee (e.g., with cream and/or sugar)</td>
<td>Liquid</td>
<td>5.72%</td>
<td>1.20%</td>
</tr>
<tr>
<td>5</td>
<td>Frozen dairy desserts (e.g., ice cream, milkshakes)</td>
<td>Solid</td>
<td>4.56%</td>
<td>0.96%</td>
</tr>
<tr>
<td>6</td>
<td>Candy (e.g., chocolates, jelly beans)</td>
<td>Solid</td>
<td>4.10%</td>
<td>0.86%</td>
</tr>
<tr>
<td>7</td>
<td>Additions (e.g., dressings, spreads or toppings)</td>
<td>Solid</td>
<td>4.04%</td>
<td>0.85%</td>
</tr>
<tr>
<td>8</td>
<td>Sweetened fruit drinks (e.g., lemonade, fruit punch)</td>
<td>Liquid</td>
<td>2.99%</td>
<td>0.63%</td>
</tr>
<tr>
<td>9</td>
<td>Cold cereal (e.g., Frosted Flakes)</td>
<td>Solid</td>
<td>2.61%</td>
<td>0.56%</td>
</tr>
<tr>
<td>10</td>
<td>Mixed meat entrees (e.g., meatloaf, chicken parmigiana, fast food entrees)</td>
<td>Solid</td>
<td>2.33%</td>
<td>0.49%</td>
</tr>
<tr>
<td>11</td>
<td>Muffins, pastries, and quick breads (e.g., donuts, Pop-tarts, cornbread)</td>
<td>Solid</td>
<td>2.20%</td>
<td>0.46%</td>
</tr>
<tr>
<td>12</td>
<td>All other breads (e.g., white bread, buns, biscuits)</td>
<td>Solid</td>
<td>1.78%</td>
<td>0.37%</td>
</tr>
<tr>
<td>13</td>
<td>Sports drinks (e.g., Powerade, Gatorade)</td>
<td>Liquid</td>
<td>1.75%</td>
<td>0.37%</td>
</tr>
<tr>
<td>14</td>
<td>Yogurt (e.g., strawberry yogurt)</td>
<td>Solid</td>
<td>1.17%</td>
<td>0.25%</td>
</tr>
<tr>
<td>15</td>
<td>Energy drinks (e.g., Redbull, Monster)</td>
<td>Liquid</td>
<td>1.16%</td>
<td>0.24%</td>
</tr>
<tr>
<td>16</td>
<td>Snacks (e.g., chips, popcorn, pretzels, granola bars)</td>
<td>Solid</td>
<td>0.97%</td>
<td>0.20%</td>
</tr>
<tr>
<td>17</td>
<td>Hot cereal (e.g., brown sugar oatmeal)</td>
<td>Solid</td>
<td>0.81%</td>
<td>0.17%</td>
</tr>
<tr>
<td>18</td>
<td>Sweetened milk (e.g., chocolate milk)</td>
<td>Liquid</td>
<td>0.77%</td>
<td>0.17%</td>
</tr>
<tr>
<td>19</td>
<td>Fruits (e.g., canned fruits)</td>
<td>Solid</td>
<td>0.61%</td>
<td>0.13%</td>
</tr>
<tr>
<td>20</td>
<td>Other desserts (e.g., pudding, Jell-O)</td>
<td>Solid</td>
<td>0.54%</td>
<td>0.11%</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>State</td>
<td>Na</td>
<td>K</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>-------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>21</td>
<td>Frozen non-dairy desserts (e.g., popsicles)</td>
<td>Solid</td>
<td>0.50%</td>
<td>0.11%</td>
</tr>
<tr>
<td>22</td>
<td>Specially formulated drinks (e.g., Carnation Instant Breakfast)</td>
<td>Liquid</td>
<td>0.40%</td>
<td>0.08%</td>
</tr>
<tr>
<td>23</td>
<td>Mixed vegetable dishes (e.g., salads, coleslaws)</td>
<td>Solid</td>
<td>0.29%</td>
<td>0.06%</td>
</tr>
<tr>
<td>24</td>
<td>Processed meats (e.g., hot dogs, lunchmeats)</td>
<td>Solid</td>
<td>0.28%</td>
<td>0.06%</td>
</tr>
<tr>
<td>25</td>
<td>Beans (e.g., canned baked beans)</td>
<td>Solid</td>
<td>0.20%</td>
<td>0.04%</td>
</tr>
<tr>
<td>26</td>
<td>Mixed grain dishes (e.g., pizza w/out meat, peanut butter and jelly)</td>
<td>Solid</td>
<td>0.14%</td>
<td>0.03%</td>
</tr>
<tr>
<td>27</td>
<td>Breakfast grains (e.g., pancakes, French toast)</td>
<td>Solid</td>
<td>0.13%</td>
<td>0.03%</td>
</tr>
<tr>
<td>28</td>
<td>Soup (e.g., ramen noodle)</td>
<td>Solid</td>
<td>0.12%</td>
<td>0.02%</td>
</tr>
<tr>
<td>29</td>
<td>Cocktails (e.g., wine coolers)</td>
<td>Liquid</td>
<td>0.12%</td>
<td>0.02%</td>
</tr>
<tr>
<td>30</td>
<td>Mixed pasta and rice dishes (e.g., Mexican rice, Spaghetti and sauce w/out meat)</td>
<td>Solid</td>
<td>0.10%</td>
<td>0.02%</td>
</tr>
<tr>
<td>31</td>
<td>Milk alternatives (e.g., soy, almond)</td>
<td>Liquid</td>
<td>0.08%</td>
<td>0.02%</td>
</tr>
<tr>
<td>32</td>
<td>Beef (e.g., beef jerky)</td>
<td>Solid</td>
<td>0.04%</td>
<td>0.01%</td>
</tr>
<tr>
<td>33</td>
<td>Pork (e.g., ham)</td>
<td>Solid</td>
<td>0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>34</td>
<td>Mixed egg dishes (e.g., deviled eggs, egg salad)</td>
<td>Solid</td>
<td>0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>35</td>
<td>Vegetables (e.g., candied carrots)</td>
<td>Solid</td>
<td>0.02%</td>
<td>0.00%</td>
</tr>
<tr>
<td>36</td>
<td>Meat alternatives (e.g., tofu)</td>
<td>Solid</td>
<td>0.01%</td>
<td>0.00%</td>
</tr>
<tr>
<td>37</td>
<td>Spices (e.g., taco seasoning)</td>
<td>Solid</td>
<td>0.01%</td>
<td>0.00%</td>
</tr>
<tr>
<td>38</td>
<td>Fish (e.g., fish sticks)</td>
<td>Solid</td>
<td>0.01%</td>
<td>0.00%</td>
</tr>
<tr>
<td>1</td>
<td>All liquids</td>
<td>--</td>
<td>65.51%</td>
<td>13.80%</td>
</tr>
<tr>
<td>2</td>
<td>All solids</td>
<td>--</td>
<td>34.49%</td>
<td>7.27%</td>
</tr>
<tr>
<td>Rank</td>
<td>Soda Type</td>
<td>% Added Sugars</td>
<td>% Total Energy</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>----------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cola (e.g., Coke, Pepsi)</td>
<td>14.18%</td>
<td>2.99%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Citrus flavored (e.g., Mountain Dew, Mello Yello)</td>
<td>12.10%</td>
<td>2.55%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dr. Pepper</td>
<td>5.62%</td>
<td>1.19%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lemon-lime flavored (e.g., Sprite, 7-up, Sierra Mist)</td>
<td>3.52%</td>
<td>0.74%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Unknown (e.g. flavor descriptor unknown)</td>
<td>1.94%</td>
<td>0.41%</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fruit flavored (e.g., grape soda, Sunkist)</td>
<td>0.96%</td>
<td>0.20%</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ginger ale</td>
<td>0.95%</td>
<td>0.20%</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Root beer</td>
<td>0.27%</td>
<td>0.06%</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cream soda</td>
<td>0.03%</td>
<td>0.01%</td>
<td></td>
</tr>
</tbody>
</table>
References


CHAPTER 3: MANUSCRIPT 2

Title: Using a socioecological approach to identify factors associated with adolescent sugar-sweetened beverage intake

Keywords: adolescent, sugar-sweetened beverages, home environment, parenting, socioecological factors

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Citation: Yuhas M, Porter K, Hedrick V, Zoellner J. Using a socioecological approach to identify factors associated with adolescent sugar-sweetened beverage intake. (Under review: J Acad Nutr Diet)
Abstract

Background: Adolescents are among the highest consumers of sugar-sweetened beverages (SSB). Yet, few studies have explored combined factors associated with adolescents’ SSB patterns across the socioecological model (SEM) in a nationally representative sample.

Objective: This cross-sectional study predicts adolescent SSB intake by exploring the associations of adolescent demographic (i.e., age, race, ethnicity, parent socioeconomic status), intrapersonal (i.e., behavioral intention, self-efficacy, media susceptibility), interpersonal (i.e., social norms and parenting practices) and home environment (i.e., home availability) variables.

Design: Descriptive statistics, correlations, ANOVAs, and step-wise multiple linear regression were used to explore factors associated with SSB intake from 1,560 adolescents who participated in the 2014 National Cancer Institute (NCI) sponsored cross-sectional Family, Life, Activity, Sun, Health, and Eating (FLASHE) study. In the step-wise regression, a five-step model was analyzed, with each subsequent step adding variables from different SEM levels.

Results: The final step that included 13 variables individually associated with SSB intake significantly predicted 16% of the variance in SSB intake. Six variables were associated with higher SSB intake in the final step: male sex ($\beta=0.066$), having a parent with public or no health insurance ($\beta=0.058$), being non-Hispanic black ($\beta=0.116$), having higher media susceptibility ($\beta=0.064$), having parents who allowed child to have SSB on a bad day ($\beta=0.152$), home SSB availability ($\beta=0.265$). Relative to adolescents’ behavioral intentions, self-efficacy and social
norms, variables representing media susceptibility and parenting practices explained more variance and the home environment explained the most variance in adolescent SSB intake.

**Conclusion:** When considering potential targets for health education activities and multi-level interventions aimed at reducing adolescent SSB intake, emphasis should be placed on reducing SSB availability at home, followed by targeting certain parenting practices and incorporating media susceptibility strategies.
Introduction

Sugar-sweetened beverages (SSB), including soda, fruit juices, sports and energy drinks, contribute to the poor health of adolescents in the United States (U.S.). Greater SSB intake is associated with a poorer diet quality such as lower intakes of fruits, dietary fiber, and vitamins and minerals important for adolescent development. SSB have also been linked with increased BMI, weight gain, tooth decay, cardiovascular disease, type 2 diabetes, and obesity-related cancers. Adolescents are the highest consuming age group of SSB, with an intake of about 232 kcal/day for boys and 162 kcal/day for girls. Although consumption is decreasing in this group, two-thirds of U.S. adolescents still drink more than 12 fluid ounces of SSB/day, which is higher than recommendations. Since reducing SSB intake could lead to improved health in adolescents, it is important to examine factors across socioecological levels that may influence SSB intake. Identified factors could help researchers and practitioners tailor interventions and health education strategies to reduce consumption.

The socioecological model (SEM) is an approach that posits health behaviors are influenced by dynamic factors at the intrapersonal, interpersonal, environmental and policy levels. It has been used in the development of many SSB focused interventions. Several studies have identified single-level SEM factors associated with SSB behaviors among adolescents. For example, intrapersonal characteristics such as attitudes, subjective norms, perceived behavioral control have been shown to be significant predictors of adolescent intention to drink soda. At the interpersonal and environmental levels, studies have found that adolescents’ SSB intake is significantly impacted by parental role modeling and practices and home availability of sugary drinks.
However, few studies have explored influences on adolescent SSB intake across multiple SEM levels. One recent study which examined adolescents’ SSB intake across personal, home, peer, school, media and neighborhood contexts revealed that the home accounted for the greatest proportion of variance for SSB intake, followed by personal factors. Peer and school factors minimally contributed to the explained variance, while media and neighborhood factors did not play a strong role. Though findings from this study are important, they are limited to one U.S. city. Therefore, additional exploration of adolescent SSB intake across SEM levels and among diverse populations and broad geographical regions is needed.

This study addresses gaps in the current literature by using a nationally representative sample to explore the associations of adolescent demographic (i.e., age, race, ethnicity, parent socioeconomic status), intrapersonal (i.e., behavioral intention, self-efficacy, media susceptibility), interpersonal (i.e., social norms and parenting practices) and home environment (i.e., home availability) variables with their SSB intake. Specifically, this study assesses which combination of variables are the strongest predictors of adolescent SSB intake. Secondarily, this study explores how adolescents’ BMI status varies by SSB intake and by home SSB availability.

Methodology

Study Design

This cross-sectional study is a secondary analysis of the Family, Life, Activity, Sun, Health, and Eating (FLASHE) survey data that was collected in 2014 and sponsored by the National Cancer Institute (NCI). The FLASHE project collected information relevant to dietary and physical activity behaviors and other correlates associated with cancer risk in parent and adolescent dyads. Participants were recruited from Ipsos’ Consumer Opinion Panel and balanced to reflect a nationally representative sample based on sex, income, age, household size, and
region. To be eligible, parents had to be at least 18 years of age and live with at least one 12-17-year-old child for 50% time. To enroll in the study invitations were sent to parents’ and adolescents’ e-mail addresses with the URL for the study website. Parents filled out a consent for themselves and their child and adolescents provided assent. Dyads completed two internet based surveys about demographic, diet, physical activity behaviors, and other cancer-preventive health behaviors. The database was made publicly available in 2016 and was previously approved through Institutional Review Board (IRB) of Westat, the National Cancer Institute’s Special Studies IRB, and the Office of Management and Budget. More information on the FLASHE methodology can be found elsewhere.\textsuperscript{15,16}

**Measures**

Data from self-reported adolescent demographic and diet measures were used to explore study aims. Additionally, self-reported data from parent surveys that captured variables not available from adolescents were also used (i.e., health insurance, income, height and weight for their adolescent and self).

**Demographic Variables**

Demographics included sex, age, grade level, and ethnicity. Age was reported on a continuous scale and recoded into two categories (12-14 and 15-17 years) for comparison. Grade level was reported in categories from 6\textsuperscript{th} grade or below to 12\textsuperscript{th} grade and recoded into middle school, high school, or ungraded/other. Participant ethnicity was coded as Hispanic, Non-Hispanic Black Only, Non-Hispanic White Only, or Non-Hispanic Other. Health insurance type, was coded as public, private or uninsured. Parent income was coded as a dichotomous variable, $0-$99,000 or >$100,000.
Sugar Sweetened Beverage (SSB) Intake

FLASHE assessed four types of SSB: sweetened fruit drinks, soda, energy drinks, and sports drinks. For each SSB, the response categories were “I did not drink [the SSB] during the past 7 days,” “1–3 times in the past 7 days,” “4–6 times in the past 7 days,” 1 time per day, “2 times per day,” or “3 or more times per day.” Responses were recoded to a continuous scale by dividing each response by 7 to reflect a frequency per day. Daily totals for each type of SSB were then added together to obtain a total intake of all SSB per day.¹⁶

SEM Level Variables

For the intrapersonal, interpersonal, and home environmental variables, adolescents reported responses on a 5-point Likert scale (1=strongly disagree/never, 5=strongly agree/always).

Intrapersonal Level Variables: These variables included one-item each for behavioral intention and self-efficacy, with both items pertaining to junk food and sugary drinks. Media susceptibility to food and drink advertisements was also included as an intrapersonal level variable. A media susceptibility index was created by averaging the responses to the three questions and then categorizing participants as having high or low susceptibility based on the median cut point as described by Cervi and colleagues.¹⁷

Interpersonal Level Variables: Eight interpersonal variables were included: one item pertaining to adolescent social norms and seven items about their parent’s practices around junk foods and sugary drinks. Each statement was treated as a single-item question as they were not intended by the FLASHE study team to be created into an index score.¹⁶
**Home Environment Variable:** Home availability of SSB was assessed with one question pertaining to frequency of availability.

**Body Mass Index (BMI)**

A continuous BMI percentile variable was calculated from parent’s report of adolescent height and weight and from parent’s report of their own height and weight. Based on established cut-points, BMI percentiles were also categorized into “underweight”, “healthy weight”, “overweight” and “obese.”

**Statistical Analyses**

The adolescent FLASHE dataset was merged with the parent demographic dataset. Data were analyzed using SPSS 24.0 (IBM Corp., Armonk, NY). Means and standard deviations were calculated for all variables. One-way ANOVAs were conducted to identify significant bivariate correlations between SSB and demographics, individual, interpersonal, home environment and BMI variables. Post-hoc analyses were performed using Tukey’s a priori significance level at p<0.05.

Variables found to be significantly associated with SSB intake in the bivariate analyses were entered into a step-wise multiple linear regression model. Variables were entered into the model following the SEM framework - Step 1: demographic factors, Step 2: behavioral intention, Step 3: self-efficacy and media susceptibility Step 4: social-norms and parenting practices, and Step 5: home availability.
For the regression model, categorical variables with more than two values were either condensed into two categories or dummy-coded based on findings from the bivariate analyses. Specifically, health insurance was collapsed into private health insurance and public/uninsured. Based on previous data on SSB consumption, ethnicity was dummy coded into three variables: (1) White vs. Hispanic, (2) White vs. Black, and (3) White vs. Other. Items reported on a Likert scale were treated as continuous variables in the regression model.

Results
Sample

This study included data from 1,560 dyads who had complete SSB data (Table 3.1). This is 90% of the total FLASHE sample (n= 1,737). Across adolescents, the average SSB intake frequency was 1.28 times per day (i.e., SSB/day).

SEM Analyses Results by Level

Demographics

The number of times adolescents consumed SSB/day significantly differed by sex (p<0.001), ethnicity (p<0.001), health insurance type (p<0.001), and BMI (p<0.003) (Table 3.1). Specifically, males consumed more SSB compared to females. Participants who identified as non-Hispanic black consumed more SSB than those identified as non-Hispanic white and other. Participants who identified as Hispanics did not have different intake patterns than the other groups. Parents with a public health insurance policy or no insurance, had adolescents who consumed higher SSB/day compared to parents with private insurance (p<0.001).

Intrapersonal Level Variables
Intrapersonal factors significantly associated with higher SSB intake per day were lower behavioral intention, lower self-efficacy, and higher media susceptibility (all \( p<0.001 \)) (Table 3.2). Adolescents who reported that they “strongly disagreed” with wanting to limit SSB intake had higher SSB intake than others, with the exception of those who reported “somewhat disagree.” When examining self-efficacy, adolescents who “strongly disagreed” that they were confident in their ability to limit the amount of SSB had a higher SSB intake than other respondents, except compared to those who chose “somewhat disagree.” Finally, adolescents who had high media susceptibility had higher SSB/day compared to those with low media susceptibility.

