A STUDY TO DETERMINE THE RELATIONSHIP BETWEEN SUGAR-SWEETENED BEVERAGES AND BMI IN PREADOLESCENTS (11-13 YEARS)

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ABSTRACT

THESIS: A Study to Determine the Relationship Between Sugar-sweetened Beverages and BMI in Preadolescents (11-13 Years)

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The purpose of this study was to determine the relationship between sugar-sweetened beverage consumption of sixth and seventh graders (ages 11 to 13) and its effect on BMI. The variables that the researcher examined were the types and amounts of sugar-sweetened beverages consumed, and gender in children attending a Region 10 middle school in Burlington, Connecticut. There were six hypotheses examined in this study. The sample consisted of 61 subjects attending Har-Bur Middle School in Burlington, CT. The current investigator modified the Block Kids Food Frequency Questionnaire (Appendix D) by adding additional questions to the original Block Kids FFQ regarding sugar-sweetened beverages that were not measured on the original FFQ. Results of the study did not show statistically significant differences for any of the hypotheses regarding sugar-sweetened beverages and BMI (p > .05). However, there were tendencies for sugar-sweetened beverage consumption to decrease as preadolescents aged. Also for each additional ounce of fruit drinks consumed there were increases in BMI. Further research needs to be conducted to determine the full extent of the effects of sugar-sweetened beverages on BMI in preadolescents.
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CHAPTER I

INTRODUCTION

There has been a concern with the growing number of obese children over the last several decades in the United States. Childhood obesity has an effect on children of all ages and ethnic groups alike (O’Connor et al., 2006). According to Story et al. (2010), obesity has quadrupled in 6 to 11 year olds (from 4% to 15.3%), and tripled among 12 to 19 year old adolescents (6.1% to 15.5%). One third of U.S children and adolescents are considered to be overweight or obese (Story et al., 2009; Kavey et al., 2010). Obesity tends to track linearly over time; children who are overweight or obese during childhood are more likely to remain overweight and obese into adolescence and adulthood (LaRowe et al., 2007; Rajeshwari et al., 2005).

Weight and height status affect body mass index (BMI). The Center for Disease Control (CDC) looks at weight and height percentiles versus BMI for children and adolescence between the ages of 2 to 20 years. The CDC defines a healthy weight as being between the 5th and 85th percentile, overweight as between the 85th and less than the 95th percentile, and obesity as equal or greater to the 95th percentile based on their growth charts (CDC, 2011). The National Health and Nutrition Examination Survey (NHANES)
from 2007-2008 revealed that 16.9% of children and adolescents had a BMI greater or
equal to the 95th percentile according to the CDC growth charts (Kavey et al., 2010).

Having a higher BMI has been associated with an increased risk for detrimental
medical conditions and co-morbidities. Overweight and obesity puts a person at a greater
risk for hypertension, cardiovascular disease, dyslipidemia, hyperinsulemia, type 2
diabetes, and some forms of cancer (LaRowe et al., 2007; Story et al., 2009; Kavey et al.,
2010, Malik et al., 2006). Consumption of sugar-sweetened beverages may directly lead
to the development of type 2 diabetes due to rapidly absorbable carbohydrates in these
beverages. In addition, these beverages contain higher dietary glycemic load and can
elevate blood glucose and insulin levels. The high glycemic load can lead to
inflammation, insulin resistance, glucose intolerance, and the metabolic syndrome
(Kavey et al., 2010). Having a higher BMI in childhood can also have negative effects
on metabolic, physical, and psychosocial health (James et al., 2005).

Total overall energy intake from beverages has been dramatically increasing over
the last several decades, especially from sugar-sweetened beverage consumption in U.S.
Both portion sizes and number of servings of sugar-sweetened beverages have increased
in children and adolescents (Gomez-Martinez et al., 2009). A significant increase in
sugar-sweetened beverages has made these beverages the primary source of added sugars
and excess empty calories (Rajeshwari et al., 2005, Fiorito et al., 2010; Kavey et al.,
2010, Park et al., 2011).

From 1989 to 2010 overall energy consumption from sugar-sweetened beverages
increased from 6.5% to 11.1% in children and adolescents from the ages of 2 to 18 years
(Kavey et al., 2010). Consumption of soda, fruit drinks, and fruit aides has accounted for
a 81% increase in added sugars consumption in the United States (Malik et al., 2006). Statistics show that half of all Americans and the majority of adolescents (65% of females and 74% of males) consume carbonated beverages on a daily basis (Ludwig et al., 2001).

Consumption of high levels of sugar-sweetened beverages has a negative impact on diet quality. As sugar-sweetened beverage consumption increases, specifically in carbonated beverages, there is a decrease in milk and 100% fruit juice consumption in children and adolescents (Blum et al., 2005; Fiorito et al., 2010). According to a study conducted by Nielsen et al. (2004), soft drink consumption increased from 3.0% to 6.9%, fruit drink consumption from 1.1% to 2.2%, and milk consumption decreased from 13.2% to 8.3% in children and adolescents. Soft drink consumption is also associated with lower intakes of Vitamin A, Vitamin C, calcium, magnesium, and riboflavin (Blum et al., 2005).

This growing trend in increased consumption of sugar-sweetened beverages is a rising problem as it is associated with increased BMI, resulting in weight imbalances. Long-term consequences of overweight and obesity will predispose individuals to be at risk for various diseases such as cardiovascular disease, type 2 diabetes and hypertension. In addition, sugar-sweetened beverages tend to be lower in vitamins and minerals, and can be a contributor to nutrient inadequacies.

**Purpose**

The purpose of this study was to determine the relationship between sugar-sweetened beverage consumption of preadolescents (ages 11 to 13) and its effect on BMI.
The variables that the researcher examined were the types and amounts of sugar-sweetened beverages consumed, and gender in children attending a Region 10 middle school in Burlington, Connecticut.