**Interpersonal Level Variables**

Interpersonal factors associated with higher SSB/day were higher social norms of drinking SSB and three of the seven parenting practices (Table 3.2). Adolescents who reported that they “strongly agreed” their friends drink SSB on most days of the week tended to have higher SSB/day compared to other responses; however, it was only significantly higher than those that responded, “neither disagree nor agree” (\( p<0.05 \)). Three parenting practices reported by adolescents showed significant differences in adolescent intake, including parents who (1) allowed their child to have SSB on a bad day, (2) bought a lot of SSB for their child, and (3) were actively monitoring their child’s intake (\( p<0.05 \)). Adolescents who reported that they “strongly agreed” that their parents let them have SSB on a bad day to make them feel better, significantly had the highest SSB/day. Adolescents also had a higher intake when they “strongly disagreed” or “somewhat disagreed” with the statement that their parents don’t buy a lot of SSB, but was only significantly different from those that “strongly agreed.” The third significant
parenting practice was parents who had to actively monitor adolescent SSB intake. The more adolescents agreed with this statement, the higher their SSB/day trended; however, no significant group differences were found.

*Home Environment*

Home availability was also significantly associated with higher adolescent SSB intake \(p<0.001\) (Table 3.2). Adolescents who reported that SSB were “always” available in their home had the highest SSB/day. Whereas those who reported “rarely” or “never” had the lowest SSB/day.

*Step-Wise Regression Results*

All five stepwise regression steps were significant (Table 3.3). Each subsequent step predicted more of the variance in adolescent SSB intake. The greatest \(R^2\) change occurred between step 4 and step 5 when the home environment variable was added and the variance increased from 10.7% to 16.2%.

Seven variables significantly contributed to the final step: sex, parent insurance, whether white or black, whether white or other race, media susceptibility, whether parents would allow their adolescent to have junk food or a sugary drink when the adolescent was having a bad day, and home availability. SSB intake was lowered by 0.07 SSB/day from male to female and by about 0.06 SSB/day from adolescents whose parents had public/uninsured to private insurance. SSB intake was higher from White to non-Hispanic Black by about 0.12 SSB/day, and was lower from White to other by about 0.10 SSB/day. As adolescents’ media susceptibility increased by one unit, their frequency increased by 0.06 SSB/day. For each unit increase in adolescents’...
agreement that their parents allowed them to have SSB on a bad day, their intake increased by 0.15 SSB/day. Finally, for every one unit increase in SSB home availability, adolescents’ SSB increased by 0.27 SSB/day.

Adolescent sex, ethnicity (White vs. Black), and parent insurance remained significant across all five steps. Behavioral intention was a significant predictor until step 3, when self-efficacy and media susceptibility were added. Media susceptibility remained significant from step 3 to 5. Two parenting practices significantly predicted SSB intake in step 4. In step 5, allowing child to have SSB on bad day remained significant, and was the second strongest predictor after home availability.

BMI Related Results

Adolescents classified as obese had significantly higher SSB intake per day compared to those in the healthy weight category (p<0.01) (Table 3.1). Adolescent BMI was also associated with home availability of SSB. Those who reported SSB were “never” available in the home had significantly lower BMI compared to other adolescents (p<0.05).

Discussion

Importantly, this is the first known study that used a nationally representative sample and SEM perspective to understand adolescent SSB consumption. Our findings align with the literature that indicates adolescents consumer greater than one SSB per day, on average, which is higher than recommended amounts. This may be contributing to the poor of health of adolescents in the U.S., including high childhood obesity rates. Previous studies have explored factors across the SEM levels pertaining to adolescent SSB intake, but few studies have looked at the combined effects. The SEM places emphasis on the interaction and interdependence of
the various factors at each level, which can better inform multi-level interventions aimed at reducing adolescent SSB intake.20

When examining demographic and intrapersonal level factors independently, our findings were consistent with previous research. Other studies have found being non-Hispanic black, male, and public or no insurance, as significant independent predictor of adolescent SSB consumption.10,11 In our study, we found that this held true even when controlling for other factors, thus suggesting the importance of SSB intervention efforts among minority and low-income populations. Behavioral intention and self-efficacy were both significant predictors of SSB intake in the expected direction, but only when controlling for demographic variables. Once media susceptibility was added into the model, behavioral intention was no longer significant.

In our study, media susceptibility was considered an intrapersonal level variable because of how the questions were phrased. Once added, it became the strongest predictor of SSB intake and remained a significant predictor with interpersonal and environmental levels. This finding signifies the importance of addressing media at the intrapersonal level. Currently, only one known SSB intervention has reported on intervening among adolescents to improve media literacy skills.21 Addressing adolescent’s media literacy skills helps them understand the purpose of media and teaches them to critically think and make their own decisions about the messages they receive.22 Researchers and practitioners should incorporate media literacy concepts to help adolescents improve their susceptibility and SSB intake.

Contrary to previous findings around peer influences on health behaviors,23,24 we found social norms did not predict SSB intake when controlling for other factors. This finding is similar to Watts and colleagues who did not find significant associations between peer factors and SSB intake when accounting for other contexts (i.e. personal, home, school, media, neighborhood).14
Interestingly, in step 4 of the regression model, we found two parenting practices were associated with SSB intake in the expected direction. This suggests that parents may play a superior role in their adolescents’ SSB consumption, relative to their adolescents’ peer groups. Even though adolescents may become more autonomous, parental influences continue to play a major role in their health decisions. When designing and delivering health education to adolescents, efforts are also needed to target parenting practices pertaining to SSB.

The last SEM level explored was the home environment. When SSB home availability was added in the final step, it became the top predictor of SSB intake. Previous literature has found significant associations with home availability and SSB intake with and without consideration of other factors. This evidence is further solidified as research has found interventions that incorporated home environment showed greater reductions in child and adolescent SSB intake compared to other settings, such as school. Given this strong evidence, it is surprising that very few adolescent SSB interventions target the home setting. One recent systematic review of 55 child and adolescent SSB related interventions found that only four intervened at the home level. There is a clear need for researchers and practitioners to design and implement health promotion programs that focus on the changing the home SSB environment.

In our study, we found BMI was associated with higher SSB intake which confers the findings from other studies. Given that childhood obesity rates continue to trend upwards, and most significantly in adolescents, reducing SSB intake could be one effective obesity-related strategy. We also found adolescent BMI was significantly associated with home availability of SSB. Prior research has found 50% to 70% of SSB calories are consumed in the home setting, further highlighting the importance of adolescents’ home SSB environment.
Our study is not without limitations. It is important to consider that most of the intra- and interpersonal level variables were only available as single item questions, self-reported, and assessed SSB and junk food intake together. There are also limitations in how the FLASHE data set is available. For examples, parent income is only available as a dichotomous variable with a $100,000 cut-point, which limits interpretations for lower SES group in the U.S. Also, due to the dataset, this study was unable to consider higher level environmental and the policy level factors. Lastly, the FLASHE survey was cross-sectional in design, therefore causality cannot be determined.

Conclusions

Our findings can be used by researchers and practitioners to prioritize multi-level health education strategies to improve adolescent SSB intake. When identifying target populations for SSB interventions, low-income and minority communities should be prioritized. SSB interventions should also have strong media literacy components to help adolescents overcome the effects of SSB media exposure. Additionally, parents should be considered as important influencers, even above peers. Likewise, more interventions are needed to intervene at the home environment level. Future studies should aim to investigate these associations in longitudinal and experimental research designs.
Table 3.1: Adolescent sugar-sweetened beverage (SSB) intake by demographics (n=1,560)

<table>
<thead>
<tr>
<th>Demographic Factors</th>
<th>Category</th>
<th>n (%)d</th>
<th>Total times SSB consumed/day Mean (SD)</th>
<th>Test Statistic (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>775 (49.7%)</td>
<td>1.41 (1.30)</td>
<td>18.20 (&lt;0.001)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>785 (50.3%)</td>
<td>1.14 (1.14)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>12-14</td>
<td>788 (50.5%)</td>
<td>1.25 (1.23)</td>
<td>0.47 (0.493)</td>
</tr>
<tr>
<td></td>
<td>15-17</td>
<td>772 (49.5%)</td>
<td>1.30 (1.23)</td>
<td></td>
</tr>
<tr>
<td>Grade Level</td>
<td>Middle School</td>
<td>640 (41.0%)</td>
<td>1.22 (1.21)</td>
<td>1.37 (0.255)</td>
</tr>
<tr>
<td></td>
<td>High School</td>
<td>912 (58.4%)</td>
<td>1.31 (1.24)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ungraded/Other</td>
<td>7 (0.0%)</td>
<td>1.61 (2.03)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Non-Hispanic White</td>
<td>990 (63.5%)</td>
<td>1.19 (1.14)a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic Black</td>
<td>256 (16.4%)</td>
<td>1.58 (1.48)b</td>
<td>7.30 (&lt;0.001)</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>151 (0.1%)</td>
<td>1.32 (1.23)a,b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>146 (0.1%)</td>
<td>1.24 (1.26)a</td>
<td></td>
</tr>
<tr>
<td>Household Incomee</td>
<td>$0 - $99,999</td>
<td>1206 (77.3%)</td>
<td>1.35 (1.41)</td>
<td>2.75 (0.097)</td>
</tr>
<tr>
<td></td>
<td>&gt;$100,000</td>
<td>323 (20.7%)</td>
<td>1.20 (1.49)</td>
<td></td>
</tr>
<tr>
<td>Parent Health Insurance Typee</td>
<td>Private</td>
<td>1070 (68.6%)</td>
<td>0.77 (1.04)b</td>
<td>27.97 (&lt;0.001)</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td>427 (27.3%)</td>
<td>1.25 (1.35)a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uninsured</td>
<td>112 (7.2%)</td>
<td>1.05 (1.30)a</td>
<td></td>
</tr>
<tr>
<td>Adolescent Body Mass Indexe</td>
<td>Underweight</td>
<td>73 (0.0%)</td>
<td>1.43 (1.75)a,b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Healthy Weight</td>
<td>1027 (65.8%)</td>
<td>1.24 (1.32)a</td>
<td>4.62 (0.003)</td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>243 (15.6%)</td>
<td>1.32 (1.35)a,b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obese</td>
<td>191 (12.2%)</td>
<td>1.65 (1.80)b</td>
<td></td>
</tr>
</tbody>
</table>

*Post-hoc analyses was done using Tukey method. Values that do not share the same superscript letter are significantly different (p<0.05)

dDoes not always add up to 100% due to missing data

eReported by parent
<table>
<thead>
<tr>
<th>Category</th>
<th>n</th>
<th>Total times SSB consumed/day</th>
<th>Test Statistic (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrapersonal Level Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Behavioral Intention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I have thought about it and decided that I want to limit junk food and sugary drinks”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>98</td>
<td>1.85 (1.53)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.54 (&lt;0.001)</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>166</td>
<td>1.53 (1.55)&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Neither</td>
<td>338</td>
<td>1.27 (1.29)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>592</td>
<td>1.27 (1.34)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>361</td>
<td>1.18 (1.53)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Self-Efficacy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I feel confident in my ability to limit the amount of junk food and sugary drinks I eat and drink”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>98</td>
<td>1.78 (1.40)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.64 (&lt;0.001)</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>240</td>
<td>1.55 (1.42)&lt;sup&gt;a,c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Neither</td>
<td>238</td>
<td>1.14 (1.21)&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>632</td>
<td>1.26 (1.29)&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>348</td>
<td>1.25 (1.72)&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Media Susceptibility</strong>&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“When I see advertisements for food or drinks...”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I want to try the advertised food or drinks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I think the advertised food or drinks will taste good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I trust the messages advertised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>607</td>
<td>1.06 (1.19)</td>
<td>33.20 (&lt;0.001)</td>
</tr>
<tr>
<td>High</td>
<td>953</td>
<td>1.48 (1.52)</td>
<td></td>
</tr>
</tbody>
</table>
## Interpersonal Level Factors

<table>
<thead>
<tr>
<th>Social Norms</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>“My friends eat junk food or drink sugary drinks on most days of the week”</td>
<td>24</td>
<td>1.11 (1.22)$^{a,b}$</td>
<td>78</td>
<td>1.11 (1.19)$^{a,b}$</td>
<td>281</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parent Practice:</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>“If I’ve had a bad day, my parent(s) let me have junk food or sugary drinks to make me feel better”</td>
<td>476</td>
<td>1.01 (1.02)$^a$</td>
<td>331</td>
<td>1.12 (1.25)$^{a,b}$</td>
<td>452</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parent Practice:</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>“My parent(s) don’t buy a lot of junk food or sugary drinks for me”</td>
<td>124</td>
<td>1.53 (1.35)$^a$</td>
<td>298</td>
<td>1.54 (1.48)$^a$</td>
<td>339</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parent Practice:</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>“My parent(s) try to avoid eating junk food or drinking sugary drinks when I’m around”</td>
<td>199</td>
<td>1.48 (1.35)</td>
<td>293</td>
<td>1.35 (1.18)</td>
<td>433</td>
</tr>
<tr>
<td>Parent Practice:</td>
<td>Strongly Disagree</td>
<td>Somewhat Disagree</td>
<td>Neither</td>
<td>Somewhat Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>---------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>“My parent(s) and I decide together how much junk food or sugary drinks I can have”</strong></td>
<td>229 1.34 (1.24)</td>
<td>294 1.27 (1.19)</td>
<td>400 1.23 (1.28)</td>
<td>435 1.42 (1.50)</td>
<td>198 1.30 (1.92)</td>
</tr>
<tr>
<td><strong>“My parent(s) have to make sure that I don’t eat too much junk food or drink too many sugary drinks”</strong></td>
<td>217 1.15 (1.13)</td>
<td>259 1.18 (1.14)</td>
<td>323 1.25 (1.30)</td>
<td>468 1.41 (1.46)</td>
<td>287 1.45 (1.76)</td>
</tr>
<tr>
<td><strong>“My parent(s) decide how much junk food or sugary drinks I can have”</strong></td>
<td>192 1.31 (1.25)</td>
<td>270 1.24 (1.08)</td>
<td>387 1.27 (1.41)</td>
<td>450 1.35 (1.36)</td>
<td>257 1.39 (1.90)</td>
</tr>
<tr>
<td><strong>“It’s okay for my parent(s) to make rules about how much junk food or sugary drinks I have”</strong></td>
<td>124 1.32 (1.23)</td>
<td>131 1.37 (1.16)</td>
<td>414 1.27 (1.26)</td>
<td>543 1.35 (1.46)</td>
<td>342 1.30 (1.68)</td>
</tr>
</tbody>
</table>
### Home Environment Factors

<table>
<thead>
<tr>
<th>SSB Availability</th>
<th>Frequency</th>
<th>Mean (SD)</th>
<th>F (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>110</td>
<td>0.41 (0.67)(^a)</td>
<td>44.47 (p&lt;0.001)</td>
</tr>
<tr>
<td>Rarely</td>
<td>308</td>
<td>0.71 (0.81)(^a)</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>451</td>
<td>1.35 (1.38)(^b)</td>
<td></td>
</tr>
<tr>
<td>Often</td>
<td>366</td>
<td>1.56 (1.51)(^b)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>319</td>
<td>1.88 (1.66)(^c)</td>
<td></td>
</tr>
</tbody>
</table>

How often are sugary drinks like regular soda, sports drinks, fruit drinks, sweetened teas and other drinks with added sugar and drinks available in your home?

\(^a,b,c\) Post-hoc analyses was done using Tukey method. Values that do not share the same superscript letter are significantly different (p<0.05)
Table 3.3: Step-wise regression model to predict adolescent sugar-sweetened beverage (SSB) intake using factors across the socioecological model (n=1,560)

<table>
<thead>
<tr>
<th></th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
<th>Step 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R^2 )</td>
<td>0.032</td>
<td>0.039</td>
<td>0.061</td>
<td>0.107</td>
<td>0.162</td>
</tr>
<tr>
<td>(p-value)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>( R^2 \Delta )</td>
<td>--</td>
<td>0.007</td>
<td>0.022</td>
<td>0.046</td>
<td>0.055</td>
</tr>
<tr>
<td>(p-value)</td>
<td>--</td>
<td>(0.001)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>Sex (Male vs. Female)</td>
<td>-0.075**</td>
<td>-0.063*</td>
<td>-0.059*</td>
<td>-0.062*</td>
<td>-0.066*</td>
</tr>
<tr>
<td>Parent Insurance</td>
<td>-0.096***</td>
<td>-0.092***</td>
<td>-0.080**</td>
<td>-0.067**</td>
<td>-0.058*</td>
</tr>
<tr>
<td>Ethnicity 1</td>
<td>0.019</td>
<td>0.024</td>
<td>0.033</td>
<td>0.024</td>
<td>0.053</td>
</tr>
<tr>
<td>Ethnicity 2</td>
<td>0.150**</td>
<td>0.146**</td>
<td>0.117**</td>
<td>0.136**</td>
<td>0.116**</td>
</tr>
<tr>
<td>Ethnicity 3</td>
<td>-0.089</td>
<td>-0.084</td>
<td>-0.073</td>
<td>-0.085</td>
<td>-0.096*</td>
</tr>
<tr>
<td>Behavioral Intention</td>
<td>--</td>
<td>-0.086**</td>
<td>-0.055</td>
<td>-0.043</td>
<td>-0.030</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>--</td>
<td>--</td>
<td>-0.060*</td>
<td>-0.012</td>
<td>-0.010</td>
</tr>
<tr>
<td>Media Susceptibility</td>
<td>--</td>
<td>--</td>
<td>0.137***</td>
<td>0.096***</td>
<td>0.064*</td>
</tr>
<tr>
<td>Social Norms</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.046</td>
<td>0.023</td>
</tr>
<tr>
<td>Parent Practice: Bad Day</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.182***</td>
<td>0.152***</td>
</tr>
<tr>
<td>Parent Practice: Not Buy A lot</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-0.085**</td>
<td>0.011</td>
</tr>
<tr>
<td>Parent Practice: Not Eat Too Much</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.044</td>
<td>0.046</td>
</tr>
<tr>
<td>Home Availability</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.265***</td>
</tr>
</tbody>
</table>

\(^\text{*} R^2 \Delta <0.05 \)  \(^* p <0.05 \)  \(^{**} p <0.01 \)  \(^{***} p <0.001 \)
References


CHAPTER 4: MANUSCRIPT 3

Title: Development and testing of mobile phone short message service (SMS) messages to reduce sugar-sweetened beverage intake in rural caregivers and adolescents: A mixed-methods study
Abstract

Background: High consumption of sugar-sweetened beverages (SSB) pose significant health concerns, particularly in health disparate groups, such as rural adults and adolescents. Developing innovative multi-level strategies that target caregivers as the agents of change could be a promising way to improve both, adolescent and caregiver health. Short message service (SMS) messages (i.e. text messaging via cell phones) have been cited as an effective way to produce positive behavioral outcomes, although not much research has been conducted in rural areas, particularly focusing on SSB intake.

Objective: The objective of this study is to develop a bank of culturally relevant SMS messages intended for rural caregivers that aim to reduce caregiver and adolescent SSB intake.

Methods: A convergent mixed-methods design was used to systematically develop and test SMS messages with caregivers in Southwest Virginia. In phase one, five focus groups and a card-sorting activity were conducted to explore acceptability, content preferences (tone of voice, audience, liked/disliked phrases) and use of SMS. In phase two, a 5-week SMS pilot trial with the same participants was used to re-evaluate these constructs and to examine effects on SSB intake and behaviors.