**Hypotheses:**

There are six hypotheses for the study:

- Preadolescents (11 to 13) consuming more than 12 fluid oz of sugar-sweetened beverages per day will have higher BMI than those consuming less than 12 fluid ounces per day.
- Irrespective of gender, older preadolescents (13 year olds) will consume greater amounts (fluid ounces) of sugar-sweetened beverages than younger (11 and 12 year olds) adolescents
- Males will consume greater amounts (fluid ounces) of sugar-sweetened beverages than females.
- Preadolescents consuming regular soda will have higher BMI’s compared with those who drink diet soda.
- Preadolescents who drink greater fluid ounces of regular soda will have higher BMI’s than those who consume less.
- Preadolescents who consume flavored fruit drinks will have a higher BMI than those who consume 100% fruit juice.

**Rationale**

The investigator chose to examine sugar-sweetened beverage consumption and BMI in preadolescents because there have been few research studies focusing on this
population. The majority of the research that has been done has focused on preschool aged children, adolescents, and adults (LaRowe et al., 2007). It would be beneficial to look at beverage consumption patterns in preadolescents because this is a time period when they are independently making food and beverage choices. Foundations for these food and beverage choices can be influenced by taste preferences developed during childhood, parental dietary patterns, peer pressure, changing dietary habits due to rapid growth and development, media advertising, and accessibility to sweetened beverages (Blum et al., 2005; Kavey et al., 2010).

Previous research that has been conducted on sugar-sweetened beverage consumption has produced variable results. Several studies have demonstrated a positive association between sugar-sweetened beverages and BMI in children and adolescents, while other studies have not exhibited similar results. Due to conflicting findings, the researcher wanted to investigate the influence of sugar-sweetened beverage consumption on BMI in preadolescents.

Definitions

For the purpose of this study, the following definitions will be used:

**BMI**: Body Mass Index. This is a measure of body composition calculated by dividing a person’s weight in kilograms by the square of their height in meters (CDC, 2009)

**Sugar-sweetened beverages**: This term will include soft drinks, fruit drinks, punches, Kool-Aid, Hi-C, Sunny Delight and sports drinks (Lim, 2009),

**Normal Weight**: As defined by CDC, this is having a BMI between the 5th and 85th percentile on the CDC growth chart (CDC, 2009)
**Overweight:** CDC defines overweight as having a BMI at or over the 85th percentile but less than the 95th percentile on the CDC growth chart (CDC, 2009)

**Obesity:** This is defined as having a BMI at or over the 95th percentile on the CDC growth chart (CDC, 2009)

**NHANES:** National Health and Nutrition Examination Survey (CDC, 2009)

**AND:** Academy of Nutrition and Dietetics. This is made up of Registered Dietitians who are advancing the health status of Americans through nutrition and food. (www.eatright.org)

**2004 Block Kids Food Frequency Questionnaire (FFQ):** This is a questionnaire used to assess food intake by food group in 4 to 17-year old children. (www.nutritionquest.com)

**Middle School-aged children:** This includes children who are in grades 6-8, ages 11-14. http://www.middleweb.com/ParntInvl.html

**SECA 700 Balance Beam Balance Scales:** Measures height to the nearest ¼ of an inch and weight to ¼ of a pound (http://www.northshorecare.com/seca-physician-eye-scale.html)

**Assumptions**

For the purpose of this study, the following assumptions were made:

- The subjects understood the survey questions and answered them honestly.
- The subjects were literate.
- The sample was representative of the 6th – 7th graders in Region 10 Schools in Connecticut.
The instruction for dissemination and collection of the surveys were followed accurately.

Limitations
The study was limited by the following factors:

- The sample was limited to one suburban school district in Burlington, CT.
- The research was based on self-reported data provided by preadolescents.

Summary
Sugar-sweetened beverage consumption needs to be further examined because it has become the major source of added sugars and excess calories in today’s youth. With the obesity epidemic gaining larger proportions, sugar-sweetened beverage consumption can contribute to overweight and obesity, and increasing BMI, putting children at greater risk of developing diseases and other medical conditions. The review of literature follows in chapter 2. The methodology, results, and discussion will follow in chapter 3, 4, and 5 respectively.
CHAPTER II

REVIEW OF LITERATURE

The objective of this study was to determine the relationship between sugar-sweetened beverage consumption and BMI in 6th-7th graders attending a Connecticut middle school. The types and amounts of beverages consumed, and gender will be examined.

This review of literature will examine the prevalence of obesity, environmental influences on sugar-sweetened beverage consumption, sugar-sweetened beverage consumption in preschool aged children, sugar-sweetened beverage consumption in school aged children, sugar-sweetened beverage consumption in adolescents, BMI as a predictor of disease risk, and sugar-sweetened beverage consumption and dental carries.

Prevalence of Obesity

The prevalence of overweight and obesity in children and adolescents is continuing to increase. One third of U.S. children and adolescents are overweight or obese (Story et al., 2009; Kavey et al., 2010). Approximately 14% of preschoolers, 19% of children (6 to 11 years) are obese (LaRowe et al., 2007).
Over the last several decades, obesity has quadrupled in 6 to 11 year old children (4% to 15.3%) and tripled in 12 to 19 year olds (6.1% to 15.5%), which is an alarming trend (Story et al., 2010). Obesity tends to track over time; children who are overweight or obese according to the CDC growth charts are more likely to remain overweight or obese as adolescents and adults (Rajeshwari et al., 2005; LaRowe et al., 2007).

Environmental Influences on Sugar-Sweetened Beverage Consumption

Environmental factors including home, childcare, school, peer pressure, and the media can influence sugar-sweetened beverage consumption patterns (DuBois et al., 2007; Story et al., 2009; Ritchie et al., 2005). Children who are overweight or obese may experience detrimental consequences including metabolic, physical, social, and psychological issues (James et al., 2005; Briefel et al., 2009).

Home Setting

In children, especially young children, the home environment plays a major role in the establishment of food and beverage patterns and preferences (O’Connor et al., 2006; Ritchie et al., 2005; LaRowe et al., 2007). Children social and physical environment can be directly influenced by their parents. Parents are responsible for providing foods and beverages provided in the home. Parents can influence what children consume through their own beliefs, attitudes, dietary habits, behavior and role-modeling (Ritchie et al., 2005).

Environment Away From Home

Many children spend a large portion of their day in either childcare settings or school. Current statistics show than two out of every three children under 6 years of age
are in a childcare setting (Erinosho et al., 2012), and children and adolescents spend approximately 6 to 7 hours at school. Children consumed a substantial amount of foods and beverages in childcare and school settings (Story et al., 2009).