Results: Overall, participants (n=33) found the SMS highly acceptable. Caregivers felt the SMS were convenient, more accessible, and easier to read than other means of communication. Additionally, caregivers preferred an empathetic and authoritative tone of voice, as long as it was providing useful strategies, and stayed away from using absolute words (i.e., always, never). The phase two, pre-post SMS pilot trial survey revealed significant caregiver improvements in home environment, parenting practices,
and rule making around SSB (all p<0.05). Also, SSB intake among caregivers and adolescents significantly improved (p<0.01).

**Conclusions:** Findings from this study were used to develop a final bank of SMS messages, which will be used in a future study testing the effectiveness of an SMS intervention of caregivers’ SSB-related behaviors.
Introduction

Sugar-sweetened beverages (SSB) pose significant health concerns due to the large amounts consumed across the United States (U.S.).\textsuperscript{1} High consumption is even more concerning in health disparate groups, including among rural adults and adolescents.\textsuperscript{2} Rurality status has been associated with an increased likelihood of drinking more than three cans of SSB per day, which is considerably higher than the recommendations and national level intake.\textsuperscript{3,4} Several systematic reviews and meta-analysis have identified health risks associated with increased SSB consumption which include obesity, cardiovascular disease, and obesity-related cancers.\textsuperscript{5-7} These chronic diseases are also known to be disproportionately high in rural areas.\textsuperscript{8-10} Developing strategies to reduce SSB intake, as part of adolescent-focused programs that also target caregivers as the agent of change in the home, could be a promising way to improve both adolescent and caregiver SSB intake.

Many studies have found that caregivers are significant influencers of adolescent dietary habits through their role modeling of behaviors, parenting practices, and management of the home environment.\textsuperscript{11,12} In rural areas multi-level interventions for adolescent SSB consumption that incorporate caregivers are substantially lacking.\textsuperscript{13} One possible reason for this is the multitude of barriers faced by rural resident such as lack of transportation, geographical dispersion, and reduced health services that make it difficult to access disease prevention programming.\textsuperscript{14} There is a need to develop and test scalable strategies that overcome these barriers while engaging rural caregivers and increasing reach.
One such strategy that is gaining momentum is the use of short message services (SMS) or text messaging for behavior change. Mobile phone and SMS use is rising rapidly in the U.S., with 95% of the adult population owning a mobile phone with SMS capabilities.\textsuperscript{15,16} In rural areas, 91% of adults have SMS enabled phones, and 65% of these are smartphones.\textsuperscript{16} Use of SMS is particularly high in low socioeconomic populations and those with poorer health, thus making SMS a prime modality for health interventions in rural areas.\textsuperscript{17} In addition, systematic reviews have found that interventions utilizing SMS-delivered interventions have been effective in producing positive behavioral outcomes.\textsuperscript{17,18} Specifically, some preliminary studies have indicated that SMS has been shown to have promise in delivering SSB strategies via SMS.\textsuperscript{19,20} One small study that included SSB as a target found that attrition rates were lower and adherence to self-monitoring was significantly higher when compared to control groups. However, there are no known published studies that use SMS targeted at rural caregivers to reduce SSB intake among both caregiver and adolescent.

While interventions using SMS for health behavior change are on the rise, few have documented theoretical rationales.\textsuperscript{18} Like with any intervention, it is important to ground the content of SMS in behavior change theory to optimize the likelihood of promoting behavior change.\textsuperscript{21} There is also an unseen aspect to the content of SMS messages. Linguistic theory can provide insight into how the language and ‘paralanguage’ (i.e. the non-lexical features) of the messages play a role in the overall meaning and effect.\textsuperscript{22} These features of the messages are elements such as tone of voice and message phrasing.\textsuperscript{22} These issues become increasingly important when delivering health education messages that are short and limited in characters, such as the 160-
character limit for SMS. One study by Pollard and colleagues explored the tone of voice and content of SMS messages created for changing dietary behaviors. They found that offering substitutes and empathetic tones were most likely to motivate behavior change in young adults. As suggested by linguistic theory, spending time in formative phases to understand these features specific to the target population may increase effectiveness of the SMS messages to change SSB behaviors.

The objective of this study is to develop SMS messages targeted at caregivers and conduct a two-phase feasibility study with caregivers of adolescents in rural Southwest Virginia. Primarily, this study explored acceptability, content preferences (tone of voice, liked and disliked words, target audience), and perceived use of SMS through focus groups. Secondarily, an SMS pilot trial was conducted to understand actual use of text messaging and re-evaluate content preference and acceptability. Lastly, as an exploratory aim, this study examined effects of the SMS pilot trial on SSB intake and behaviors of caregivers and their adolescents. Findings from this study will inform the development of a larger scale multi-level intervention targeting SSB intake among adolescents and their caregivers.

Methodology

Design

This formative study took place from August 2017 to August 2018. A convergent mixed-methods design was used to systematically develop and test SMS, and included an initial development stage and two phases of message testing (see figure 4.1). The development stage focused on crafting a sample set of SMS messages that was also reviewed by a panel of experts. The two phases of testing included focus groups with a
card sorting activity and a five-week pilot SMS trial. A pre-post survey was conducted at the beginning of the focus group and end of the pilot trial. Also, individual follow-up telephone interviews were conducted with participants following the pilot SMS trial.

This study was approved by the Institutional Review Board at the University of Virginia. Participants reviewed and signed an informed consent at the beginning of the focus group and prior to any study activities. Participants received a $25 gift card after the focus group, and another $25 gift card after completing the follow-up interview.

Participants

To be eligible, participants had to be at least 18 years of age, have a child in middle school (grades 5 through 8), speak English, and own a mobile phone with SMS capabilities. Recruitment took place in three counties across Southwest Virginia's central Appalachia. These counties included Tazewell, Wise, and Montgomery counties which have a rurality status of 7, 5, and 3 respectively, on the Rural-Urban Continuum Codes (i.e., 1 = metro/urban, 9 = non-metro/very rural).25

SMS Development Phase

The development process included crafting of a sample set of SMS messages by the research team. Messages were adapted from content used in a previous trial grounded in the Theory of Planned Behavior that aimed to reduce SSB consumption in rural adults.26 These messages consisted of two types, educational and strategy messages, which both aimed to reduce SSB intake. Content of the educational messages contained facts about SSB, such as what is considered an SSB and health risks of drinking them in excess. Strategy messages included strategies and tips caregivers could use to help the whole family reduce SSB intake (see Table 4.1 for example messages). Seven messages
were developed, four educational messages and three strategy messages, with each message written in three different tones of voice adapted from Pollard and colleagues (i.e. authoritative, empathetic, catchy, see Table 4.1 for definitions), and targeted towards three different audiences (i.e. caregiver, adolescent, family) for a total of nine different versions of each message (n=63). The length of each message was kept to 160 characters to stay within the maximum amount of text that can be sent to most mobile telephones. Subsequently, the research team developed a 23-item mixed-methods survey intended to assess face validity of the messages, that is, if the messages conveyed the intended tone of voice. This survey was emailed to an expert panel consisting of 15 registered dietitians, PhD, and/or graduate level behavioral health researchers. Descriptive statistics were used to analyze quantitative data and qualitative responses were summarized.

**SMS Testing Phase 1: Focus Groups with Card Sorting Activity**

*Focus Groups*

In the first phase of testing, five focus groups were conducted using methods as previously suggested. Each focus group consisted 4-9 participants, lasted around 120 minutes, was led by a trained moderator and co-moderator, and was audio recorded. At the start of the focus group, participants completed a survey (pre-post survey described further below). Then, a semi-structured focus group guide with open ended questions and probes was used to elicit thoughts around acceptability, content preference, and perceived use of SMS for changing SSB behaviors.

*Card Sorting Activity*

During the focus groups, participants also completed a card sorting activity to understand specific content preferences including tone of voice preferences, liked and
disliked words and phrases, and audience preferences. Card sorting techniques have been previously described as a systematic and efficient way to determine agreement or disagreement among respondents. Each participant was given a set of two educational and one strategy message cards (n=27), a sorting mat, a pink and green highlighter, and red stickers. Participants were first instructed to sort the cards into three piles: mostly liked, mostly disliked, and neutral. Next, participants went through their separated piles and used a green highlighter to highlight words and phrases liked and a pink highlighter for those disliked. Lastly, participants were instructed to place a red sticker on any card that triggered reactance, or made them feel angry, irritated, defensive, annoyed or aggravated. Participants were given the option to write comments on the cards and/or write new SMS messages.

Phase 1 Data Analysis

Discussions from focus group were summarized in notes, audio recorded, and audio files were transcribed. Notes and transcriptions were qualitatively analyzed using an inductive approach. First the data was reviewed by the primary interviewer multiple times and notes were taken to summarize all aspects of the content. This data was then categorized into themes and a codebook was developed to facilitate the next steps of analysis. Next, two additional reviewers independently reviewed all sources of data and identified meaning units that corresponded to the themes. Themes were reviewed for overlap and more were added or collapsed, as needed. Finally, the three reviewers met to discuss findings and resolve any discrepancies in data coding and gain consensus.

To analyze the card sorting activity, each card was coded with the tone of voice and audience. Descriptive statistics were used to understand preferences for tone of voice,
audience and liked and disliked phrases. The number of cards in the liked, disliked and neutral categories were combined from all focus group and frequencies were calculated to understand preferences for tone of voice and audience. To analyze liked and disliked phrases, green and pink highlighted words were tallied. Any additional written comments were also summarized. Findings from Phase 1 were incorporated and used to revise SMS before starting the pilot trial.

**SMS Testing Phase 2: Pilot Trial**

**Pilot Trial**

In the second phase of testing, focus group participants participated in a five-week SMS pilot trial. The first week of this trial introduced the program, reminded participants what counted as SSB, and assessed three baseline questions. The first message obtained caregiver intake and the second message obtained adolescent intake. The SMS software then separated participants into four categories based on consumption patterns: caregiver consumer/adolescent consumer, caregiver consumer/adolescent non-consumer, caregiver non-consumer/adolescent consumer, and caregiver non-consumer/adolescent non-consumer (see Figure 4.2). If either were an SSB consumer, the third message they were given was an option to select a personalized strategy that caregivers would randomly receive over the next few weeks (i.e. tasty alternatives, breaking your habit, home and shopping tips, parenting tips). If neither the caregiver or adolescent were SSB consumers, caregivers received positive reinforcement (e.g. “Congrats on drinking little to no sugary drinks! Keep up the good work.”) or responded with strategies they use with their own families (i.e. “Other families could use your help! What types of things do you do as a parent to help your child drink less (or no) sugary drinks?”). Over the next three weeks,
participants were sent two SMS per week: an educational message and a random strategy message from the category chosen (or positive reinforcement). The last week, participants received one last educational message followed by the second and final SSB intake assessment for the caregiver and adolescent. At the last assessment participants were given the option to choose one last strategy message based on consumption patterns. This message was then displayed immediately after they made their strategy type selection. Process data was collected on assessment response rate and changes in consumer type and strategy selection from baseline to follow-up.

The SMS-based SSB assessment used a one-item question adapted from the validated 15-item beverage intake questionnaire (BEVQ-15) to quickly assess the frequency of all SSB intake for caregiver and adolescent over the past week. Participants reported from seven categories: less than 1 time, 1 time, 2 to 3 times, 4 to 6 times, every day, 2 per day, or 3 or more per day. Responses were recoded to a continuous scale by dividing each response by 7 to reflect a frequency per day.

**Pre-post survey**

Demographics. Demographic information was collected from the survey administered during the focus group. Participants reported gender, year of birth, race/ethnicity, education and income. Race was reported across five categories and ethnic background was categorized as Hispanic or Non-Hispanic. Education was reported across six categories, ranging from completion of grades 0-8 to graduate school. Income level was reported on 12 categories ranging from <$5,000 to >$55,000.

SSB Intake. An abbreviated version of the validated BEVQ-15 was used to assess SSB intake. The BEVQ-15 includes questions that assess frequency and amount of each
individual SSB including, sweetened fruit drinks, soda, sweetened tea, sports and energy
drinks and coffee with cream and/or sugar. Using standardized scoring procedures,
frequency was recoded to a continuous scale by dividing each response by seven to
reflect a frequency per day and the amount reported was converted into fluid ounces.
These values were then multiplied to obtain an average daily fluid ounces per day, and
then were converted into calories per day.

SSB Home Availability. Caregivers reported home availability of each individual
SSB assessed on a five point Likert scale from “all the time” to “never”, taken from the
instrument developed by Van De Gaar and colleagues. Responses were reverse coded,
so that “0” would reflect “never” and “5” would reflect “all the time”, and recoded onto a
continuous scale. Availability of each type of SSB were then averaged to obtain
availability of all SSBs reported.

Caregivers’ SSB Related Environmental Factors. Items involving caregivers’
SSB related environmental factors was obtained from the instrument developed by Van
De Gaar and colleagues. These included parenting practices towards the adolescent’s
SSB intake (four items), rules at home around adolescent’s SSB intake (two items), and
role modeling of SSB behaviors (one item). Parenting practices asked questions around
how often the caregivers monitor their adolescent’s intake, if the adolescent is allowed to
drink SSB whenever he/she wants, if the adolescent receives an SSB when he/she asks
for it, and if the caregivers buys the adolescent SSB when he/she asks for it. Role
modeling asked one question around how often the caregivers drink SSB with the
adolescent and how often they drink SSB in total. Items were assessed on five point
Likert scale, with the exception of the two items around rules at home with adolescent,
which was reported as yes or no. All Likert-type responses were recoded onto a continuous scale for analysis.

Post-interview

Following the SMS pilot trial, participants also received a follow up-phone call. The calls were audio recorded and used semi-structured, open-ended questions with probes to reevaluate content preference, perceptions and acceptability of the SMS.

Phase 2 Data Analysis

Quantitative analyses were performed using SPSS statistical analysis software, version 25.0. Frequencies were used to analyze assessment response, consumer category, and personalized strategy choice rates. Descriptive statistics, including means and standard deviations, and paired t-tests were used to assess changes in SSB intake, home availability, parenting practices, and role modeling behaviors. Cohen’s d effect sizes for paired samples were calculated. A McNemar test was used to assess difference in the proportion of caregivers reporting “yes” versus “no” to making rules around SSB and Phi effect sizes were calculated. Discussions from post-interview were summarized in notes and audio recorded. Notes were qualitatively analyzed using an inductive approach.

Results

SMS Development Phase

The expert panel categorized SMS messages correctly 67% of the time and also revealed areas for improved clarity. The prominent finding that emerged from this panel was to create more distinction between authoritative and empathetic tones. These modifications were made to improve face validity of messages before moving into the testing phases (see Table 4.1).
Participants

A total of 49 caregivers were screened and eligible for the focus groups. Of these, 16 caregivers were either unable to be reached or had a conflict during the time the focus group was held. Overall, 33 caregivers were reached and agreed to attend the focus group. Most of the caregivers were female (85%), white (97%) and had an income greater than $55,000 per year (76%). Around 49% were college graduates, 30% had completed graduate school, 12% had some college, and 9% had completed high school only. Of these 33 caregivers, 31 participated in the pilot trial and 30 were reached for the follow-up interview.

SMS Testing Phase 1: Focus Groups with Card Sorting Activity

Semi-Structured Discussion

Table 4.2 illustrates the themes that emerged from the focus groups and sample quotations that represent the themes. Main themes emerged around advantages and disadvantages of using SMS for SSB behavior change, liked and disliked content and features of SMS, and thoughts around best practices to increase SMS use among caregivers (e.g., personalization, completing assessment via SMS, timing and frequency).

Some of the top advantages identified included that SMS are convenient due to the timing, more accessible than other means of communication such as fliers or emails, short and easy to read and understand, and are supported by most cellular plans in this region. Other advantages mentioned less frequently included that caregivers would respond much more quickly to SMS compared to other forms of communication and that using SMS may increase reach of the program. On the contrary, participants felt that some of the top disadvantages included some people may not have SMS capable devices,
poor coverage or service areas, and some may be using temporary phones or phone numbers. Some of the less common disadvantages mentioned includes that people will ignore the texts and that plans might have limited texting or charge for SMS.

After participants had a chance to review the SMS messages, they provided feedback around the liked content and features of the SMS. Some of the top themes that emerged included messages that contained memorable phrases, used a family approach or sparked discussion with family, provided useful information and solutions to drinking less SSB, and were phrased encouragingly. One of the less frequently mentioned liked feature included messages that relayed truthful information, such as what SSB companies do with their money. Some of the top disliked features included messages that “told them what to do” without providing any useful strategies, made them feel judged as a parent/caregiver, used symbols that may be hard to interpret, used condescending and demeaning tones, made assumptions about their drinking habits, or used absolute words such as “never”, “always” or “only.” Some of the less common cited disliked features included use of slang/trendy (e.g. “fam” or “nah”) or governmental/official (e.g. “research”) type words.

Lastly, participant provided thoughts around best practices to increase SMS use among caregivers. Some participants felt that personalizing with caregiver and/or adolescent name might grab attention, but some others also felt personalization was unnecessary and would not make a difference in their behavior. Participants also felt that doing assessments to check in on caregiver and adolescents SSB intake would be helpful in reaching their goals; however, the response quality might be poor. Some of the less frequently mentioned thoughts were that the assessments might increase accountability
but on the negative side, might be too lengthy. Most participants preferred or felt that most caregivers would benefit the most from the SMS delivered at a time when they are with the adolescent, such as afterschool. Some other participants felt that delivering messages at the start of the day, week or month, would be preferred since that is when most people set goals. Lastly, most participants agreed that 1-2 times per week was a good frequency to receive SMS.

*Card Sorting Activity*

All messages (n=63) were tested at least once, and several of them were tested two or three times. Data analyses revealed that there was no strong preference for messages framed for a particular target audience (Figure 4.3), however some tone of voice preferences emerged (Figure 4.4). Of all educational messages that were liked, 37% were empathetic, 34% were catchy, and 30% were authoritative (Figure 4.4). Of all personalized strategy messages that were liked, 43% were empathetic, 41% were authoritative and 16% were catchy (Figure 4.4). Some common words disliked included absolute words such as “only”, “always”, and “never”, and commanding words and phrases such as “stop” or “don’t be tricked”. Liked words included positive actions such as “practice” and “help.” Changes were made to messages based on recommendations from semi-structured discussions and card sorting activity before moving into the pilot trial.

*SMS Testing Phase 2: Pilot Trial*

*SMS Actual Use*

Of the 31 participants, 27 (87%) fully completed the baseline assessment (i.e., answered all three SMS questions on caregiver SSB intake, adolescent SSB intake, and
personalized strategy choice) (Table 4.3). There were also three partial completers and one non-responder at baseline. At the follow-up, 24 of 31 (77%) participants fully completed the three SMS assessment questions and there were two partial completers and one non-responder.

At baseline, 19 of 27 (70%) participants started in the caregiver consumer/adolescent consumer category 70%), but at follow-up only 8 of 27 (33%) were categorized into this group. At follow-up, most participants were categorized into the caregiver non-consumer/adolescent consumer bucket (11/24, 46%). When given the choice of strategy, home and shopping tips was the top choice at both baseline and follow-up (about 45%). The other strategies chosen were relatively evenly distributed, ranging from 8-17%. Also, 65% (15/23) of the participants changed their strategy from baseline to follow-up.

**SSB Behavior Change Reported via SMS**

Paired t-test analyses of the caregiver reported SMS based assessments found that both caregivers ($P = 0.003$) and adolescents ($P = 0.005$) significantly reduced their frequency of SSB intake per day and effect sizes were medium to large (Table 4.4).

**Pre-post Survey**

As further illustrated in Table 4.4, pre-post survey data found that caregivers significantly reduced their frequency of SSB intake per day ($P = 0.02$). Caregiver changes in SSB calories and fluid ounces per day were not significant, although intake in both units trended downwards with small to moderate effect sizes. Availability of total SSB in the home also significantly decreased ($P = 0.003$). When analyzed by individual SSB, home availability of coffee made with cream and/or sugar ($P = 0.001$), soda ($P =$
0.01), and sweet tea ($P = 0.02$) also each significantly decreased; yet sports drinks and sweetened fruit drinks did not change. Related to environmental factors, caregiver’s parenting practices significantly improved towards encouraging adolescent behaviors that promote reduce SSB intake ($P = 0.02$). Role modeling trended in the direction hypothesized, however was not significant. Related to SSB parenting rules, rules for when adolescents can have sugary drinks significantly increased ($P = 0.04$), yet rules for how many sugary drinks their adolescents can have didn’t significantly change. Effect sizes ranged from small to medium for all variables.

Post Interview

After completing the pilot trial, the majority of the participants (25/30, 83%) reported liking all the messages and higher acceptability of receiving an intervention component through SMS. Some statements made by participants about the trial included “It was encouraging and informative”, “I didn’t realize how much I drank until I joined your program”, and “It was a good way for me to start thinking about a plan.”

Most participants (28/30, 93%) reported that the number of messages sent were a good amount, and would have accepted more than two messages per week. There was a shift in more people reporting a preference of receiving messages in the evening time. Some of the ways that participants used the messages included making mental notes (17/30, 57%), sharing messages with family members, friends and coworkers (24/30, 80%), and looking back at messages as reminders (15/30, 50%).

All 30 participants who were reached for the follow up interview reported that the messages were beneficial to their family. Participants stated benefits such as “It gave me more ammunition as a parent”, and “It’s now at a point where we are discussing the issue
and consciously thinking about our choices.” Of these, 87% (26/30) reported making actual changes around SSB behaviors such as changing parenting practices (e.g. made rules around when and how many SSBs their adolescent can have, increased adolescent’s access to water and healthy alternatives), decreased home availability of SSBs, increased communication around making healthy drink choices, reducing SSB intake for both caregiver and adolescent, and a general constant awareness of their intake. The two participants that reported no changes were made, stated that they were either maintaining their intake or are now planning to make some changes.

Discussion

Principal Findings

This study used a concurrent, mixed-methods approach to develop and refine SMS messages intended to improve SSB behaviors in rural Southwest Virginian caregivers and adolescents. Overall through the use of focus groups and a pilot trial, it was found that SMS would be an acceptable way to deliver educational, strategy, and assessment messages to reduce SSB intake in both caregivers and adolescents. Additionally, there are unique cultural perspectives of rural caregivers to take into consideration around the language of behavior change messages that may help improve SSB behaviors. These include evaluating tone of voice with attention to the words, phrases, and other content and features preferred by the target population. Finally, this study produced some positive preliminary effects in caregiver and adolescent SSB behaviors. This is the first known study that evaluates SMS targeted to caregivers to reduce SSB intake in both caregivers and adolescents in a rural setting. Finally, this study
provides a framework for researchers testing SMS and can be utilized in other settings to increase cultural relevancy of interventions.

**Acceptability**

SMS have several advantages that make it a prime modality for health promotion and intervention delivery in rural areas. Such advantages include the low cost of implementing, convenience of accessing messages, and increasing reach to those who would otherwise be unable to attend an in-person intervention. Encouragingly, these advantages from the literature were also cited by participants in this current study. While most participants felt that the program was acceptable and beneficial, one of the top disadvantages mentioned in the focus group was that some caregivers may not have SMS capable devices. This perception is not consistent with a recent report that found 91% of rural residents in 2018 had access to mobile phones. The gap between the actual data and perceptions of rural residents may be due to the fact that mobile phone ownership has risen dramatically in the past few years, and perceptions have not yet modernized. Other disadvantages mentioned included, poor coverage in very rural areas and the use of temporary phones. Even given these disadvantages, participants felt that this program could be effective and beneficial in their respective communities. Given the potential continued increase in use of this technology in rural populations and the benefits it provides to overcoming barriers to accessing evidence-based programs, this is a crucial time to develop and test SMS-based interventions.

**Content Preferences**

As technology for delivering health behavior interventions advances, theoretical approaches must continue to be utilized. Few studies have documented the development
and testing process for SMS using theory-based approaches\textsuperscript{17}, particularly those that focus on the features of language. Linguistic theory postulates that word choice and underlying tones can help the target audience identify with the messages and, in conjunction with behavior change theories, can produce desired health outcomes.\textsuperscript{32} Furthermore, theorists have stated that considering cultural perspectives of the targeted population when developing health education messages could lead to not only an appreciation of the messages but ultimately adoption of the desired behavioral outcomes.\textsuperscript{33}

Results from the focus groups revealed several important language considerations for the targeted rural caregiver population and are supported by a study by Denham and colleagues around health messaging for Appalachian residents.\textsuperscript{34} Overall catchy type tones were disliked due the use of slang and trendy words that some participants found offensive, but the memorable aspect of these messages was liked. Authoritative tones were preferred, as long as the messages were providing useful strategies and stayed away from absolute words (i.e. always, never, only). Empathetic tones were also liked, as long as the messages were not making assumptions about the participants SSB behaviors or using condescending tones. Finally, although no audience preferences emerged from the card sorting activity, benefits of a family-based approach was a prominent theme that emerged from focus group discussion and the post interview. Importantly, Denham and colleagues found similar results when conducting focus groups around health messaging to decrease underage drinking and tobacco use, not exclusive to SMS.\textsuperscript{34} Their study suggests that messages should be based on fact, have a polite tone, and present information in a non-judgmental way, all which agree with the results presented here.
Furthermore, this same study found an importance on focusing on the family as a whole, particularly among women who felt they were the gatekeepers to their family’s health. Together these results suggest that preferences for message content and framing does not change between modalities or health behaviors, and they provide a strong foundation of evidence for future message development for the Appalachian area.

**SMS Use and Preliminary Effectiveness**

During the SMS pilot trial participants interacted with the messages, by responding to assessments, making mental notes, and sharing messages with family and friends. The high rate with which caregivers utilized the SMS in this study indicates that this may be an effective modality for caregivers to receive and track SSB related behavior change. This finding is supported by several studies which have found greater adherence to self-monitoring practices and higher intervention completion rates through use of SMS. Not only does SMS have the potential to increase adherence, results in this study suggest that SMS delivered to caregivers may also be an effective method to improve caregiver SSB related behaviors and reduce SSB intake of both caregivers and adolescents. Studies have found that parenting practices, home environment and parental role modeling have significant influence over adolescent SSB intake, but few studies have tested this using SMS. In one study by Grutzmacher and colleagues, it was found that delivering a nutrition and physical activity intervention through SMS to low-income parents of school-aged children was able to significantly improve home environment, parent behaviors and intake, and child intake around fruit and vegetable consumption. Findings from Grutzmacher and colleagues reinforce the current study's preliminary
results and emphasize the potential for SMS delivered to caregivers to change caregiver and adolescent health behaviors.

**Limitations**

The results of this study should be interpreted with limitations in mind. First our recruitment methods may have resulted in a more motivated and informed sample of caregivers. Caregivers that are less motivated to change their SSB intake may have had different reactions to the content of the messages. However, during the focus group elicitation process, caregivers were asked to think about themselves and their whole community. Second, due to the small sample size this study was not representative in terms of sex, income, education, and SSB intake. SSB intake in this population was lower than what has been found in prior research with representative samples. Thus, these factors limit the generalizability of the results. Future studies should aim to obtain a larger, more representative sample to strengthen these findings. Third, there are several limitations in interpreting behavior change results. Measures were self-reported by the caregiver and may have introduced bias or human error. Additionally, it is important to distinguish that the SMS strategy tested was not a stand-alone intervention. The pilot trial was prefaced by a focus group, so participants naturally received some education and face-to-face discussion around SSB prior to receiving messages, which makes it difficult to tease out the exclusive effects of the pilot trial. Finally, this study did not compare behavior change to a control group. Studies building upon this work should test the effectiveness of this strategy with a more methodologically rigorous study design.

**Conclusions and Future Directions**
This study aimed to develop and test culturally-relevant SMS messages to reduce the high consumption of SSB in rural areas, that may be contributing to the widespread health disparities. Spending time in the formative phases of SMS development helped understand the unique cultural perspectives and language preferences of our target population. Our study also found that delivering an intervention through SMS has the potential to reduce SSB intake in rural caregivers and adolescents, where SSB intake is a prevalent problem. This is promising since SMS has many benefits such as being low-cost, easily accessible, and asynchronous, which may help overcome some of the current barriers to programming faced by rural populations. However, additional, large scale studies are needed to determine engagement, adherence, and effects of an SMS intervention targeting SSB. Testing SSB interventions is essential to improving the health of rural areas.

The SMS based intervention to reduce SSB consumption in caregiver and adolescents shows promise, yet there are important considerations for future work. Future SMS studies should aim to incorporate the ability to choose frequency and timing of the delivery of messages to fit the needs of various caregiver work schedules and general preferences for increased adherence and response rates. Additionally, future studies should explore incorporating tailored feedback, as studies have shown they improve behavioral outcomes\textsuperscript{20,39}. Finally, for significant public health impacts, studies should be conducted to understand how SMS can be used or incorporated into interventions that target multiple levels of influence on caregiver and adolescent SSB behaviors.
## Tables and Figures

### Table 4.1: Example educational and strategy messages used in testing phases

<table>
<thead>
<tr>
<th>Audience Targeted</th>
<th>Authoritative: Tone conveys a commanding, all-knowing voice, and gives readers information to act on</th>
<th>Empathetic: Tone conveys that the reader’s struggles are understood, and then asks the reader to act on the information</th>
<th>Catchy: Tone uses pleasing, rhyming, and easy to remember words, to give reader information to act on</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Educational Message: Recommendations for Sugary Drinks</strong></td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where you can cut back.</td>
<td>We know it’s hard to cut back &amp; most people drink too much sugar. Adults should drink &lt;8oz &amp; kids should have 0 so start by figuring out how much you drink.</td>
<td>Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults can lead to a long and healthy life!</td>
</tr>
<tr>
<td>Caregiver Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where your child can cut back.</td>
<td>We know it’s hard for your kid to cut back their sugary drinks. Adults should drink &lt;8oz &amp; kids should have 0. Start by figuring out how much they drink.</td>
<td>Drink less, live more, throw sugar out the door! Helping your kids stop drinking sugary drinks can lead to a long and healthy life for them.</td>
</tr>
<tr>
<td>Adolescent Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where your family can cut back.</td>
<td>We know it’s hard for your family to cut back their sugary drinks. Adults should drink &lt;8oz &amp; kids should have 0. Start by figuring out how much they drink.</td>
<td>Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults, and 0 for kids can lead to a long and healthy life for the whole fam.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where your family can cut back.</td>
<td>We know it’s hard for your family to cut back their sugary drinks. Adults should drink &lt;8oz &amp; kids should have 0. Start by figuring out how much they drink.</td>
<td>Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults, and 0 for kids can lead to a long and healthy life for the whole fam.</td>
</tr>
<tr>
<td><strong>Strategy Message: Bringing Alternatives on the Go</strong></td>
<td>Stay on track when you’re on the go. Sugary drinks are everywhere, so always remember to pack your favorite non-sugary drink so you don’t</td>
<td>We know it’s hard to stay on track when you’re on the go. There may be sugary drinks where you go. Pack your favorite non-sugary drink</td>
<td>Don’t slip on your trip! Make sure to carry your favorite non-sugary drink when you leave the house to help stay on track.</td>
</tr>
<tr>
<td>Caregiver Focused</td>
<td></td>
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</tr>
<tr>
<td>Focus</td>
<td>Message</td>
<td>Adjusted Message</td>
<td>Final Message</td>
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<tr>
<td>---------------------</td>
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</tr>
<tr>
<td>Adolescent Focused</td>
<td>Make sure your child stays on track when on the go. Sugary drinks are everywhere. Always pack their favorite non-sugary drink so they don’t slip up.</td>
<td>We know it’s hard to stay on track when on the go. There may be sugary drinks where your child goes. Pack their favorite non-sugary drink so they don’t slip up!</td>
<td>Don’t let your child slip on their trip! Make sure they carry their favorite non-sugary drink when they leave the house to help keep them on track.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>Make sure your family stays on track when on the go. Sugary drinks are everywhere. Always pack their favorite non-sugary drink so they don’t slip up.</td>
<td>We know it’s hard to stay on track when on the go. There may be sugary drinks where your family goes. Pack their favorite non-sugary drink so they don’t slip up!</td>
<td>Don’t let your family slip on their trip! Make sure they carry their favorite non-sugary drinks when they leave the house to help keep them on track.</td>
</tr>
</tbody>
</table>

*These messages are the revised versions modified after face validity testing by the expert panel*
<table>
<thead>
<tr>
<th>Category: Advantages of Using SMS for SSB Behavior Change</th>
<th>Themes</th>
<th>Definitions</th>
<th>Sample Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenient/ good timing</td>
<td>Participants feel that SMS are convenient method of sending information due to timing</td>
<td>“I think one advantage is that they can look at it on their own time. If it comes through at a bad time, then I can look at it later and think about it when it is convenient.”</td>
<td></td>
</tr>
<tr>
<td>More accessible</td>
<td>Participants stated that they have their phone on them all the time or it is more accessible than other means of communication.</td>
<td>“You’ll get right to them…I mean they’ve got their phone on them.” “I’m thinking of it as opposed to various in comparison to like a flier that would be in a school notebook. It may not get lost because then you would see it more regularly I guess.”</td>
<td></td>
</tr>
<tr>
<td>Easy to read, re-read and understand</td>
<td>Participants felt that messages were a simple, easy method to send information because they are short and easy to understand. They can also be saved and re-read.</td>
<td>“Parents don’t wanna take a lot of time. They don’t wanna take you know, we even have parents who can’t read very well. I mean, you know so… that would be simple for them instead of, you know, [a handout] or a big long email.” “If you send me a text, most likely I’ll have a phone and most likely I can reread that sucker if I need to reread it. For me that’s the reason I like text better”</td>
<td></td>
</tr>
<tr>
<td>Most plans support SMS</td>
<td>Participants stated that most cell phone plans include an SMS component, an unlimited SMS component, or only few percentage of people would not have SMS plans.</td>
<td>“Nobody complains when I send a text, so…” “I think the texts are pretty much unlimited…It’s probably data that would be the issue.”</td>
<td></td>
</tr>
<tr>
<td>Quick</td>
<td>Participants stated that they would respond much more quickly to an SMS than to other forms of communication</td>
<td>“I know you’ll get me faster if you send me a text than you will an email.”</td>
<td></td>
</tr>
<tr>
<td>Category: Disadvantages of Using SMS for SSB Behavior Change</td>
<td>Participants felt that more people would be reached through sending SMS compared to other forms of communication</td>
<td>“You’d be including more people. Most people have a cell phone now. I’m one of the few who still has a landline in their house.”</td>
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<tr>
<td>No SMS capable devices</td>
<td>Participants felt that people in the region may not have SMS capable devices</td>
<td>“Well I guess there could be some that wouldn’t have the technology, they wouldn’t have a cell phone. Depending on where you are.”</td>
<td></td>
</tr>
<tr>
<td>Poor coverage/service areas</td>
<td>Participants reported that some areas in the region would have poor reception, coverage, or service.</td>
<td>“There’s still places that don’t [have service]. I know a friend of mine that has to wait till she comes up the road.” “I lived up in [redacted]. You’d have to sit out on the porch with your arm like that. When they did have service out there you wasn’t getting none.”</td>
<td></td>
</tr>
<tr>
<td>Temporary phones/numbers</td>
<td>Participants stated that people in this region might have temporary phones and phone numbers that change often.</td>
<td>“We know that from trying to get ahold of parents. They may have one phone and the next month that number doesn’t work anymore. It’s very difficult.”</td>
<td></td>
</tr>
<tr>
<td>Can be repetitive/People can easily ignore</td>
<td>Participants felt that receiving SMS about the same behavior every week may be repetitive and it can be easy for people to ignore.</td>
<td>“…there’s probably a too often you know that people will tune it out, but I don’t know what that cutoff is.”</td>
<td></td>
</tr>
<tr>
<td>Plans have limited SMS</td>
<td>Participants stated that cell phones may not have an unlimited SMS component, or may get charged for receiving SMS.</td>
<td>“And I wonder, does everybody automatically have unlimited texting? I don’t know if that’s something.”</td>
<td></td>
</tr>
<tr>
<td>Category: Liked Content &amp; Features of SMS</td>
<td></td>
<td></td>
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<tr>
<td>Memorable phrases</td>
<td>Participants liked messages that contained</td>
<td>“It rhymed and it would be easy to remember if you”</td>
<td></td>
</tr>
<tr>
<td><strong>Family approach</strong></td>
<td>Participants liked messages and phrases that targeted a family approach for drinking less SSB.</td>
<td>“And I think that as a mom, we think more of the family as opposed to one child. Does that make sense? Because since you’re targeting middle school, you may have younger kids and you may have older kids, whereas if you’re targeting a family you can change everybody’s, and then you’re helping all age groups.”</td>
<td></td>
</tr>
<tr>
<td><strong>Provides useful information</strong></td>
<td>Participants liked messages that provided useful advice, information and solutions to drinking less SSB.</td>
<td>“Yeah. It gives you clear cut instructions….Some things you think it doesn’t have sugar, but it teaches you’ll always look for the label and if it says zero then it’s [ok].”</td>
<td></td>
</tr>
<tr>
<td><strong>Telling you what to do with strategies</strong></td>
<td>Participants like messages that told them what to do as long as they were telling them what strategies to try.</td>
<td>“I think I would like to see more tips for how, how to reduce. Like give me some ideas. I might not know where to start.”</td>
<td></td>
</tr>
<tr>
<td><strong>Sparks discussion with family</strong></td>
<td>Participant liked messages that had a call to action that includes changing behaviors of or starting discussion with family members.</td>
<td>“…for younger kids it’s a way for you to know what they’re doing in school, and maybe a game to play with them to just reinforce those concepts.” “And maybe getting them involved in the process of it. Informing the child or informing your family this is what you need to be looking for in order to make a healthy choice.”</td>
<td></td>
</tr>
<tr>
<td><strong>Encouraging</strong></td>
<td>Participants liked encouraging messages.</td>
<td>“I guess I liked the fact that you’re saying yeah, we get that it’s hard to, but here’s an alternative. You’re not just saying “stop” or “don’t do it”, you’re saying “we understand it’s hard, but try this”.”</td>
<td></td>
</tr>
<tr>
<td>Category: Disliked Content &amp; Features of SMS</td>
<td><strong>Honest/Truthfulness</strong></td>
<td>“Keep reducing” kind of sounds like ‘hey, you’re doing it! You’re doing it! Just keep going’.”</td>
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<tr>
<td>Participants like messages that were honest, truthful, to the point, and without any “fluff”.</td>
<td>“The truth about [companies] using the pics and slogans to make us buy their products. I think that is the truth.”</td>
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</table>
| **Telling you what to do** | Participants disliked informational messages that told you what to do without giving useful strategies to help change that behavior. | “…if you tell somebody to stop doing something, that’s what they’re gonna do. They’re just gonna... [do] the opposite.”