Child-care providers can play a major role in children’s dietary habits and behaviors. Participation and role-modeling by child-care providers can influence children’s dietary preferences and acceptance of new foods (Erinosho et al., 2012).

School policies play a large role in determining availability of foods and beverages offered, and accessibility to à la carte items and vending machines (Briefel et al., 2009). Sugar-sweetened beverage and soft drink consumption at school accounted for approximately 17% in elementary school children, 32% in middle school children, and 36% in high school students (Briefel et al., 2009).

Fast food consumption can contribute excess calories, disease risk, and higher BMI in children and adolescents (Ritchie et al., 2005; Briefel et al., 2009). Children and adolescents who consume fast food two or more times per week are more likely to have a higher BMI than those who consume fast food one or less times per week (Ritchie et al., 2005).

Peer Pressure

Peer pressure, especially in preadolescents and adolescents can influence sugar-sweetened beverage consumption patterns. Trends have shown changes in beverage consumption from early childhood through adolescents. Sugar-sweetened beverages, such as soda and sport drinks increases, while milk and 100% fruit juice decrease from early childhood to adolescents (Blum et al., 2005; Rajeshwari et al., 2005).
Preadolescents and adolescents tend to conform to social norms based on observation, surveys, and surveys. These can influence dietary habits, attitudes and behaviors (Perkins et al., 2010). Perkins et al., (2010) conducted a study that examined misperceptions of peer norms and how they influence sugar-sweetened beverage consumption in 6th to 12 graders. Results from this study showed that a large proportion of students reported consumption of multiple servings of sugar-sweetened beverages per day. This study found a strong relationship between subjects’ misperceptions regarding peers sugar-sweetened beverage consumption and their own reported sugar-sweetened beverage consumption. The subjects tended to overestimate the amount of sugar-sweetened beverages consumed by their peers, which can cause increased consumption of sugar-sweetened beverages (Perkins et al., 2010). This can contribute to overweight and obesity in preadolescents and adolescent subjects.

**Media Influences**

Media and advertising can have a strong influence over children and adolescents food and beverage choices. Children spend approximately 3 hours a day watching television (Bar-on et al., 2001). Children and adolescents view approximately 40,000 commercials per year, with fast foods, high sugar foods and snacks heavily advertised on children’s television programs (Ritchie et al., 2005). Approximately 75% of food manufacturers and 95% of fast food restaurants advertise on television (Wiecha et al., 2006).

Children’s television viewing has been linked to increased consumption of sweets, salty snacks, fats, fast food, and decreased intakes of fruits and vegetables (Ritchie et al., 2005). Television viewing is a sedentary behavior which can increase
energy intakes while decreasing energy expenditure, which can be contribute to the obesity epidemic.

Wiecha et al., (2006) conducted a two year longitudinal study that examined if increased television viewing is associated with increased energy intake and increased intakes of foods advertised on television in 11 year olds. From baseline to follow up 27.7% of the subjects increased television viewing by one hour or less per day, and 15.1% of subjects increased television viewing by more than one hour per day. Results showed from baseline with each additional hour of television watched, there was an additional increase of 167 calories/day and increased consumption of foods and beverages that were advertised on television (Wiecha et al., 2006).

**Sugar-Sweetened Beverage Consumption in Preschool Aged Children**

Preferences for types of beverages consumed begin as early as the preschool years (2 to 5 year olds). Research has shown that 100% fruit juice and fruit drinks are a possible source of high energy, and low nutrients, which can start initiating the prevalence of overweight and obesity (O’Connor et al., 2006). The majority of preschool aged children consume 100% fruit juice and fruit drinks daily (Lim et al., 2009; O’Connor et al., 2006).

There has been a trend with increases in 100% fruit juice over the years. A two year longitudinal study by Lim et al., (2009) examined sugar-sweetened beverage consumption and obesity in preschool aged children (3 to 5 years). The study demonstrated that fruit juice consumption increased from baseline to follow up (13.0 to 16.5 oz/day). There was a 4% increase in obesity for each additional ounce of fruit juice
consumed per day from baseline. Overweight prevalence increased (12.9% to 18.7%),
while obesity almost doubled from baseline (Lim et al., 2009).

Not only can the total amount of sugar-sweetened beverages consumed per day
effect BMI status, but also when these beverages are consumed (DuBois et al., 2007). In
2007, DuBois et al., conducted a study which examined the relationship between sugar-
sweetened beverages (i.e. non-carbonated drinks and fruit drinks) consumed between
meals and overweight status in preschool aged children (2.5 to 4.5 years). At ages 2.5,
3.5, and 4.5 years, 14-16% of children consumed sugar-sweetened beverages between
meals on a daily basis. Results showed a positive association between sugar-sweetened
beverages consumption between meals and not the total amount of sugar-sweetened
beverages consumed per day (DuBois et al., 2007).

Beverage consumption patterns during the preschool years may influence
beverage consumption patterns in adolescents and adulthood. Fiorito et al., (2010)
examined whether beverage consumption patterns (i.e. 100% fruit juice, fruit drinks,
soda, and milk) at 5 years would predict beverage and nutrient intakes at age 15. Results
of the study showed that there were significant changes in the types of beverages
consumed as age increased. Decreased beverage consumption occurred in the following
beverages: milk (90% to 61%), 100% fruit juice (67% to 37%), and fruit drinks (78% to
57%). Soda consumption tended to increase from ages 5 to 15 (23% to 42%). Preschool
aged children who consumed soda were more likely to have higher intakes of added
sugars and lower intakes of milk, Vitamin D, calcium, potassium, and fiber in the diet at
age 15 (Fiorito et al., 2010).
Sugar-Sweetened Beverage Consumption in Elementary School Children

Childhood dietary preferences can influence dietary intake in adolescents and adulthood (LaRowe et al., 2007; Kavey et al., 2010). There has been a significant increase in the number of children who are consuming sugar-sweetened beverages. Soft drink consumption has doubled from 1997 to 2007 (DuBois et al, 2007). Higher soft drink consumption in children and adolescents have shown to decrease intakes of calcium, Vitamin A, Vitamin C, riboflavin, and magnesium (Blum et al., 2005; LaRowe 2007). It has also been suggested that soft drinks may also be replacing nutritious beverages such as 100% fruit drinks and milk in the diet (Rajeshwari et al., 2005; LaRowe et al., 2007). These beverages are becoming the primary source of added sugars and empty calories in the diet (LaRowe et al., 2007; Lim et al., 2009; Gomez-Martinez et al., 2009).