“.they'll just skip it. You know if you're telling me what to do, I'm not going to even read the rest of that, so.” |
| **Judging** | Participants disliked messages that were judging them as a parent or insinuating poor parenting. | “I looked more at “don’t slack, [cut back!]”. Well just because I give my kids PowerAde, doesn’t mean I’m a slacking parent. Slacker to me means negative. And we are working as hard as we can to be the best parent we can be. And you’re saying if I give my kid a sugary drink every now and then, I’m slacking.” |
| **Use of Symbols** | Participants disliked messages that used symbols such as greater than sign or an exclamation point because they felt people may not understand their meaning or purpose. | “I think the greater sign, some may not understand at all.” |
| **Condescending/demeaning tones** | Participants disliked messages that had condescending and demeaning tones | “I think tricky has been a word that has been overused a lot. It’s condescending that’s questioning intelligence. Questioning like you’re just zombies zoned into TV and not fully putting any thought into anything.” |
| Assumptions/making excuses | Participants disliked messages that made assumptions about their SSB habits or made excuses for their SSB habits. | “I’m not a victim of excuses. You just do it or you don’t. It’s not that it’s hard. You just do it.”
“The thing I didn’t like about it was, like "we know it’s hard to cut back". Like that sounds a little bit presumptuous. Why is it hard to cut back?” |
<table>
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<tbody>
<tr>
<td>Use of absolute words</td>
<td>Participants disliked words like always, never or only that represent an absolute or unbounded period of time.</td>
<td>“Mine was the “the labels always tell the truth”. That was something if I read that I would be skeptical automatically when I saw that “always tells the truth”. Because I guess that one of the words that you always look for. When you see always or never you never choose those.”</td>
</tr>
<tr>
<td>Blame displacement</td>
<td>Participants disliked messages that placed blame on companies or other entities for their adolescent’s SSB behaviors.</td>
<td>“That's why they are in business. I don't see that as a problem. I just don't like the idea of like she mentioned blaming McDonalds...it's their fault that I eat too many french fries. No, it's my fault that I eat too many... I don't like blaming people for what I do.”</td>
</tr>
<tr>
<td>Use of slang or trendy words</td>
<td>Participants disliked use of slang or trendy words like “fam” or “nah”.</td>
<td>“I don’t like the slang. Just because we’re Appalachian doesn’t mean we’re all hicks. I took that as a negative.”</td>
</tr>
<tr>
<td>Use of governmental or official words</td>
<td>Participants disliked use of governmental or official words, such as “research”.</td>
<td>“Where it says research, for someone who values research, or thinks about research frequently, that may make a difference, thinking about wow okay, that makes sense, or I didn’t realize that, whereas someone with a low, lower health literacy, it might be like “I don’t care”… I think it would turn them off.”</td>
</tr>
</tbody>
</table>

**Category:** Personalization of SMS

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103
<table>
<thead>
<tr>
<th>Grabs attention (positive)</th>
<th>Participants thought personalizing messages with adolescent/caregiver names grabs attention.</th>
<th>“…everybody loves to hear their name. If the parent's first name is on there, might draw them in more.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unnecessary (negative)</td>
<td>Participants felt that personalizing with names was unnecessary and/or would not make a difference.</td>
<td>“I don’t have to have a name. I just want you to tell me what you want to tell me and move it on. And then I’ll read your message. If it’s globbity glook I’m not going to read it probably. That’s just the truth.”</td>
</tr>
</tbody>
</table>

**Category: Completing Assessments via SMS**

<table>
<thead>
<tr>
<th>Helps with reaching goals (positive)</th>
<th>Participants felt that assessments would be beneficial in helping them keep track of and reach their goals.</th>
<th>“I mean, if you text me and I say what's at my house at the time, the likelihood is I'm gonna look around and see what's in the house and if I have a goal then I'm gonna work on decreasing it.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor response rates/unreliable responses (negative)</td>
<td>Participants felt that assessments may have poor response rates or that people may not be truthful in their reporting.</td>
<td>“…there's also some of these people may get into this initially and then they may just tell you what you wanna hear just to get you...get an answer to you.”</td>
</tr>
<tr>
<td>Increase accountability (positive)</td>
<td>Participants felt that assessments would be beneficial in increasing accountability for their goals.</td>
<td>“[It’s] like having an accountability group or somebody that's checking up on you.”</td>
</tr>
<tr>
<td>May be too lengthy/overwhelming (negative)</td>
<td>Participants felt that assessments may be too lengthy and therefore disliked by caregivers.</td>
<td>“Well don’t do it a lot or it will get on my nerves, but if you ask me one question I will probably answer you.”</td>
</tr>
</tbody>
</table>

**Category: Preferred Timing for SMS**

<table>
<thead>
<tr>
<th>While caregiver is with adolescents/afterschool</th>
<th>Participants felt receiving messages while with adolescents would be most beneficial.</th>
<th>“I like to send em right after school cause their kids are on the way home and… they're gonna say &quot;they've got this to do, this to do, all games”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of the month/week/day</td>
<td>Participants felt receiving messages at the start of the month or the week would be beneficial because</td>
<td>“Yeah I don’t have any worries yet in the morning. And if by 3 or 4 o’clock I’ve had a couple stresses”</td>
</tr>
</tbody>
</table>
that’s when people might plan and set goals. Probably that are taking up my mind, then a Coke is going to be fine, but in the morning, I might set a goal for water.”

| Category: Preferred Frequency of SMS | 1-2 times/week | Participants preferred receiving messages 1-2 time per week. | “One to two times a week…If you do more than that they aren’t going to respond.” |
Table 4.3 SMS response rates and changes in consumption category and personalized strategy choices

<table>
<thead>
<tr>
<th></th>
<th>Participants at Baseline (n=27)(^a)</th>
<th>Participants at Follow Up (n=24)(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td><strong>Caregiver &amp; Adolescent SSB Intake Category(^b)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver Consumer/Adolescent Consumer</td>
<td>19 (70%)</td>
<td>8 (33%)</td>
</tr>
<tr>
<td>Caregiver Consumer/Adolescent Non-Consumer</td>
<td>1 (4%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Caregiver Non-Consumer/Adolescent Consumer</td>
<td>3 (11%)</td>
<td>11 (46%)</td>
</tr>
<tr>
<td>Caregiver Non-Consumer/Adolescent Non-Consumer</td>
<td>4 (15%)</td>
<td>4 (17%)</td>
</tr>
<tr>
<td><strong>Chosen Personalized Strategy(^c)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home and Shopping Tips</td>
<td>12 (44%)</td>
<td>11 (46%)</td>
</tr>
<tr>
<td>Parenting Tips</td>
<td>4 (15%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Tasty Alternatives</td>
<td>3 (11%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Breaking your Habit</td>
<td>4 (15%)</td>
<td>4 (17%)</td>
</tr>
<tr>
<td>Positive Reinforcement/Qualitative Response</td>
<td>4 (15%)</td>
<td>4 (17%)</td>
</tr>
</tbody>
</table>

\(^a\) Only considers participants that fully completed both baseline and follow-up assessments. At baseline, there were three partial completers and one non-responder. At follow-up there were two partial completers and one non-responder. Participants were considered partial complete if they didn’t respond to all three assessment questions, and were not considered in the calculations for changes in consumption category and personalized strategy choice.

\(^b\) Categories were assigned based on responses to assessment. Caregiver/Adolescent were considered consumers if SSB intake was ≥ 2 to 3 times per week.

\(^c\) Caregivers who were consumers or had an adolescent that was a consumer were given the choice between strategies. Non-consumers received positive reinforcement messages or were asked for some tips they would give other families.
Table 4.4 SSB Related Behavior Change from SMS Assessment and Pre-Post Survey (n = 29) a-h

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline m (SD) or %</th>
<th>Follow-up m (SD) or %</th>
<th>Effect size b</th>
<th>Test Statistic (P-value) h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SMS Assessment (Caregiver and Adolescent Intake)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver SSB intake frequency (times/day)c</td>
<td>0.60 (0.53)</td>
<td>0.22 (0.40)</td>
<td>.82</td>
<td>3.241 (.003)</td>
</tr>
<tr>
<td>Adolescent SSB intake frequency (times/day)c</td>
<td>0.77 (0.70)</td>
<td>0.46 (0.41)</td>
<td>.54</td>
<td>3.103 (.005)</td>
</tr>
<tr>
<td><strong>Pre-Post Survey Assessment (Caregiver Intake Only)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSB intake Frequency (times/day)c</td>
<td>1.26 (1.25)</td>
<td>0.85 (0.88)</td>
<td>.38</td>
<td>2.435 (.02)</td>
</tr>
<tr>
<td>SSB intake in fl ozd</td>
<td>17.70 (28.73)</td>
<td>9.60 (9.64)</td>
<td>.38</td>
<td>1.633 (.12)</td>
</tr>
<tr>
<td>SSB intake in kcald</td>
<td>184.42 (252.53)</td>
<td>105.83 (110.71)</td>
<td>.40</td>
<td>1.813 (.08)</td>
</tr>
<tr>
<td><strong>SSB Availability in the Home</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total SSBe</td>
<td>1.90 (0.70)</td>
<td>1.47 (0.74)</td>
<td>.60</td>
<td>3.266 (.003)</td>
</tr>
<tr>
<td>Coffee w/cream and/or sugare</td>
<td>1.86 (1.33)</td>
<td>1.21 (1.26)</td>
<td>.50</td>
<td>3.732 (.001)</td>
</tr>
<tr>
<td>Sodae</td>
<td>2.25 (1.43)</td>
<td>1.71 (1.36)</td>
<td>.39</td>
<td>2.737 (.01)</td>
</tr>
<tr>
<td>Sweetened Teae</td>
<td>1.46 (1.23)</td>
<td>1.07 (1.21)</td>
<td>.32</td>
<td>2.499 (.02)</td>
</tr>
<tr>
<td>Sports/Energy Drinks e</td>
<td>1.57 (1.60)</td>
<td>1.18 (1.72)</td>
<td>.24</td>
<td>1.036 (.31)</td>
</tr>
<tr>
<td>Sweetened Fruit Drinks e</td>
<td>2.40 (1.17)</td>
<td>2.27 (1.15)</td>
<td>.11</td>
<td>0.486 (.63)</td>
</tr>
</tbody>
</table>

**Notes:**
- a: Calculated from survey responses.
- b: Effect size calculated using Cohen’s d.
- c: Based on daily intake.
- d: In fluid ounces and kilocalories.
- e: SSB availability measured.
- h: Significance level for statistical tests.
<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean (SD) 1</th>
<th>Mean (SD) 2</th>
<th>Effect Size</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenting Practices f</td>
<td>3.20 (0.8)</td>
<td>3.45 (0.54)</td>
<td>.37</td>
<td>-2.519 (.02)</td>
</tr>
<tr>
<td>Role Modeling f</td>
<td>2.98 (0.7)</td>
<td>3.17 (0.54)</td>
<td>.30</td>
<td>-1.516 (.14)</td>
</tr>
<tr>
<td>Rules</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Are there rules in your home about when your child can drink sugary drinks?”</td>
<td>58.62% yes</td>
<td>82.76% yes</td>
<td>.36</td>
<td>4.000 (.04)</td>
</tr>
<tr>
<td>“Are there rules in your home about how many sugary drinks your child can drink?”</td>
<td>68.97% yes</td>
<td>79.31% yes</td>
<td>.39</td>
<td>0.571 (.45)</td>
</tr>
</tbody>
</table>

a Total of 29 responses were analyzed, however sample sizes fluctuate between variables due to missing responses.
b Effect size reported as Cohen’s d, except for the two variables around rule making which was reported as Phi
c Reported on 7-point scale from <1 time to 3 or more per day. Responses recoded to a continuous scale by dividing each response by 7 to reflect a frequency per day.
d Calculated by considering frequency per day and amount as reported in pre-post surveys
e Reported on a 5-point scale and coded so that 0 = never available, 4 = available all the time.
f Reported on a 5-point scale and coded so that a higher number represented a more positive behavior.
g Reported as yes/no
h Changes analyzed using paired t-tests expect for the two variables around rule making, which was analyzed using McNemar’s Test
Figure 4.1 Overall study design

Development Phase
Crafting a set of messages & expert panel review (n=15)

Testing Phase 1:
Focus Groups (n=33)*

Testing Phase 2:
5 week SMS Pilot Trial (n=31)*

Self-reported assessment points:

* Participants did not change across phases
SMS = Short Message Service
Figure 4.2 Flow diagram for the SMS-based assessment
Figure 4.3 Audience preferences for educational and personalized strategy messages
Figure 4.4 Tone of voice preferences for educational and personalized strategy messages


CHAPTER 5: GENERAL CONCLUSIONS
Improving the health of rural adults and adolescents is a national priority, as chronic disease and obesity rates exceed those seen in urban areas. Rural residents are experiencing higher mortality from cancer, heart disease, and all-cause mortality compared to their urban counterparts. Disparities in adult and childhood obesity rates and obesity-related behaviors (i.e. nutrition and physical activity), may be significant contributors to these chronic diseases. When considering the nutritional status of rural populations, excessive added sugars, and more specifically sugar-sweetened beverage (SSB) intake, is a prevalent problem. Some regional data from the rural Appalachian area suggests that added sugars intake is 24% higher when compared to the national levels. When looking at the source of these added sugars, national level analyses have found that overall SSB prevalence (drinking ≥1 SSB/day) and high consumption (drinking ≥ 3 SSB/day) are both significantly higher in rural populations. The work described in this dissertation provides essential information to understand the intake and the behavioral context of added sugars and SSB consumption in rural adults and adolescents. Furthermore, this work provides feasibility and preliminary effectiveness data from an innovative strategy to reduce SSB intake within these populations. Collectively, data from the three manuscripts described in this dissertation can be used to advance research initiatives to improve rural health disparities in Appalachia and beyond.

Synthesizing the Data: Important Findings and Implications

The first dissertation manuscript explored food sources of added sugars in the diets of adults residing in rural southwest Virginia, considered part of central Appalachia. While it is known that SSB is consumed in large amounts, its contribution to total added sugars intake was unclear. This manuscript found that SSB contributed to around 14% of
total energy intake, with the majority from soda, which is double the national levels. Moreover, analyses revealed that the relative contribution of solids versus liquid to added sugars, was reversed when comparing rural to national level data (rural: 65.5% from SSB and 35% from solids; national: 33% from SSB and 67% from solids). This study also provided a formal assessment on the types of soda consumed, finding that both cola (e.g. Coke, Pepsi) and citrus-flavored (e.g. Mountain Dew, Mello Yello) were top contributors of soda intake. This manuscript helped answer the question “where” added sugars is coming from and the next manuscript aimed to answer “what” factors are associated with this intake.

Prior studies have found a correlation between adolescent obesity and adult obesity and have established that adolescents are the highest consumers of SSB nationally. Therefore, it becomes reasonable to target prevention efforts towards adolescents for maximum health impact. The second dissertation manuscript focused on this susceptible group and sought to understand factors associated with SSB intake. Using a nationally representative sample and the socioecological model (SEM) to guide the process, findings revealed that media susceptibility and parenting practices explained more variance relative to adolescents’ behavioral intentions, self-efficacy and social norms. The adolescent’s home environment explained the most variance in adolescent SSB intake.

Findings from the first two manuscripts culminate into the final manuscript of this dissertation. Manuscript three used mixed methods to understand acceptability, content preferences and preliminary effectiveness of a short message service (SMS) intervention to reduce SSB intake in rural caregivers and adolescents. SMS has been suggested as a
prime modality to deliver health behavior interventions to rural population. In addition to the wide use of SMS among rural residents, it has the ability to overcome unique barriers to accessing programs traditionally experienced by rural populations (i.e. cost, community resources, transportation barriers). Findings from this study revealed that the use of SMS for SSB behavior change was highly acceptable and several content preferences emerged. These results helped to increased cultural relevancy of messages before testing the messages in the pilot trial. The pilot trial further demonstrated high utilization of SMS as well as significant caregiver improvements in home environment, parenting practices, and rule making around SSB. Also, SSB intake among caregivers and adolescents significantly improved. The results from this study provides preliminary effectiveness data for larger scale trials.

Together, the results acquired from these three manuscripts can help program planners in developing or adapting evidence-based interventions to reduce SSB consumption in rural areas, particularly in Appalachia. First, results can be used to define and prioritize targets for multi-level evidence based interventions that are developed or adapted. For example, program planners would want to ensure that the intervention targets changing the adolescents home environment, and intervening to improve parenting practices and media susceptibility as second priority would further enhance effectiveness. When considering intervention components, an SMS-strategy should be considered as way to engage adult and/or caregivers, or replace more resource intensive, costly strategies. Furthermore, these findings should be used to modify nutrition education materials to reflect more culturally relevant dietary behaviors. For example, nutrition education materials should have a strong emphasis on soda, and can provide
images and examples using commonly consumed sodas such as colas and citrus-flavored sodas so that participants may relate more to the behaviors. Applying these recommendations have the potential to increase cultural relevancy, engagement, adherence and effectiveness of an intervention to reduce SSB intake in rural Appalachian settings.

**Looking Ahead: Guidance for Future Research**

*Replicating Studies with Different Samples*

The work in this dissertation has identified gaps in the literature that should be addressed in future research. The methods used in all manuscripts should be repeated using a representative rural adolescent sample. Although the data from manuscript one on the top sources of added sugars offers specific insights into the rural food culture, different patterns may emerge from an adolescent sample and could provide further data to define dietary behaviors. Similarly, given that variations in SSB intake have been found between national and rural samples, variations may also be present in factors across the SEM that influence rural adolescent SSB intake. Repeating the methods outlined in manuscript three with rural adolescents is discussed in more detail in the next section. Lastly, due the sample in manuscript one and three being drawn from the Appalachian region of rural southwest Virginia, this dissertation may have limited generalizability to other rural regions. Opportunely, this research provides a methodological framework to repeat and test the utility of these studies in other rural populations. In fact, given the vast cultural differences of each rural area, repeating these studies in other communities is encouraged for the development of culturally appropriate interventions.
Development and Testing of SMS Messages for Rural Adolescents

Adolescence is an important developmental period where the establishment of positive health behaviors can reduce the burden of chronic disease into adulthood.\textsuperscript{16} Studies have suggested that rural adolescents in particular, are at greater risk for poor health outcomes due to increased risk factors for obesity.\textsuperscript{3,16} Systematic reviews of adolescent interventions have found that not only is there a large disparity in the amount of SSB interventions being conducted in rural compared to urban adolescents,\textsuperscript{17} but also there have been no mobile health efforts cited in rural areas with respect to changing dietary and physical activity behaviors.\textsuperscript{18} Rose and colleagues also found that adolescent generally found digital means of communication to be highly acceptable.\textsuperscript{18} Furthermore, the Pew Research Center reported that around 88\% of adolescents aged 13-17 in the United States had access to mobile phones, and there were no significant differences in ownership when comparing rural to urban adolescents.\textsuperscript{19} There is a great opportunity here to develop and test not only SMS but other mobile health interventions in rural adolescents to address their high consumption of SSB.

To fill these gaps in the literature, future studies should repeat the methodology as described in manuscript three with rural adolescents, with a few suggestions for improvement and advancement. First youth participatory principles should be utilized in all phases of the study, from adapting and constructing the SMS messages to informing the delivery of the interventions to not only increase the likelihood of acceptance of the intervention, but also to empower the adolescents in the community the study will be conducted.\textsuperscript{20} Second, in order to strengthen the study’s findings on effectiveness,
different samples of adolescents should be recruited for each phase of the study. Finally, the “think aloud” method should be deliberated for use within the focus groups, before the pilot trial, to understand more about how adolescents will interact with the SMS-based intervention.21

**SMS Effectiveness Study for SSB Behavior Change**

While this SMS strategy described in this dissertation shows promise in reducing SSB intake in caregivers and adolescents residing in rural southwest Virginia, this was not a primary aim of the study. It is also important to consider that the SMS pilot study was not truly a stand-alone intervention. Participants attended a focus group that preceded the pilot trial which provided some education and allowed participants to interact, which may have influenced health behaviors differently than a stand-alone SMS trial might have. Therefore, an additional trial using a methodologically rigorous design is needed to understand the effectiveness of an SMS-based intervention towards changing these behaviors.

This trial should be a comparative effectiveness study and a randomized control trial, where the SMS strategy is compared to a group that receives SSB educational and strategy messages from more traditional, yet effective means (i.e. attending in-person sessions and/or receiving information over the phone). Comparative effectiveness research, which places emphasis on stakeholder perspectives, has been suggested for reducing health disparities in susceptible populations, thus can be ideal for a rural setting.22 It can help ensure the most pressing needs of the community are addressed, increases community buy-in and appropriate allocation of resources while providing all
participants the opportunity to benefit. Moreover, this intervention should span a longer-period of time to determine long-term outcomes related to behavior change, adherence and retention.

Finally, this subsequent trial should be guided by a theoretical framework and should include outcomes that evaluate related constructs. While the SMS messages in the pilot trial were developed using the TPB, relative outcomes were not considered. Systematic reviews of mobile health interventions have consistently found that few efforts have provided a theoretical basis, and from those that did, few evaluated the constructs hypothesized to be affected by the intervention.\textsuperscript{23,24} Riley and colleagues have even argued that current behavioral theories are not sufficient to keep up with the changing world of mobile health interventions.\textsuperscript{23} They contend that traditional behavioral theories focus on constructs that influence a person’s behavior before they engage with the intervention, thus explaining between-participant differences. However, SMS interventions are able to adapt as a person changes behavior (e.g. in the pilot described in this study, participants receive different content based on SSB consumption patterns) and theoretical approaches must be able to describe with-in-person differences over length of the intervention.\textsuperscript{23} Nevertheless, in order to increase the understanding of traditional behavioral theories with the dynamic and adaptive nature of SMS interventions, it is essential to document theory-driven approaches and evaluate the hypothesized constructs. These data will contribute to the advancement mobile health behavior interventions and potentially the understanding of health behavior change overall.
Final Considerations

This work provides essential data for improving behaviors around added sugars and SSB intake that contribute to the disproportionate rates of health disparities in rural populations. To continue to advance these efforts, directions for future research are also specified. However, SSB and added sugars intake are only two of the various health behaviors contributing to the health disparities experienced by rural residents. This dissertation recognizes that improving rural health disparities is a complex issue requiring a systems levels approach that is perceptive of the shifts in cultures and physical environments in rural areas. Strategies discussed in this dissertation can be used to improve other health behaviors beyond SSB intake. There are opportunities for rural health researchers to work together with rural stakeholders and policymakers to utilize existing resources, programs and opportunities, with an ultimate goal of creating a comprehensive approach to improving health for both adults and children in rural areas.
References


APPENDICES
Assessing caregiver text messages to reduce sugar-sweetened beverage intake among middle school students

Study Screening Script

Hi [insert community member’s name],

[INTRODUCE YOURSELF].

[READ]: I am contacting you/talking to you today on behalf on University of Virginia. I am helping them conduct a study to develop and assess content of text messages for caregivers of middle school aged children that will be part of a future program to reduce sugar-sweetened beverage consumption. This current study is targeting the caregivers of middle school students. If you are a caregiver or parent of middle school student you may qualify for this study. This brief screening survey has 6 questions and will help determine if you are eligible to participate. By answering these questions, you agree to let the University of Virginia use the answers you provide to determine eligibility for a study being conducted in your community.

If you are eligible and interested in participating, the study has two parts. In the first part, caregivers who agree to participate will be asked to attend a 2-hour focus group to provide their opinions on text messages to reduce the intake of sugary beverages among middle school students. In the second part, caregivers will receive 2 text messages per week for one month. Then caregivers will be asked to complete a survey and telephone interview to provide feedback on the text messages. Eligible caregivers who would like to participate in this two-part study will receive $50 to compensate for their time.

The information you provide on this screening survey will be kept private; only the researchers will know how you replied. If you do not want to answer a question, you can skip it. If you have any questions about this screening survey, please ask the staff member who asked you to complete the survey or you can call Dr. Zoellner who is leading
this project at 434-962-4488. Would you like to take this survey today and see if you are eligible to participate?

Assessing caregiver text messages to reduce sugar-sweetened beverage intake among middle school students

Study Screening Survey

1. Do you have a child who is currently in middle school?
   ○ No   ○ Yes, please list current grades & name of middle school:
   __________________________________________________

2. Do you own a phone that you can receive text messages with?
   ○ No   ○ Yes

Next, we would like to know what beverages you have drank in the past month.

3. During the past 30 days, how often did you drink regular soda or pop that contains sugar? Do not include diet soda or diet pop. Select only one and fill in number.
   ○ ___ Times per day   ○ ___ Times per week
   ○ ___ Times per month   ○ Never

4. During the past 30 days, how often did you drink sugar-sweetened fruit drinks (such as Kool-aid™ and lemonade), sweet tea, and sports or energy drinks (such as Gatorade™ and Red Bull™)? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks. Select only one and fill in number.
Finally, we would like to know what beverages your middle school child has drank in the past month.

5. During the past 30 days, how often did your middle school child drink regular soda or pop that contains sugar? Do not include diet soda or diet pop. Select only one and fill in number.

   ○ ___ Times per day       ○ ___ Times per week
   ○ ___ Times per month     ○ Never

6. During the past 30 days, how often did your middle school child drink sugar-sweetened fruit drinks (such as Kool-aid™ and lemonade), sweet tea, and sports or energy drinks (such as Gatorade™ and Red Bull™)? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks. Select only one and fill in number.

   ○ ___ Times per day       ○ ___ Times per week
   ○ ___ Times per month     ○ Never

If qualify for this two-part study, are you interested in participating and providing your information to be contacted at a later time to schedule your appointment for a focus group?

   ○ Yes. (Please fill out information on the next page)
   ○ No, why not:__________________________________________
Name: ______________________________________________________

Mailing Address: ______________________________________________________

Home Phone Number: ____________________

Email Address: __________________________

Cell Phone Number: ______________________

Cell Receives Text Messages:    Yes ___ No ___

What day would you prefer to attend a focus group (check all that apply)?

○ Monday  ○ Tuesday  ○ Wednesday  ○ Thursday  ○ Friday  ○ Saturday  ○ Sunday

What time would you prefer to attend a focus group (check all that apply)?

○ Mornings (8am-11am)  ○ Afternoon (12pm-5pm)  ○ Evenings (6pm-9pm)

Thank you! Someone from our study team will contact you within the next 10 days.
Appendix B: Informed consent (Manuscript 3)

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: The purpose of this study is to use focus groups and surveys to find out how caregivers of middle school aged children react to text messages and what kind of content they would like to see in text messages. These text messages are being developed for caregivers as part of a future program designed to reduced sugar sweetened beverage (SSB) consumption among 7th graders in Southwest and Southside Virginia.

What you will do in the study: Your participation in this study will include attending one audio-recorded focus group, receiving a set of text messages over 4 weeks on your personal mobile device, and completing one audio-recorded follow-up interview over the phone.

The focus groups will include: (i) a brief introduction to the SSB reduction program that we are designing these text messages for, (ii) a survey that assesses your sugar-sweetened beverage intake, home environment, health and demographics, (iii) completion of a text message sorting activity, and (iv) an open discussion around receiving health related text messages and your feelings/opinions around the text messages proposed. Our study team will take your suggestions from this focus group to revise and improve the text messages. After the focus group, you will be enrolled in a text message system that will send your personal mobile phone 2-4 text messages per week for 4 weeks. The text message rate for the texts sent as a part of this study will be the same as your personal mobile phone plan. If you do not have unlimited texting messages, charges for each text may be applied to your phone bill. Following this 4-week period, we will send you a survey to complete and schedule a follow-up phone interview with you. You will be asked to complete a similar survey to the focus group survey including your sugar-sweetened beverage intake and home environment. In the phone interview, we will ask you questions about your opinions, feelings and behaviors related to the text messages.

You may skip questions that make you uncomfortable and can stop participation in the focus group, text-message trial or follow-up interview at any time.

Time required: The study will require about 4 hours of your time in total. The first part, the focus groups, are estimated to take a maximum of 2 hours on one day. The second part is estimated to take 2 hours, which consists of reading and responding to text messages, taking the survey, and completing the follow up phone interview.

Risks: There are minimal risks for being involved in this study. The only foreseeable risk is the possible inconvenience associated with answering the questions during the focus group or follow-up interview. Your responses will not be completely anonymous during
the focus group as there are other participants present. While we ask that everyone agrees to not to disclose anything said within the context of the discussion, it is important to understand that other participants may not keep all discussion points private and confidential. Also, you can decline to answer any questions in the focus group and follow-up interview, and you can ask the study staff to turn off the audio-recorder if there is a response you would not want taped. The time to complete this focus group may take you away from other responsibilities. Though we have made the focus group as short as possible if it goes over the allotted time or pressing responsibilities arise, you may leave to address them.

**Benefits:** There are no direct benefits to you for participating in this research study. However, the study may indirectly provide health benefits to you through receiving messages about reducing consumption of sugar sweetened beverages. This study will help us understand more about developing and testing text messages for cultural appropriateness and the practical use of text messages for health interventions in rural areas. Practice implications include the refining the text message so they can be shared more broadly to other parents and caregivers in your community in a future program.

**Confidentiality:** The information that you give in the study will be handled confidentially. Your information will be assigned a code number. The list connecting your name to this code will be kept in a locked file. When the study is completed and the data have been analyzed, this list will be destroyed. Your name will not be used in any report.

Since part of this study is a focus group and there are multiple participants, we ask that participants respect one another’s privacy and confidentiality by not disclosing anything said within the context of the discussion. Therefore, by consenting to participate in this study, you are also agreeing to keep the discussion points private and confidential.

**Voluntary participation:** Your participation in the study is completely voluntary.

**Right to withdraw from the study:** You have the right to withdraw from the study at any time without penalty.

**How to withdraw from the study:** To withdraw from the study, tell the study staff or interviewer you wish to stop participating in the focus group, mock text message trial, or follow-up interview. There is no penalty for withdrawing. You will still receive full payment for the portion of the study you attended. If you would like to withdraw after your materials have been submitted, please contact Jamie Zoellner, PhD, RD at (434) 962-4488.

**Payment:** In return for your input, we will provide you with a $25 gift card at the focus group and then another $25 gift card after the follow-up interview. Even if you decide not to continue the focus group or follow-up interview, you will still receive a $25 gift card for the portion you attended.
If you have questions about the study, contact:
Jamie Zoellner, PhD, RD
Principal Investigator
Associate Professor, Department of Public Health Sciences
University of Virginia, School of Medicine
Campus Address: P.O. Box 800717, Charlottesville, VA 22908-0717
Cancer Center Address: 16 East Main St, Christiansburg, VA 24073
Email: Jz9q@virignia.edu
Telephone: (434) 962-4488

If you have questions about your rights in the study, contact:
Tonya R. Moon, Ph.D.
Chair, Institutional Review Board for the Social and Behavioral Sciences
One Morton Dr Suite 500
University of Virginia, P.O. Box 800392
Charlottesville, VA 22908-0392
Telephone: (434) 924-5999
Email: irbsbshelp@virginia.edu
Website: www.virginia.edu/vpr/irb/sbs

Agreement:
I agree to participate in the research study described above.

Signature: ________________________________ Date: ____________

You will receive a copy of this form for your records.
Appendix C: Focus group script (Manuscript 3)

Assessing caregiver text messages to reduce sugar-sweetened beverage intake among middle school students

Focus Group Script

Introduction- 1 minutes
"Hello everyone, my name is ________ [provide a brief introduction of yourself]. I am helping out with a research study being conducted by the University of Virginia. This is a two-part study that will help us understand what kind of text messages caregivers of middle school age children would prefer to receive for a future program that we are designing to reduce consumption of sugary drinks. You are currently attending the first part of this study- the focus group. I would really appreciate your help today in informing me about your opinions and preferences for text messages. Any feedback is welcome and any information you can give will be very helpful to me and my project. Snacks and drinks are provided for you, please feel free to help yourselves throughout the length of this focus group."

Informed Consent- 15 minutes
"Before we begin, we will go over the informed consent document that you all have received in the mail to review. After reading through this together, you will have time to ask any questions and obtain any clarifications. If you agree to what is written in this document, please sign and date in the given area to indicate your participation in this study. We will then begin the focus group." [Read informed consent document & address any questions.]

Ice Breaker - 10 minutes (Action Syllables)

Sugar-Sweetened Beverage Intake, Home Environment and Demographics Survey- 20 minutes
"Before we introduce you the text messages portion of this focus group, we want to start of with a survey. The purpose is two fold: first we want to get a little more information about sugary drink intake of your family, how your home environment looks and some more demographic details about you such as gender, race and education level. Second, we want to test out this survey, and get your feedback about what you liked and didn't like. Feel free to write in the margins, circle/flag anything that you think is hard to understand etc. This survey should take you about 20 minutes to complete. For each response, pick the answer that fits you and your family the best." [QUESTION] "Was there anything about the survey that you have comment about or general impressions of the survey?"
KidsSIPSmartER Introductory PowerPoint - 5 minutes
“We want to begin by giving you a brief overview of the SSB reduction program that we are developing. This will help you understand why these text messages are being developed and how your feedback is so important.” [Go through presentation & address questions]

[QUESTION 1] “Before we get started with sharing the messages we have developed, I wanted to start with some general questions. What do you feel are some advantages and disadvantages of parents receiving text messages, compared to other forms of receiving information like email or phone calls, about reducing the consumption of sugary drinks of the whole family? [Probe: any more advantages? any more disadvantages or barriers? What types of text messaging plans do people in your area typically have?]”

(Break – 5 minutes if needed)

Text Message Ranking and Sorting Activity – 20 minutes
“We are now passing around the first of 3 sets of notecards. Each set corresponds to one topic area that we would like to address with a text message. As you can see, each text message is written in 9 different ways on 9 different notecards in one group. Let’s start with the first set of notecards.” [Read first message].

[Potential to Persuade]: “First what we would like you to do is sort these notecards into three piles: most favorite, neutral and least favorite. Your piles do not have to be even, you can put as many or as few as you would like in each pile.”

[Phrases Most Liked and Disliked]: “Next you will see in front of you two highlighters, green and pink. Keeping them in the same piles you just made, use green to highlight any words or phrases on these text messages that you really liked. Use the pink highlighter to highlight any words or phrases that you really disliked. You can highlight as many as you want, you do not have to highlight something on every message.”

[Reactance]: Third, we want you to look at all the messages one more time. Did any of these messages make you feel defensive, angry, annoyed, aggravated or irritated? Indicate this to us by placing the red stickers provided for you on the corner of these messages. If you have certain feeling towards the messages feel free to write them down on that note card.” [Give participants time to do this]

“We will repeat this process with the next two set of notecards.” [Co-facilitator collects the messages and organizes messages on a wall/board where all participants can see, into commonly liked and disliked categories while participants work on the next sets of notecards.]

Semi-Structured Interview- 40 minutes
[Allow co-facilitator to finish organizing messages while starting discussion.]
“Thank you everyone for taking some time to read through those messages. Now we want to start a discussion around what everyone thought of these messages. [QUESTION 2] “Now let’s draw our attention to the compiled messages on the board/wall. Overall, what are your feeling towards these specific messages?”
[Probes]

“Is there a particular message that stood out to you?”
“Did you notice that the audience was different for these messages? What do you think about that?”
[If there’s a particular tone of voice that sticks out, bring that to participant attention]
“We also framed these messages in different tones of voices: authoritative, empathetic and catchy. It seems like ____ tone of voice was most/least liked. What are your feelings/thoughts on that?”
[If there’s a particular word or phrase that most people did not like, bring that to participant attention]
“We can also see on the board that most of you did not like and/or really liked these specific words/-phrases: _______. Why is that?”
[If there’s a particular message that had a strong reactance, bring that to participant attention]
“We’ve also noticed that most of you had strong feelings of anger or irritation towards _____ message. Can anyone explain more about why that message brought on those feelings?”

[QUESTION 3] “Now we want to give you an opportunity to write your own message. You should have some blank cards in front of you that came with the group of messages, use these to either re-write a message that you see up here, or even write your own message. Feel free to write 1 or 2 messages [allow participants time to each write 1-2 of their own text messages and share with the group].

[QUESTION 4] “Now I want to gauge your feelings about personalized messages. How do you think it would make a difference, if any, if messages were to be personalized with parent and/or child name, or goals that they identified? Do you think it’s necessary?”

[QUESTION 5] “What are your opinions on having interactive or two-way communication type messages as part of this program? This means that parents would be able to respond to messages with the amount of sugary drinks they are drinking and having in the home for their child. In response, parents would receive strategies to help them if they are struggling. What are some advantages and disadvantages of doing this?

[QUESTION 6] “Now I want you take a moment and pretend you part of this program and are enrolled to receive text messages. I want to ask you a few questions about the delivery. First how often would you like to receive these types of text messages? How often are you likely to check your phone throughout the day? Next, what time of the day and/or days of the week do you think you would like to get the messages?”
[Probe]
“Think back to your own experiences receiving text messages. When are you most likely to look and reflect at these messages? When are you most likely to ignore the message? Do you get annoyed when you receive too many messages? How many is too many?”