Beverage consumption patterns tend to change as children grow (Blum et al., 2005; Fiorito et al., 2010; LaRowe et al., 2007, Rajeshwari et al., 2005). A longitudinal study conducted by Blum et al., (2005) examined changes in beverage consumption patterns and BMI in children (grades 3 to 6) over a 2 year period. Beverages examined included milk, 100% juice, diet soda, and sugar-sweetened beverages (i.e. regular soda, HI-C, flavored fruit drinks, Kool-Aid, sport drinks, iced tea, and hot chocolate). Results showed significant increases in diet soda consumption (0.3 ± 1.8 to 2.0 ± 5.3 oz/day) and significant decreases in milk consumption (19.5 ± 12.0 to 16.1 ± 12.0 oz/day) from baseline to follow up. Diet soda was the only beverage examined that showed a positive association with increased BMI. It was suggested that from baseline, each additional 12 fluid ounce serving there was a 0.156 increase in BMI (Blum et al., 2005). Disagreeing
with Blum et al., (2005) was Ludwig et al., (2001), who found from baseline that each additional fluid ounce serving of sugar-sweetened beverage consumed. There was increased BMI and the ratio of becoming obese was 1:6 (Ludwig et al., 2001).

LaRowe et al., (2007) examined beverage consumption patterns in school-aged children (6 to 11 years) using the 2001-2002 NHANES data and BMI. Beverages examined were 100% fruit juices, high-fat milk (whole or 2%), low fat milk (nonfat or 1%), soda, diet soda, sweetened beverages (fruit drinks, fruit juices sweetened with sugar), and water. Children were categorized into clusters based on reported beverages consumed. These categories were mixed/light drinker (n = 147), high-fat milk (n = 156), water (n = 147), sweetened drinks (n = 100) and soda (n=124). Results showed that 6 to 11 year olds, who were in the water, sweetened drinks, and soda clusters had higher BMI’s than those children who were part of the mixed/light drinker or high-fat milk cluster.

Results of the Bogalusa Heart Study would disagree with results of Blum et al., (2005) and LaRowe et al., (2007). The Bogalusa Heart Study also examined beverage trends over a 21 year period and its effects on BMI (Rajeshwari et al., 2005). Beverage consumption patterns were established at 10 years and followed through 31 years. The beverages examined included soft drink, fruit drinks (not including 100% fruit juice), iced tea (with sugar), and coffee (with sugar). Like LaRowe et al., (2007), children were categorized into groups (none, low, medium, and high) based on reported sweetened beverages consumption. From 1973 to 1994 there were significant decreases in the percentage of children who consumed soft drinks (83% to 81%) and coffee (9% to 3%). Even though there was a decrease in the percentage of children consuming sweetened
beverages as they became adults, as the mean amounts (grams) of sweetened beverages increased from 1973 to 1994. Findings from the Bogalusa Heart Study did not support a relationship between increased sweetened beverage consumption and increased BMI, as the mean BMI for each of the consumption groups examined was 18.3 ± 0.3 (Rajeshwari et al., 2005).

**Sugar-sweetened Beverage Consumption and Adolescents**

In adolescence, beverage choices are influenced by the new independence of the child in decision making and peer pressure. Based on the NHANES survey, 84% of adolescents reported consumption of at least one sugar-sweetened beverage/day, and 67% of adolescents reported consuming soda daily (Park et al., 2012).

Beverage consumption patterns continue to change from childhood through adolescents, which may be a result of independence, peer pressure, and the media (Perkins et al., 2010; Wiecha et al., 2006). In younger children (6 to 11 years) milk is the primary beverage of choice, while carbonated soft drink consumption is the predominant beverage of choice in 12 to 19 year old adolescents (Forshee et al., 2003). In agreement with Forshee at al., (2003), similar findings were seen in studies conducted by Blum et al., (2005) and Rajeshwari et al. (2005). Results of these studies showed increased consumption of soda and sport drinks, and decreased milk and 100% fruit juice consumption from early childhood to adolescents (Blum et al., 2005; Rajeshwari et al., 2005).

Several studies have examined soft drink consumption in adolescents (Gomez-Martinez et al., 2009, Park et al., 2012). Gomez-Martinez et al., (2009) examined the
relationship between soft drink consumption and body composition (specifically obesity) in Spanish adolescents (13 to 18.5 years). Results from this study did not find an association between increased sugar-sweetened beverage consumption and increased obesity in this Spanish population (Gomez-Martinez et al., 2009).

Park et al., (2012), examined the association between self-reported academic grades and other correlates of soda consumption in high school students (14 to 18 years). Other correlates besides grades examined were: amount of sleep, sedentary behaviors, television/video games, and cigarette smoking. Results suggested that factors such as poor academics, inadequate amounts of sleep (less than 8 hours on school nights), watching television or playing video games two or more hours a day, less than 60 minutes of physical activity per day, and cigarette smoking were associated with increased soda consumption in adolescents (Park et al., 2012).

**BMI as a Predictor of Disease Risk in Children**

BMI can be useful in determining the likelihood of developing a disease. The higher the BMI, the greater the risk for developing a medical condition and/or co-morbidity. These include obesity/overweight, heart disease, hypertension, fatty liver, dyslipidemia, hyperinsulemia, and type 2 Diabetes and several types of cancers (Baker et al., 2007; Garnett et al., 2007; LaRowe et al., 2007; Story et al., 2009; Kavey et al., 2010).

13 year olds. Results from this study showed that children who had a higher BMI had an increased risk of having CHD as an adult. Of the 276,835 subjects examined, 10,235 men and 4,318 women developed CHD as adults (Baker et al., 2007).

Disagreeing with Baker et al., (2007) was Garnett et al., (2007), who also examined waist circumference in addition to BMI in childhood (7 years) predicted cardiovascular disease risk in adolescents (15 years). Results showed that neither waist circumference nor BMI predicted cardiovascular disease risk factors in adolescents (Garnett et al., 2007).

Sugar-sweetened Beverages and Dental Caries in Children

Beverages containing high amounts of added sugars can lead to plaque formation, enamel erosion, and dental caries in children and adults (Heller et al., 2001). Due to the dramatic increase in the amount of sugar-sweetened beverages consumed, particularly carbonated beverages, there is a greater likelihood of developing dental caries (Heller et al., 2001; LaRowe et al., 2007).

Heller et al., (2001) conducted a study that examined soft drink consumption and dental caries in preadolescents through adulthood (12 years and older). Results showed a positive association between increased consumption of soda at and between meals and increased number of dental caries in preadolescents and adults (Heller et al., 2001).

Summary

This review of literature highlighted contributing factors that may lead to increased BMI in young children through adolescents. The environment, peer pressure,
and media can all contribute to the obesity epidemic. Beverage trends have shown increased consumption of sugar-sweetened beverages, which can contribute to increases in BMI and disease risk. The methodology will follow in Chapter 3.
CHAPTER III

METHODOLOGY

Childhood obesity has quadrupled over the last several decades (Story et al., 2010) and it is continuing to rise, making it a major public health concern. As obesity increases, there is also an increase in BMI. It is important to examine how sugar-sweetened beverage consumption in preadolescent children contributes to an increase in BMI. The purpose of this study was to determine the relationship between consumption of sugar-sweetened beverages and BMI in preadolescents in grades 6 through 7 (11-13 years) attending Region 10 Schools located in Burlington, CT. Secondary purposes of this included if gender differences in sugar-sweetened beverages existed between preadolescents and if older preadolescents consumed larger amounts (fluid ounces) than their younger counterparts. This chapter describes the methods conducted for the research.

Subjects

According to the 2009 CDC report, obesity in children and adolescents in Connecticut is between 20% and 24%. When compared to national averages, it was found that Connecticut represented the average incidence of obesity in the pediatric
population. The investigator chose a school district in Connecticut because it was accessible for the study data to be taken and representative of the average level of obesity in the United States.

The investigator decided to use Har-Bur middle school in Burlington, CT because it was representative of the study criteria. Since the investigator had graduated from the above mentioned school, had good rapport with the school administrator and resided in close proximity to the school she was able to obtain permission to conduct sugar-sweetened beverage consumption surveys of preadolescents.

For the 2009-2010 academic calendar years, there were 465 students enrolled in 6th and 7th grade at Har-Bur Middle School. These students came from a middle class, suburban environment where they had access to food and beverages within a 10 mile radius.

Permission from Har-Bur Middle School

The investigator contacted the superintendant of Har-Bur Middle School to determine if a study could be conducted within the school system. The investigator explained the purpose of the study and what was expected of the students in the study. Once the superintendant gave his approval, the investigator met with the principal. The principal provided a signed document giving the investigator permission to conduct the study (Appendix A).

A recruitment flyer was distributed to three physical education teachers requesting student participation. The recruitment flyer gave students information about the purpose
of the study and how their participation would be beneficial in determining effects of sugar-sweetened beverage consumption on BMI of preadolescents (Appendix B).

Letters of Consent

Letters of consent (Appendix C) were distributed to the physical education teachers in the selected classrooms. The physical education teachers were responsible for giving the letter of consent to their students. These letters were sent home to the parents via the student. Students had to return the signed consent form one week prior to the administration of the survey in order for them to participate in the study. Any student who did not return the signed consent form was unable to participate in the study.

Survey Instrument

Permission was obtained by the investigator to use the previously validated survey (www.nutritionquest.com, 2004) for the current study. Permission was granted to use these questions for the current study (Victoria Zielinski, personal communication, August 18, 2009). The current investigator modified the Block Kids Food Frequency Questionnaire (Appendix D) by adding additional questions to the original Block Kids FFQ with additional questions regarding beverages that were not measured on the original FFQ. The original questions that were used from the Block Kids Food Frequency Questionnaire were about consumption of the following beverages: regular soda, 100% fruit juice, milk and flavored fruit drinks. Additional questions regarding diet sodas, fountain drinks, sport drinks, low calorie sport drinks, energy drinks, water, and flavored water were added with the original questions on the Block Kids food frequency questionnaire. The researcher wanted to include these additional questions because the
original questionnaire did not include all the different beverage categories that can influence BMI. Thus the beverage section of the survey had a total of 24 questions.

Not only were the subjects asked about the types of beverages consumed but also their frequency of consumption, fluid ounces consumed, and the serving sizes. To aid the subjects understanding of fluid ounces and serving sizes, the investigator provided pictures models (Appendix E).

Besides using the modified Block Kids FFQ, other demographical information was also collected from preadolescents. These included height, weight, and BMI.

**Height and Weight**

Height and weight measurements of preadolescents were taken by the investigator. The physical education teacher also assisted with height and weight measurements. Height and weight measurements were assessed using a Seca 700 Balance Beam Scale (http://balance.balances.com/scales/721). The physical education teacher was already trained on how to use the Seca 700 Balance Bean Scale. Subjects were weighed in light clothing and without shoes.

Participants were instructed to empty their pockets and take off their shoes. Each subject was given a plastic bag to place their personal belongings in so they could easily find them after their height and weight measurements had been recorded. To determine the height of the subjects, the preadolescents were instructed to stand erect with their shoulders level, hands to the sides, and have even weight distribution on each of their feet. The subjects placed their feed flat on the foot piece with their heels together touching the base of the vertical board. Each student was asked to adjust the angle of
their head by moving the chin up or down and to look forward. Height of the subjects was recorded to the nearest .25 of an inch and weight to .10 of a pound. Height and weights were measured twice to make sure they were accurate.

**Reliability and Validity**

Prior to the start of the actual study, the modified Block Kids FFQ was tested for validity and reliability. To determine reliability, students in a classroom who were not selected to participate in the study were recruited.