**Conclusion**
We have reached the end of the focus group! Hooray! You receive a $25 dollar gift card for participating today. There is a gift card receipt sheet going around for you to sign and date. As a reminder, starting sometime in February you will start receiving these text messages to you over 4 weeks so we can get some feedback from you about the process. Following the 4 weeks, you are going to complete the KSS survey through mail and we will also do a follow up interview. Feel free to write down your thoughts and feelings as you receive these messages and any other notes about the overall process in the coming weeks. This may help you answer questions during the phone interview and will be very valuable to our study. Thank you for participating in the focus group today. We want you all to know that your input is very valuable to us and we will be using what we learned today to modify our current bank of text messages, and even develop new ones that we will use in Kids SIPsmarter.

[End of focus group]
Appendix D: Pre-post caregiver surveys (Manuscript 3)

Assessing caregiver text messages to reduce sugar-sweetened beverage intake among middle school students.

Thank you for participating in this survey!

Please read all the instructions, questions and answers closely. There are no right or wrong answers, please just report your honest opinions. Some of the questions may sound the same; this helps the project directors to fully understand your thoughts about the questions. It is important that you answer as many questions as you can.

Use the handout about sugary drinks provided to help you answer questions throughout the survey. Additionally, answer all child related questions about your middle schooler. If you have more than one middle schooler, answer questions for the younger one.

Here is an overview of the sections you will need to complete:

Part 1: Sugary Drink Intake and Home Environment
Questions 1-9

Part 2: Your Beliefs About Sugary Drinks
Questions 10-15

Part 3: Parenting Practices Around Sugary Drinks
Questions 16-45

Part 4: Media Literacy
Questions 46-52

Part 5: Quality of Life
Questions 53-57

Part 6: Demographics and Health Literacy
Questions 58-66

The survey starts on the next page.
KidsSIPSsmartER Survey

Part 1: Sugary Drink Intake and Home Availability

The first set of questions asks you about the types of drinks that you drink. For each drink, you will answer how often you drink it, then how much (refer to handout to see what each amount looks like), and lastly if you have them available for your middle-school child in your home. There are no right or wrong answers.

1. How often do you drink sweetened juice beverages/drinks (such as fruit aides, lemonade, punch, or Sunny Delight. Do not include 100% Juice)?

   - □ Never or less than 1 time per week (Skip 1a)
   - □ 1 time per week
   - □ 2-3 times per week
   - □ 4-6 times per week
   - □ 1 time per day
   - □ 2 times per day
   - □ 3 or more times per day

   1a) When you drink sweetened juice beverages/drink, how much do you normally drink at one time?

   □ less than 6 fluid ounces (or ¾ cup)
   □ 8 ounces (1 cup)
   □ 12 ounces (1 ½ cups)
   □ 16 ounces (2 cups)
   □ 20 ounces (2 ½ cups)
   □ >20 oz. specify amount__________

   1b) How often are all sweetened juice beverages/drinks available for your child at home?

   □ All the time
   □ Often
   □ Sometimes
   □ Almost Never
   □ Never

2. How often do you drink 100% fruit juice (such as 100% orange juice, grape, cranberry juice, and apple juice)?

   - □ Never or less than 1 time per week (Skip 2a)
   - □ 1 time per week
   - □ 2-3 times per week
   - □ 4-6 times per week
   - □ 1 time per day
   - □ 2 times per day
   - □ 3 or more times per day
2a) When you drink **100% fruit juice**, how much do you normally drink at one time?

- □ less than 6 fluid ounces (or ¾ cup)
- □ 8 ounces (1 cup)
- □ 12 ounces (1 ½ cups)
- □ 16 ounces (2 cups)
- □ 20 ounces (2 ½ cups)
- □ >20 oz. specify amount__________

2b) How often are **all 100% fruit juices** available for your child at home?

- □ All the time
- □ Often
- □ Sometimes
- □ Almost Never
- □ Never

3. How often do you drink **regular soft drinks** (NOT diet)?

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<th>□ Never or less than 1 time per week (Skip 3a)</th>
<th>□ 1 time per week</th>
<th>□ 2-3 times per week</th>
<th>□ 4-6 times per week</th>
<th>□ 1 time per day</th>
<th>□ 2 times per day</th>
<th>□ 3 or more times per day</th>
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3a) When you drink **regular soft drinks**, how much do you normally drink at one time?

- □ less than 6 fluid ounces (or ¾ cup)
- □ 8 ounces (1 cup)
- □ 12 ounces (1 ½ cups)
- □ 16 ounces (2 cups)
- □ 20 ounces (2 ½ cups)
- □ >20 oz. specify amount__________

3b) How often are **all regular soft drinks** available for your child at home?

- □ All the time
- □ Often
- □ Sometimes
- □ Almost Never
- □ Never
4. How often do you drink **diet soft drinks**?

4a) When you drink diet soft drinks, how much do you normally drink at one time?

4b) How often are all diet soft drinks available for your child at home?

5. How often do you drink **sweetened tea (sweetened with sugar)**?

5a) When you drink sweet tea, how much do you normally drink at one time?
5b) How often is sweet tea available for your child at home?

6. How often do you drink unsweetened tea? (This includes tea with NO sugar OR tea that may have artificial sweeteners such as Splenda or Sweet and Low)

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<td>Never or less than 1 time per week (Skip 6a)</td>
<td>☐ less than 6 fluid ounces (or ¾ cup)</td>
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<td>1 time per week</td>
<td>☐ 8 ounces (1 cup)</td>
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<td>2-3 times per week</td>
<td>☐ 12 ounces (1 ⅓ cups)</td>
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<td>4-6 times per week</td>
<td>☐ 16 ounces (2 cups)</td>
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<td>☐ Almost Never</td>
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6a) When you drink unsweetened tea, how much do you normally drink at one time?

6b) How often is unsweetened tea available for your child at home?

7. How often do you drink tea or coffee, with cream and/or sugar (includes non-dairy creamer)?

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<td>Never or less than 1 time per week (Skip 7a)</td>
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<tr>
<td></td>
<td>☐ Never</td>
</tr>
</tbody>
</table>
7a) When you drink tea or coffee, with cream and/or sugar, how much do you normally drink at one time?

- less than 6 fluid ounces (or ¾ cup)
- 8 ounces (1 cup)
- 12 ounces (1 ½ cups)
- 16 ounces (2 cups)
- 20 ounces (2 ½ cups)
- >20 oz. specify amount__________

7b) How often is tea or coffee, with cream and/or sugar available for your child at home?

- All the time
- Often
- Sometimes
- Almost Never
- Never

8. How often do you drink **energy and sports drinks** (such as Red Bull, Rockstar, Gatorade, Powerade, etc.)?

<table>
<thead>
<tr>
<th>Never or less than 1 time per week (Skip 8a)</th>
<th>1 time per week</th>
<th>2-3 times per week</th>
<th>4-6 times per week</th>
<th>1 time per day</th>
<th>2 times per day</th>
<th>3 or more times per day</th>
</tr>
</thead>
</table>

- less than 6 fluid ounces (or ¾ cup)
- 8 ounces (1 cup)
- 12 ounces (1 ½ cups)
- 16 ounces (2 cups)
- 20 ounces (2 ½ cups)
- >20 oz. specify amount__________

8a) When you drink energy and sports drinks, how much do you normally drink at one time?

8b) How often are energy and sports drinks available for your child at home?

- All the time
- Often
- Sometimes
- Almost Never
- Never
9. How often do you drink **water**?

<table>
<thead>
<tr>
<th>Never or less than 1 time per week (Skip 9a)</th>
<th>1 time per week</th>
<th>2-3 times per week</th>
<th>4-6 times per week</th>
<th>1 time per day</th>
<th>2 times per day</th>
<th>3 or more times per day</th>
</tr>
</thead>
</table>

9a) When you drink **water**, how much do you normally drink at one time?

- less than 6 fluid ounces (or ¼ cup)
- 8 ounces (1 cup)
- 12 ounces (1 ½ cups)
- 16 ounces (2 cups)
- 20 ounces (2 ½ cups)
- >20 oz. specify amount__________

9b) How often is **drinking water** available for your child at home?

- All the time
- Often
- Sometimes
- Almost Never
- Never
The next questions ask what you think about drinking less than 1 cup of sugary drinks per day. Refer to handout to see what counts as a sugary drink and also what 1 cup of sugary drinks looks like. Pick the answer that best represents you for each question and select it.

10. For you, drinking less than 1 cup of sugary drinks each day would be...

<table>
<thead>
<tr>
<th>Extremely Enjoyable</th>
<th>Quite Enjoyable</th>
<th>Slightly Enjoyable</th>
<th>Neither Enjoyable or Unenjoyable</th>
<th>Slightly Unenjoyable</th>
<th>Quite Unenjoyable</th>
<th>Extremely Unenjoyable</th>
</tr>
</thead>
</table>

11. For you, drinking less than 1 cup of sugary drinks each day would be...

<table>
<thead>
<tr>
<th>Extremely Healthy</th>
<th>Quite Healthy</th>
<th>Slightly Healthy</th>
<th>Neither Healthy or Unhealthy</th>
<th>Slightly Unhealthy</th>
<th>Quite Unhealthy</th>
<th>Extremely Unhealthy</th>
</tr>
</thead>
</table>

The next question asks you about what other people (like your friends and family) think about you drinking less than 1 cup of sugary drinks per day. Refer to handout to see what counts as a sugary drink and also what 1 cup of sugary drinks looks like. Remember to think about your friends and family when answering.

12. Most people who are important to you want you to drink less than 1 cup of sugary drinks each day.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
These next questions are concerned with how much control you believe you have over limiting your sugary drinks to 1 cup or less each day. Refer to handout to see what counts as a sugary drink and also what 1 cup of sugary drinks looks like. Pick the answer that best represents you for each question and select it.

13. You have complete personal control over limiting your sugary drinks to less than 1 cup each day, if you really wanted to.

| □ | Strongly Disagree | □ | Moderately Disagree | □ | Slightly Disagree | □ | Neither Disagree or Agree | □ | Slightly Agree | □ | Moderately Agree | □ | Strongly Agree |

14. You plan to limit your sugary drinks to less than 1 cup each day.

| □ | Strongly Disagree | □ | Moderately Disagree | □ | Slightly Disagree | □ | Neither Disagree or Agree | □ | Slightly Agree | □ | Moderately Agree | □ | Strongly Agree |

15. How many days per week do you intend to limit your sugary drinks to less than 1 cup?

| □ | 0 | □ | 1 | □ | 2 | □ | 3 | □ | 4 | □ | 5 | □ | 6 | □ | 7 |

Continue to Part 3 on the next page.
**KidsSIPS SMARTER Survey**

**Part 3: Parenting Practices Around Sugary Drinks**

For the next set of questions, we will ask you about your opinions, parenting styles and practices around sugary drinks for your children. Refer to handout to see what counts as a sugary drink. Pick the response that best represents you. There are no right or wrong answers. Remember to think about your middle school aged child when answering.

16. How often do you give your child sugary drinks to take to school?

| □ Never | □ 1 school day per week | □ 2 school days per week | □ 3 school days per week | □ 4 school days per week | □ Every school day |

17. How often are sugary drinks available for your child in your home?

| □ All the Time | □ Often | □ Sometimes | □ Almost Never | □ Never |

18. When my child drinks sugary drinks, I find it...

| □ Very Good | □ Good | □ Neither Good or Bad | □ Bad | □ Very Bad |

19. When my child drinks sugary drinks, I find that to be...

| □ Very Pleasant | □ Pleasant | □ Neither Pleasant or Unpleasant | □ Unpleasant | □ Very Unpleasant |

20. When comparing your child with other children of his/her age, does your child drink more or less sugary drinks?

| □ Much Less | □ Less | □ About the same | □ More | □ Much More |
21. How often do you and/or your partner drink sugary drinks with your child?

<table>
<thead>
<tr>
<th>Never</th>
<th>1 time per week</th>
<th>2–4 times per week</th>
<th>5–6 days per week</th>
<th>Every day, once a day</th>
<th>Every day, several times a day</th>
</tr>
</thead>
</table>

22. My child likes the taste of sugary drinks.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

23. My child drinks sugary drinks often.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

24. I think my child should drink less sugary drinks.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

25. How often do you drink sugary drinks?

<table>
<thead>
<tr>
<th>All the Time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

26. How often does your partner drink sugary drinks?

<table>
<thead>
<tr>
<th>I do not have a partner</th>
<th>All the time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

27. My partner thinks that my child needs to drink sugary drinks less often.

<table>
<thead>
<tr>
<th>I do not have a partner</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

28. If my child drinks sugary drinks less often, I think that is...

<table>
<thead>
<tr>
<th>Very Good</th>
<th>Good</th>
<th>Neither Good or Bad</th>
<th>Bad</th>
<th>Very Bad</th>
</tr>
</thead>
</table>
29. If my child drinks sugary drinks less often, I think that is...

<table>
<thead>
<tr>
<th>Very Healthy</th>
<th>Healthy</th>
<th>Neither Healthy or Unhealthy</th>
<th>Unhealthy</th>
<th>Very Unhealthy</th>
</tr>
</thead>
</table>

30. Does it seem difficult or easy to let your child drink less sugary drinks?

<table>
<thead>
<tr>
<th>Very Easy</th>
<th>Easy</th>
<th>Neither Easy or Hard</th>
<th>Pretty Hard</th>
<th>Very Difficult</th>
</tr>
</thead>
</table>

31. Do you think that you are able to reduce the amount of sugary drinks your child drinks?

<table>
<thead>
<tr>
<th>Certainly</th>
<th>Probably</th>
<th>Maybe, Maybe Not</th>
<th>Probably Not</th>
<th>Certainly Not</th>
</tr>
</thead>
</table>

32. Are you planning to have your child drink less sugary drinks in the next six months?

<table>
<thead>
<tr>
<th>Certainly</th>
<th>Probably</th>
<th>Maybe, Maybe Not</th>
<th>Probably Not</th>
<th>Certainly Not</th>
</tr>
</thead>
</table>

33. To what extent do you monitor how often your child drinks sugary drinks?

<table>
<thead>
<tr>
<th>All the time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

34. It’s a habit for my child to drink sugary drinks.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

35. Drinking sugary drinks is something that suits my child.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
36. My child often drinks sugary drinks without thinking about it.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

37. My child drinks sugary drinks whenever he/she wants.

<table>
<thead>
<tr>
<th>All the time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

38. If my child asks for sugary drinks, he/she will get that.

<table>
<thead>
<tr>
<th>All the time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

39. When my child asks for a particular sugary drink, I buy it for him/her.

<table>
<thead>
<tr>
<th>All the time</th>
<th>Often</th>
<th>Sometimes</th>
<th>Almost Never</th>
<th>Never</th>
</tr>
</thead>
</table>

40. Are there rules in your home about how many sugary drinks your child can drink?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

41. Are there rules in your home about when your child can drink sugary drinks?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

42. When does your child drink sugary drinks? You can choose all that apply.

- He/she never drinks sugary drinks
- At breakfast
- During snack time at school
- At lunch time
- After school
- At dinner time
- While watching TV
- During/after sports
- With friends
- At parties
- On weekends
- In the evening

Others (please list):
43. How often does your child buy sugary drinks with their own money/allowance?

- I don’t know
- All the time
- Often
- Sometimes
- Almost
- Never
- Never

44. Who buys sugary drinks for the home or for your child to take to school? You can choose all that apply.

- Mom
- Dad
- Others: ______________________
- No one buys sugary drinks

45. Who decides which sugary drinks to buy for the home or for your child to take to school? You can choose all that apply.

- Mom
- Dad
- Others: ______________________
- No one buys sugary drinks

*Continue to Part 4 on the next page.*
KidsSIPSmaertER Survey
Part 4: Media Literacy

This next section is about the media and ads as it relates to sugary drinks. Some of the questions are also about sugary drink companies. When you think of sugary drink companies, please think about companies like Coca-Cola or PepsiCo or Nestea. Refer to handout to see what counts as a sugary drink.

46. Sugary drink companies only care about making money.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

47. When designing an ad campaign, sugary drink companies think very carefully about the people they want to buy their beverages.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

48. Sugary drink ads link drinking these beverages to things people want, like love, good looks, and power.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

49. People are influenced by advertising.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
50. Most movies and TV shows that show people drinking sugary drinks make it look more attractive than is really is.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

51. When you see a sugary drink ad, it is very important to think about what was left out of the ad.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

52. When sugary drink companies make advertisements, every picture and image is very carefully planned.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree or Agree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

*Continue to Part 5 on the next page.*
160

*KidsSIPS SmartER Survey*

**Part 5: Quality of Life**

*The next set of questions asks about your health. Pick the response that best represents you. There are no right or wrong answers.*

53. Would you say that in general your health is:

<table>
<thead>
<tr>
<th></th>
<th>□</th>
<th>□</th>
<th>□</th>
<th>□</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
<td>Very Good</td>
<td>Good</td>
<td>Fair</td>
<td>Poor</td>
</tr>
</tbody>
</table>

54. Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days were you ill or not feeling well?

<table>
<thead>
<tr>
<th></th>
<th>□</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0 days)</td>
<td>Write in number of days in the past 30 days (1 month): __________</td>
<td></td>
</tr>
</tbody>
</table>

55. Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days were you feeling stressed, depressed, or had emotional problems?

<table>
<thead>
<tr>
<th></th>
<th>□</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0 days)</td>
<td>Write in number of days in the past 30 days (1 month): __________</td>
<td></td>
</tr>
</tbody>
</table>

56. During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?

<table>
<thead>
<tr>
<th></th>
<th>□</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0 days)</td>
<td>Write in number of days in the past 30 days (1 month): __________</td>
<td></td>
</tr>
</tbody>
</table>

57. On the average, how many hours did you sleep each night during the past 30 days? (Write in # of hours/night)

<table>
<thead>
<tr>
<th></th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write in number of hours per night: __________</td>
<td></td>
</tr>
</tbody>
</table>
For the last section, we have some questions about you so we can learn about the people who are taking part in this research.

58. What is your gender?
   - Male
   - Female

59. What year were you born?
   Year: ____________

60. Which of the following best describes you? Choose all that apply.

   - □ White
   - □ Black or African American
   - □ American Indian/Alaskan Native
   - □ Asian
   - □ Native Hawaiian or Other Pacific
   - □ Other: ____________
   - □ Prefer not to respond

61. Which of the following best describes you? Choose one.

   - □ Hispanic
   - □ Non-Hispanic
   - □ Not Sure

62. What is the highest grade of school that you completed? Choose one.

   - □ Grades 0-8
   - □ Grades 9-11
   - □ High School
   - □ Some College
   - □ College Grad
   - □ Graduate School

63. Which income range best represents your family’s total income (before taxes) in the last 12 months? Choose one.

   - □ Less than $5,000
   - □ $5,000-$9,999
   - □ $10,000-$14,999
   - □ $15,000-$19,999
   - □ $20,000-$24,999
   - □ $25,000-$29,999
   - □ $30,000-$34,999
   - □ $35,000-$39,999
   - □ $40,000-$44,999
   - □ $45,000-$49,999
   - □ $50,000-$54,999
   - □ more than $55,000
   - □ I don’t know
   - □ Prefer not to respond
[ID NUMBER]: [___] [___] [___] [___] [___] [___] [___] [___]

These next 3 questions will help us understand the reading needs of people taking this survey. Choose only one answer for each question.