There was an 8th grade physical education class of 17 students who participated in testing the survey. The survey was administered twice, with the second administration occurring a week after the initial administration of the survey to determine test-retest reliability. The investigator administered the questionnaire under similar circumstances as the previous week. Prior to the initiation of the survey, instructions were given by the investigator about the nature of the study (i.e., what the questions were asking, and how to fill out the survey), and explanations of the picture diagrams that went along with the questions.

By participating in the pilot study, the subjects not only assisted in testing the survey, but also the amount of time needed to complete the survey. Average completion of the survey took 15 minutes. The Kappa Coefficient or the intra class correlation coefficient was used in assessing test-retest reliability. The Kappa Coefficients were .340 and .432 for regular soda, .597 and .583 for diet soda, .543 and .655 for fountain drinks, .263 and .158 for 100% fruit juice, .208 and .364 for flavored drinks, .360 and .352 for sport drinks, 1.00 and .845 for low calorie sport drinks, .729 and 1.00 for energy drinks,
1.00 and .610 for milk, .309 and .904 for water, .718 and .897, indicating interrator reliability or agreement of the test-retest results of the modified Block Kids FFQ.

The modified Block Kids FFQ survey was validated by five Registered Dietitians at Ball State University to ensure it would be a good indicator of beverage consumption patterns in the preadolescent population.

Selection of Preadolescents

The researcher used the cluster sampling technique to select participants for the study. The investigator decided to recruit students from three physical education teacher classes because they promote overall health and well-being and were interested in determining the BMI of the students.

Data Collection

Between April 1\textsuperscript{st} and April 25\textsuperscript{th}, 2010, data was collected at Har-Bur Middle School. The investigator selected physical education classes to administer the beverage consumption survey. Prior to administering the surveys, instructions were given by the investigator about the nature of the study (e.g. what the questions were asking, and how to fill out their answers to the survey questions), and explanations of the picture diagrams that went along with the questions. Once the subject completed the survey, their heights and weights were taken.
Data Entry

All of the data collected from the surveys and anthropometrics (heights and weights) were entered into excel spreadsheets. To maintain anonymity, each of the subjects had a random number identification that corresponded to the number that was on their survey. The random number was used for data entry and analysis.

The data for each of the surveys was recorded in an excel spreadsheet by the random number identification. The beverages investigated (i.e. regular soda, diet soda, fountain drinks, 100% fruit juice, fruit drinks, sport drinks, low calorie sport drinks, energy drinks, milk, water, flavored water, and other) were categorized for comparison purposes. In each of the beverage categories, there were subcategories of number of days the beverages were consumed, the number of servings consumed, and the serving size. For milk, there was an additional category for the type of milk (fat-free, 1%, 2%, whole, chocolate, strawberry, soy, lactaid) consumed. For the serving sizes, the following was used for the number of fluid ounces consumed: 1=< 8 fl. oz., 2=8 fl. oz, 3=12 fl oz., 4=16 fl. oz, 5=20 fl. oz, 6=32 fl. oz., and 7= > 32 fl. oz. The guide to determine the type of milk consumed was 0=fat-free, 1=1%, 2=2%, 3=whole, 4=chocolate, 5=strawberry, 6=soy, and 7=lactaid. Once all the subject data was entered into the spreadsheet statistical analysis was completed.

Statistical Analysis

Correlation and regression analysis were used in assessing sweetened beverage consumption, and BMI. Descriptive data was collected from each survey. A correlation
matrix of predictors of BMI was screened for potential multicollinearity between the beverage categories.

For regression analysis, an ordinary least scores multiple regression was used to predict BMI using the predictors of gender and intakes of soda, diet soda, fountain drinks, 100% fruit juice, fruit drinks, sport drinks, low calorie sport drinks, energy drinks, milk, water, and flavored water over a week period. The assumptions of regression were tested to see if there is compliance and if any outliers occurred they will be investigated to ascertain their cause. There was also an examination of the regression coefficient to see which variables had a relationship with BMI after controlling for other variables. Significance was established at p < .05.

**IRB Approval**

Prior to the start of the study, the research protocol was submitted to Region 10 Middle Schools and Ball State University, as an expedited study in December of 2009 (Appendix F). The investigator completed the NIH human subject module (Appendix G).

**Summary**

This chapter describes the subjects, permission from Har-Bur middle school, letters of consent, survey instrument, height and weight, reliability and validity, selection of preadolescents, data collection, and IRB approval.
CHAPTER IV

RESULTS

The purpose of this study was to determine the relationship between beverage consumption of sixth to seventh graders (ages 11 to 13) and its effect on BMI. The variables that the researcher looked at were the types and amounts of sugar-sweetened beverages consumed, and gender in middle school aged children attending a Region 10 middle school in Burlington, Connecticut.

Currently, the research shows inconsistent results on whether or not beverage selection affects BMI. This investigator wanted to provide a greater understanding of the relationship between sugar-sweetened beverage consumption and BMI.

Hypotheses

There are six hypotheses for the study:

- Preadolescents (11 to 13) consuming more than 12 fluid oz of sweetened beverages per day will have higher BMI than those consuming less than 12 fluid ounces per day.
- Irrespective of gender, older preadolescents (13 year olds) will consume greater amounts (fluid ounces) of sweetened beverages than younger (11 and 12 year olds) adolescents
• Males will consume greater amounts (fluid ounces) of sugar-sweetened beverages than females.

• Preadolescents consuming regular soda will have higher BMI’s compared with those who drink diet soda.

• Preadolescents who drink greater fluid ounces of regular soda will have higher BMI’s than those who consume less.

• Preadolescents who consume flavored fruit drinks will have a higher BMI than those who consume 100% fruit juice.

**Demographics**

For this study, there were 61 students who volunteered to participate; 36 females and 25 males. Each of the physical education classes for one physical education teacher was given a random number. A random numbers table was used to determine which classrooms participated in the study. There were a total of four physical education classes that participated in the study. There were approximately 15 students in each physical education classrooms that were not able to participate due to not returning their permission forms in the allotted amount of time. Each subject completed a survey to self-report types and amount of beverages consumed and the number of servings per day, and had their height and weight measured to determine BMI.

The researcher needed between 100 and 120 responses for sufficient statistical power to detect moderate effect sizes. The total number of subjects enrolled in the study was 61. The reason there was only 61 participants was because only one physical education teacher was willing to allow her students to participate in the investigator’s
study and not all of the students who were in these physical education classes returned their permission forms in the allotted time frame.

The mean BMI of the subjects was 19.3 ± 3.2. Using a one-way Analysis of Variance (ANOVA), within subjects, the mean fluid intake of beverages was found to be varied (Pillai’s Trace = .647, F (10,50) = 9.18, p < .001), with the highest intake for water, milk, 100% juice, flavored fruit drinks, and regular soda. Only two out of the 61 subjects consumed energy drinks. Table 1 provides the descriptive statistics for the mean BMI and the average intakes of each of the beverages that were examined. The very large standard deviations relative to the means for the fluid intake indicate a high degree of positive skewness. This was due to many subjects having little or no intake of some of the drinks with a few having very high levels. In other words, this would suggest individual subjects tended to have favorite beverages rather than a wide variety.

Table 1 Descriptive Statistics of the Subjects for Each Beverage Category

<table>
<thead>
<tr>
<th>Beverage Category</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>19.85</td>
<td>3.2</td>
<td>61</td>
</tr>
<tr>
<td>Regular Soda</td>
<td>41.67</td>
<td>74.8</td>
<td>60</td>
</tr>
<tr>
<td>Diet Soda</td>
<td>12.69</td>
<td>31.9</td>
<td>61</td>
</tr>
<tr>
<td>Fountain Drinks</td>
<td>32.69</td>
<td>53.35</td>
<td>61</td>
</tr>
<tr>
<td>100% Juice</td>
<td>76.98</td>
<td>137.0</td>
<td>61</td>
</tr>
<tr>
<td>Flavored Fruit Drinks</td>
<td>43.84</td>
<td>96.6</td>
<td>61</td>
</tr>
<tr>
<td>Sports Drinks</td>
<td>70.3</td>
<td>130.1</td>
<td>61</td>
</tr>
<tr>
<td>Low Calorie Sport Drinks</td>
<td>27.25</td>
<td>100.6</td>
<td>61</td>
</tr>
<tr>
<td>Energy Drinks</td>
<td>1.51</td>
<td>6.024</td>
<td>61</td>
</tr>
<tr>
<td>Milk</td>
<td>129.08</td>
<td>156.8</td>
<td>61</td>
</tr>
<tr>
<td>Water</td>
<td>220.92</td>
<td>275.5</td>
<td>61</td>
</tr>
<tr>
<td>Flavored Water</td>
<td>19.25</td>
<td>82.7</td>
<td>61</td>
</tr>
</tbody>
</table>
Hypothesis One: Preadolescents consuming greater than 12 fluid ounces per day of sugar-sweetened beverages will have a higher BMI than those consuming less than 12 fluid ounce daily.

Based on the results of an independent t-test, there were no significant differences in BMI between the two groups (t = -.958, df = 59, p = .34). There were a similar number of preadolescents who consumed less than 12 fluid ounces of sugar-sweetened beverages per day (n = 30) and those who consumed greater than 12 fluid ounces per day (n = 31). The BMI was similar between the two groups, showing that the total amount in fluid ounces of sugar-sweetened beverages each day did not result in differences in preadolescents BMI. Table 2 provides the group statistics of those preadolescents daily fluid ounce consumption of sugar-sweetened beverages, the mean, standard deviation, and independent samples t-test.

<table>
<thead>
<tr>
<th>Fluid Ounces</th>
<th>N</th>
<th>BMI</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 fluid ounces or less</td>
<td>30</td>
<td>19.5</td>
<td>2.84</td>
<td>-.958</td>
<td>59</td>
</tr>
<tr>
<td>12 fluid ounces or more</td>
<td>31</td>
<td>20.2</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Two: Irrespective of gender, older preadolescents (13 year olds) will consume greater amounts (fluid ounces) of sugar-sweetened beverages than younger (11 and 12 year old) adolescents.

When looking at if age affected consumption of sugar-sweetened beverages, it was found that the younger preadolescents (11 and 12 year olds) tended to consumed
greater amounts of sugar-sweetened beverages than older preadolescents (13 year olds).

Eleven year olds (n = 16), on average consumed 33 ounces of sugar-sweetened beverages while 13 year olds (n = 23) consumed about 27 fluid ounces of sugar-sweetened beverages per day.

A one-way (ANOVA) was run to determine if the results were statistically significant between each of the age groups. Results of the ANOVA ($F(2,58) = .58$, $p = .57$) showed that there were no statistically significant differences between the age groups. Preadolescents consumed similar amounts of fluid ounces for each of the beverage categories. Table 3 provides the descriptive statistics for each age group, mean fluid ounces of sugar-sweetened beverages consumed, standard deviation, and the ANOVA results.

**Table 3: Descriptive Statistics for Each Age Group on Daily Fluid Ounces of Sugar-Sweetened Beverages Consumed Daily**

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>16</td>
<td>33.4</td>
<td>35.9</td>
<td>1097.39</td>
<td>59</td>
<td>0.58</td>
<td>0.57</td>
</tr>
<tr>
<td>12</td>
<td>22</td>
<td>27.1</td>
<td>35.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>23</td>
<td>22.6</td>
<td>20.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>27.0</td>
<td>30.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $F_{(2,58)} = .58$, $p = .57$
Hypothesis Three: Males will consume greater amounts (fluid ounces) of sugar-sweetened beverages than females

When comparing the amount of sugar-sweetened beverages consumed daily, it was found that irrespective of gender, beverage consumption between both groups was similar in fluid ounces/day based on an independent sample t-test ($t = -0.286$, $df = 59$, $p = 0.78$). Males consumed approximately 28 fluid ounces/day while females consumed approximately 26 fluid ounces/day. There was a net difference of 2 fluid ounces between the 2 groups. Table 4 provides gender statistics for the mean, standard deviation, and independent sample t-test results.