64. How certain are you that you could fill out medical forms by yourself?

☐ Extremely ☐ Quite a bit ☐ Somewhat ☐ A little bit ☐ Not at all

65. How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy?

☐ Never ☐ Sometimes ☐ Often ☐ Usually ☐ Always

66. How would you describe your ability to read?

☐ Excellent or Very Good ☐ Good ☐ Okay ☐ Poor ☐ Terrible or Very Poor

End of Survey.

Thank you for completing!
Appendix E: Full list of messages tested in focus groups (Manuscript 3)

Assessing caregiver text messages to reduce sugar-sweetened beverage intake among middle school students

Focus Group Text Message List

Text Message Type A: Educational

<table>
<thead>
<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative</th>
<th>Tone of Voice: Empathetic*</th>
<th>Tone of Voice: Catchy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where you can cut back.</td>
<td>We know it’s hard to cut back &amp; most people drink too much sugar. Adults should drink &lt;8oz &amp; kids should have 0 so start by figuring out how much you drink.</td>
<td>Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults can lead to a long and healthy life!</td>
</tr>
<tr>
<td>Child Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where your child can cut back.</td>
<td>We know it’s hard for your kid to cut back their sugary drinks. Adults should drink &lt;8oz &amp; kids should have 0. Start by figuring out how much they drink.</td>
<td>Drink less, live more, throw sugar out the door! Helping your kids stop drinking sugary drinks can lead to a long and healthy life for them.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>Research says adults should only drink less than 8 oz or 1 small cup of sugary drinks/day, and kids should have 0 oz! Think about where your family can cut back.</td>
<td>We know it’s hard for your family to cut back their sugary drinks. Adults should drink &lt;8oz &amp; kids should have 0. Start by figuring out how much they drink.</td>
<td>Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults, and 0 for kids can lead to a long and healthy life for the whole fam.</td>
</tr>
</tbody>
</table>
Group #2: Read Nutrition Labels

<table>
<thead>
<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative</th>
<th>Tone of Voice: Empathetic</th>
<th>Tone of Voice: Catchy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>The nutrition label will help you find grams of sugar. It always tells the truth, unlike the logos &amp; pictures at the front of the bottle. Practice with a label.</td>
<td>We know it’s tricky to tell what’s truthful on the drink bottle. The nutrition label always tells the truth. Next time, find drinks with 0g of sugar.</td>
<td>Want to find the truth? Flip the bottle of juice! It’s tricky to tell if a drink is sugary but a nutrition label tells us the truth. &gt;0g of sugar = sugary drink.</td>
</tr>
<tr>
<td>Child Focused</td>
<td>The nutrition label will help you find grams of sugar. It always tells the truth, unlike the logos &amp; pics at the front of the bottle. Practice with your child.</td>
<td>We know it’s tricky to tell what’s truthful on the drink bottle. The nutrition label always tells the truth. Help your child find drinks with 0g of sugar.</td>
<td>Want to find the truth? Flip the bottle of juice! It’s tricky for kids to tell but a nutrition label tells the truth. &gt;0g of sugar = sugary drink.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>The nutrition label will help you find grams of sugar. It always tells the truth, unlike the logos &amp; pics at the front of the bottle. Practice with your family.</td>
<td>We know it’s tricky to tell what’s truthful on the drink bottle. The nutrition label always tells the truth. Help your family find drinks with 0g of sugar.</td>
<td>Want to find the truth? Flip the bottle of juice! It’s tricky for your family to tell but a nutrition label tells the truth. &gt;0g of sugar = sugary drink.</td>
</tr>
</tbody>
</table>

Group #3: Health Risks of Sugary Drinks

<table>
<thead>
<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative</th>
<th>Tone of Voice: Empathetic</th>
<th>Tone of Voice: Catchy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>Drinking too many sugary drinks can cause health problems like tooth decay &amp; diabetes. Stop drinking sugary drinks today and improve your health!</td>
<td>We know its hard to cut back on sugary drinks, but did you know drinking &gt;8oz can lead to health issues like tooth decay &amp; diabetes? Ask your child to name more.</td>
<td>Trying to be healthy? Don’t slack, cut back! Drinking fewer sugary drinks can prevent tooth decay, weight gain, and heart problems.</td>
</tr>
<tr>
<td>Child Focused</td>
<td>Drinking too many sugary drinks can cause health problems for kids like tooth decay &amp; diabetes. Stop drinking sugary drinks today and improve your kids health!</td>
<td>We know its hard to cut back on sugary drinks, but did you know drinking &gt;8oz can lead to health issues like tooth decay &amp; diabetes? Ask your child to name more.</td>
<td>Worried about your child’s health? Don’t slack, cut back! Drinking fewer sugary drinks can prevent tooth decay, weight gain, and heart problems.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>Drinking too many sugary drinks can cause health problems for your family like</td>
<td>We know its hard to cut back on sugary drinks, but did you know drinking &gt;8oz</td>
<td>Worried about your family’s health? Don’t slack, cut back! Drinking fewer sugary drinks can prevent tooth decay, weight gain, and heart problems.</td>
</tr>
<tr>
<td>Audience</td>
<td>Tone of Voice: Authoritative</td>
<td>Tone of Voice: Empathetic</td>
<td>Tone of Voice: Catchy*</td>
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</tr>
<tr>
<td>Parent Focused</td>
<td>The goal of sugary drink companies &amp; their ads is to make money. They don't care about your health. Stop giving these guys your hard-earned money!</td>
<td>All of us have been tricked by the media. They use colorful pics &amp; slogans to make us by their products. Think about how your fav drink company might trick you.</td>
<td>Do you have a jingle you just love to sing? Sugary drink companies make these to convince us to buy their stuff &amp; don't they do a good job at it too!</td>
</tr>
<tr>
<td>Child Focused</td>
<td>The goal of sugary drink companies &amp; their ads is to make money. They don't care about your kids health. Stop giving these guys your hard-earned money!</td>
<td>All of us have been tricked by the media. They use colorful pics &amp; slogans to make kids by their products. Think about how a drink company might trick your kids.</td>
<td>Does your kid have a jingle they just love to sing? Sugary drink companies make these to convince kids to buy their stuff &amp; don't they do a good job at it too!</td>
</tr>
<tr>
<td>Family Focused</td>
<td>The goal of sugary drink companies &amp; their ads is to make money. They don't care about your family's health. Stop giving these guys your hard-earned money!</td>
<td>All of us have been tricked by the media. They use colorful pics &amp; slogans to make us by their products. Think about how a company might trick your family.</td>
<td>Does your fam have a jingle they just love to sing? Sugary drink companies make these to convince us to buy their stuff &amp; don't they do a good job at it too!</td>
</tr>
</tbody>
</table>

**Text Message Type B: Strategies for Identified Barriers**

**Strategy #1: Gradually Reduce (Barrier of Habit)**

<table>
<thead>
<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative</th>
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<th>Tone of Voice: Catchy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>To cut down on sugary drinks, gradually reduce your drinks over the week. This easy strategy will help break your habit and drink fewer sugary drinks.</td>
<td>Habits can be hard to break! This week try to gradually reduce your sugary drinks. Start where you're comfortable. Eventually you'll make</td>
<td>You gotta have it, but try to break that habit! Gradually reduce your sugary drinks over the week. Eventually you'll create new, healthier habits!</td>
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</table>
### Strategy #2: Tasty Alternative (Barrier of Taste)

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<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative</th>
<th>Tone of Voice: Empathetic</th>
<th>Tone of Voice: Catchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>To cut down on sugary drinks, find a tasty alternative like flavored water. This easy strategy will curb those cravings and keep you on track.</td>
<td>We know it's hard to replace the taste of sugary drinks. Try a tasty alternative like flavored water. You'll soon find a new, sweet favorite.</td>
<td>Craving those sugary drinks? Nah, you're sweet enough! Try a tasty alternative like flavored water. You'll soon find a new, sweet favorite.</td>
</tr>
<tr>
<td>Child Focused</td>
<td>Help your child cut down on sugary drinks &amp; find a tasty alternative like flavored water. This will curb their cravings and keep them on track.</td>
<td>We know it's hard to replace the taste of sugary drinks. Help your child find a tasty alternative like flavored water. They'll soon find a new, sweet favorite.</td>
<td>Is your child craving sugary drinks? Nah, they're sweet enough! Help them find a tasty alternative like flavored water. They'll soon find a new, sweet favorite.</td>
</tr>
<tr>
<td>Family Focused</td>
<td>Help your family cut down on sugary drinks &amp; find a tasty alternative like flavored water. This will curb their cravings and keep them track to drink.</td>
<td>We know it's hard to replace the taste of sugary drinks. Help your family find a tasty alternative like flavored water. They'll soon find a new, sweet favorite.</td>
<td>Is your fam craving sugary drinks? Nah, they're sweet enough! Help them find a tasty alternative like flavored water. They'll soon find a new, sweet favorite.</td>
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</table>

### Strategy #3: Bring Alternative (Barrier of Access)

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<tr>
<th>Audience</th>
<th>Tone of Voice: Authoritative*</th>
<th>Tone of Voice: Empathetic</th>
<th>Tone of Voice: Catchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Focused</td>
<td>Stay on track when you're on the go. Sugary drinks are</td>
<td>We know it's hard to stay on track when you're on the go.</td>
<td>Don't slip on your trip! Make sure to carry your favorite non-</td>
</tr>
<tr>
<td></td>
<td>everywhere, so always remember to pack your favorite non-sugary drink so you don’t slip up.</td>
<td>There may be sugary drinks where you go. Pack your favorite non-sugary drink so you don’t slip up!</td>
<td>sugary drink when you leave the house to help stay on track.</td>
</tr>
<tr>
<td>----------------------</td>
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<td>----------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Child Focused</strong></td>
<td>Make sure your child stays on track when on the go. Sugary drinks are everywhere. Always pack their favorite non-sugary drink so they don’t slip up.</td>
<td>We know it’s hard to stay on track when on the go. There may be sugary drinks where your child goes. Pack their favorite non-sugary drink so they don’t slip up!</td>
<td>Don’t let your child slip on their trip! Make sure they carry their favorite non-sugary drink when they leave the house to help keep them on track.</td>
</tr>
<tr>
<td><strong>Family Focused</strong></td>
<td>Make sure your family stays on track when on the go. Sugary drinks are everywhere. Always pack their favorite non-sugary drink so they don’t slip up.</td>
<td>We know it’s hard to stay on track when on the go. There may be sugary drinks where your family goes. Pack their favorite non-sugary drink so they don’t slip up!</td>
<td>Don’t let your family slip on their trip! Make sure they carry their favorite non-sugary drinks when they leave the house to help keep them on track.</td>
</tr>
</tbody>
</table>

*Messages that have been refined after review from expert panel*
Appendix F: SMS intervention flow and logic diagram (Manuscript 3)

Week 0

Intro
Welcome to KidsSIPsmartER! This program helps kids drink fewer sugary drinks. You are now enrolled to get texts to help you work as a family to drink less.

Educational Message #1
1/2: To get started, we'll start off with a quick review of sugary drinks then later ask you a few questions about how much you and your child, NAME, drink.
2/2: Sugary drinks include: soda, sweetened tea, coffee, energy/sports drinks, flavored juices, & 100% fruit juices. Diet & artificial sweeteners don’t count.

Parent Intake Assessment
How often did you drink sugary drinks last week? Reply with LETTER A) Less than 1 time B) 1 time C) 2-3 times D) 4-6 times E) Everyday F) 2 per day G) 3 or more per day

Child Intake Assessment
How often did NAME drink sugary drinks last week? Reply with LETTER A) Less than 1 time B) 1 time C) 2-3 times D) 4-6 times E) Everyday F) 2 per day G) 3 or more per day

Parent Consumers
*No Response A

Parent Non-Consumers

Child Consumers

Child Non-Consumers

*No Response B

Combined Barrier Message
Thanks! In the coming weeks, what tips would you like to get? A) Parenting around sugary drinks B) Time or shopping C) Breaking your habit or D) Tasty alternatives

Parent Barrier Message
Thanks! In the coming weeks, what tips would you like to get? A) Parenting strategies around sugary drinks or B) Home or shopping tips?

Child Barrier Message
Thanks! In the coming weeks, what tips would you like to get? A) Parenting strategies around sugary drinks or B) Home or shopping tips?

Positive Reinforcement Message
Great job! Keep up the good work! Other parents could use your help. What is one tip or trick that you have for parents who are struggling?

Response Message
Great, thanks! Starting next week you will get an informational message followed by a personalized message based on your responses today. We'll be in touch!

*No Response A: Send message again on Friday. If no response, proceed to week 1, and send parent barrier messages the following weeks.
*No Response B: Send message again on Friday. If no response, proceed to week 1, and send child barrier messages the following weeks.
*No Response C: Send message again on Friday. If no response, proceed to week 1, and send random message from specific group.
Week 1-3

Monday

Educational Message Week 1
Drink less, live more, throw sugar out the door! Limiting sugary drinks to 8oz for adults, and 0 for kids can lead to a long and healthy life for the whole fam.

Wednesday

Tailored Strategy Message
Combined, Parent, Child, or Non-consumer message

Monday

Educational Message Week 2
We know it’s tricky to tell what’s truthful on the drink bottle. The nutrition label always tells the truth. Help your child find drinks with 0g of sugar.

Wednesday

Tailored Strategy Message
Combined, Parent, Child, or Non-consumer message

Monday

Educational Message Week 3
Worried about your family’s health? Don’t slack, cut back! Drinking fewer sugary drinks can prevent tooth decay, weight gain, and heart problems.

Wednesday

Tailored Strategy Message
Combined, Parent, Child, or Non-consumer message
Week 4

Educational Message Week 4
Does your kid have a jingle they just love to sing? Sugary drink companies make these to convince kids to buy their stuff & they do a good job at it too!

Final Assessment Intro
Thanks for taking part in this study so far! For the last few messages, we want to ask you the same questions we asked in the beginning.

Parent Intake Assessment
How often did you drink sugary drinks last week? Reply with LETTER A) Less than 1 time B)1 time C)2-3 times D)4-6 times E)Everyday F)2 per day G)3 or more per day

Child Intake Assessment
How often did NAME drink sugary drinks last week? Reply with LETTER A) Less than 1 time B)1 time C)2-3 times D)4-6 times E)Everyday F)2 per day G)3 or more per day

Parent Consumers

Parent Non-Consumers

Child Consumers

Child Non-Consumers

Combined Barrier Message
Thanks! For your last strategy what tip would you like? A) Parenting around sugary drinks B)Home or shopping C)Breaking your Habit or D)Tasty Alternatives

Parent Barrier Message
Thanks! For your last strategy what tip would you like? A) Parenting around sugary drinks or B) Finding Tasty Alternatives?

Child Barrier Message
Thanks! For your last strategy what tip would you like? A) Parenting strategies around sugary drinks or B) Home or shopping tips?

Positive Reinforcement Message
Great job, keep up the good work! After going through this program, what would you tell parents who are struggling?

Tailored Strategy Message
Here’s one last one to try: Combined, Parent, Child, or Non-consumer message

Concluding Message
Thanks for being a part of this program. You will be receiving a phone call from me soon to complete your follow up interview. We hope we helped you make some healthy changes!
Appendix G: Follow-up interview script (Manuscript 3)

Follow-up Interview Script

Participant ID #:________________

Summary:

Initial survey completed? No Yes - PC/CC PC/CNC PNC/CC PNC/CNC
Strategy picked/assigned:
Number of educational messages responded to:
Number of resource links viewed:
Number of strategy messages responded to:
Final survey completed? No Yes - PC/CC PC/CNC PNC/CC PNC/CNC
Strategy picked/assigned:
KSS Parent Survey Received? No Yes

Introduction

“Hi my name is _________ and I am calling from the University of Virginia. Is [participant name] available to speak to me? He/she should be expecting my call.”

[If participant picks up, but cannot complete call, reschedule to call back another time.]

[If participant unavailable]

“Ok thank you, please let [participant name] know that I will be calling back again, or he/she can call me to schedule the call at a better time.”

[If leaving voicemail]

“Hi my name is _________ and I am calling from the University of Virginia for [participant name] in regards to research study about sugary drinks and text messaging. Please give me a call back to reschedule this call at [276-200-4055]. Thank you!”

[If participant available]

“I’m calling to complete the follow-up interview about the text messages you have been receiving over the past 5 weeks about sugar-sweetened beverages. This is
the last step for you as a participant in this research study. Just as a reminder, this phone call is being audio recorded to ensure that we capture all your thoughts and suggestions. I will let you know when I start and stop recording. Survey check if not received: Have you completed and returned the survey that was sent to you?"

[If no, then possibly can record answers over the phone if participant unable to return survey soon. If yes, continue to interview.]

**Semi-structured Interview- up to 60 minutes**

[Quality Check] “You should have a sheet summarizing all the text messages you received, do you have that on hand? Based on this, did you receive all the messages?

Did you experience any technical difficulties?"

[QUESTION 1 - Potential to Persuade] “Take a look at the sheet of text messages again. Which messages did you really like and/or dislike? Why?”

[Probes]
[Thought Listing] ] “For the messages that you liked what were some thoughts and feelings that you had while reading them?

[Thought Listing / Reactance] “For the messages that you disliked what were some thoughts and feelings that you had while reading them? Did any of them make you feel angry, irritated, annoyed, or aggravated?”

[QUESTION 2 – Timing and Frequency] “Where were you/ what were you doing when you received the text messages?”

[Probes]
“Was the timing appropriate? In the future, would there be an ideal day or time to send messages or should it be random? Why or why not?”

“How did you feel about how many text messages you received? Too many or too little?”

[QUESTION 3] “Whenever you received a message, how did you respond and/or use each message?”

[Probes]
“Did you make a mental and/or written note to change/do something?”

172
“Did you share the message with a child, family or friend? How did they respond”

“Did you ever look back to any of the messages, including the linked resources? If so which ones, and why? Were the linked resources helpful?”

[QUESTION 4] “How did you feel about the portion of the messages where you had to answer about your and your child’s intake? [Probes] “Was it easy, hard, or time consuming in anyway? How?”

“Did you feel that it gave you the information that you needed/ were the responses appropriate to you?”

At the end of these messages we asked to pick a type of strategy that you would like to receive. This could have been _____ (fill in based on information gathered up top). What did you think about the strategy messages that you received? Did they help address your barriers to drinking less sugary drinks?”

[QUESTION 5] “As a result of receiving these text messages, have you and/or your child or family made any behavior changes?” [Probes] “What changes were made and how?”

“Do you feel receiving these messages have benefited you and/or your family in anyway?”

“Do you have any additional feedback about the text messages that you haven’t already reported?”

**Conclusion**

“Thank you so much for your time today and for the entire study. Once we receive your survey we will mail out the second $25 gift card. Confirm address:

Your opinions have been very valuable to us, and will be very important in improving our program that will help families in communities like your become healthier.”