Table 4: Gender Differences Statistics in Daily Fluid Ounces of Sugar-Sweetened Beverages Consumed

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>36</td>
<td>26.10</td>
<td>29.79</td>
<td>-0.286</td>
<td>59</td>
<td>0.776</td>
</tr>
<tr>
<td>male</td>
<td>25</td>
<td>28.40</td>
<td>32.36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Four: Preadolescents consuming regular soda will have higher BMI’s compared with those who consume diet soda

Based on the results of an independent sample t-test, there were no statistical differences in BMI between the types of soda (regular versus diet) and BMI ($t = 0.529$, $df = 58$, $p = 0.60$). There were more preadolescents who consumed regular soda ($n = 53$) than those who consumed diet soda ($n = 7$). The BMI was similar between those consuming
regular soda and diet soda, indicating that soda consumption did not exhibit an increase in BMI. Table 5 provides group statistics of daily fluid consumption for each of types of soda consumed, mean, standard deviation, and independent sample t-test.

Table 5: Group Statistics for BMI Based on Fluid Ounces of Regular vs. Diet Soda Consumption

<table>
<thead>
<tr>
<th>Soda</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>53</td>
<td>20.0</td>
<td>3.2</td>
<td>0.539</td>
<td>58</td>
<td>0.60</td>
</tr>
<tr>
<td>Diet</td>
<td>7</td>
<td>19.3</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Five: Preadolescents who drink greater fluid ounces of regular soda will have higher BMI’s than those who consume less

When comparing the amount of regular soda consumed and its effects on BMI, there was no statistically significant relationship between the amount of regular soda consumed and BMI (Pearson’s correlation r = .202, p = .12). The majority of subjects (n = 53) consumed regular soda on a daily basis. Table 6 provides the correlation results between BMI and fluid ounces of regular soda consumed.

Table 6: Correlations between Fluid Ounces of Regular Soda Consumed and BMI

<table>
<thead>
<tr>
<th>N</th>
<th>Pearson Correlation r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>0.202</td>
<td>0.12</td>
</tr>
</tbody>
</table>
Hypothesis Six: Preadolescents who consume flavored fruit drinks will have a higher BMI than those who consume 100% fruit juice

Based on the results of an independent sample t-test, there were no significant differences between the type of juice consumed (100% fruit juice versus flavored fruit drinks) and BMI ($t = .710$, df = 59, $p = .48$). More preadolescents consumed 100% fruit juice ($n = 36$) than those consuming flavored fruit drinks ($n = 25$). As the BMI was similar between the two groups, it shows that the type of juice consumed does not predict BMI. Table 7 provides statistics for differences in types of juice consumed, the mean, standard deviation, and independent sample t-test.

Table 7: Group Statistics for BMI Based on Fluid Ounces of 100% Fruit Juice vs. Flavored Fruit Drinks Consumed Daily

<table>
<thead>
<tr>
<th>BMI</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Fruit Juice</td>
<td>25</td>
<td>20.2</td>
<td>3.7</td>
<td>0.710</td>
<td>59</td>
<td>0.48</td>
</tr>
<tr>
<td>Flavored Fruit Drinks</td>
<td>36</td>
<td>19.6</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Analysis

Regression Analysis was performed to determine which of the predictors (type of beverage) had the greatest effect on BMI. With the regression analysis, there were assumption violations that occurred with the Variation Inflation Factor (VIF), which is a measure of multicollinearity. VIF values are always greater or equal to one, but when the VIF is greater than 10, it is an indicator of multicollinearity. There was too high a relationship seen for both low calorie sport drinks (VIF = 14.32) and flavored water (VIF = 13.33). Table 8 provides the collinearity statistics for each beverage category.
### Table 8: Collinearity Statistics for each Beverage Category

<table>
<thead>
<tr>
<th>Beverage</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Soda</td>
<td>1.3</td>
</tr>
<tr>
<td>Diet Soda</td>
<td>1.4</td>
</tr>
<tr>
<td>Fountain Drinks</td>
<td>1.5</td>
</tr>
<tr>
<td>100% Fruit Juice</td>
<td>1.2</td>
</tr>
<tr>
<td>Flavored Fruit Drinks</td>
<td>1.3</td>
</tr>
<tr>
<td>Sport Drinks</td>
<td>3.5</td>
</tr>
<tr>
<td>Low Calorie Sport Drinks</td>
<td>14.3</td>
</tr>
<tr>
<td>Energy Drinks</td>
<td>1.2</td>
</tr>
<tr>
<td>Milk</td>
<td>1.8</td>
</tr>
<tr>
<td>Water</td>
<td>1.5</td>
</tr>
<tr>
<td>Flavored Water</td>
<td>13.3</td>
</tr>
</tbody>
</table>

#### Residuals

The residuals were examined to assess the fit of the model for the predicted BMI based on the types of beverages that were examined. When data points diverge from the overall pattern and have large residuals, they are considered outliers. In residuals, both the sum and mean should be equal to zero, and normally distributed. When the standardized residual is greater than two, the data point may be considered an outlier.

The current study showed outliers with some of the subjects data points because the maximum Cook’s value was excessive (greater than one), which could have an effect on the accuracy of the results. The regression was rerun after removing the subject with a Cook’s distance greater than one, to increase the accuracy of the results.

When the regression was rerun, the VIF for the predictors were all below 2.00 and the maximum Cook’s distance was less than 1.00. However, the subjects variable ratio was low (6:1 instead of the recommended 10-20:1) and if replicated, the $R^2$ shrinkage
estimate of around 8% of the variance being accounted for in BMI may be a more realistic estimate than the 26% variance shown in the original regression. Table 9 provides the result of the regression analysis.

Table 9: Regression Analysis

<table>
<thead>
<tr>
<th>Constant</th>
<th>R</th>
<th>R square</th>
<th>Adj R square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.505</td>
<td>0.255</td>
<td>0.08</td>
<td>0.18</td>
</tr>
</tbody>
</table>

**Standardization of Variables (beverage type) in Regression Analysis**

Although the overall regression was not statistically significant (p = .18), the individual predictors were examined to see if any may have potential for future research. When the beverages are standardized, it shows the relative strength of each type of beverage to the others. After controlling for the influence of the other variables, flavored fruit drinks ($\beta = .378$, t = 2.59, df = 47, p = .01) and sport drinks ($\beta = -.374$, t = -2.21, df = 47, p = .03) were significant predictors of BMI and milk (p = .08) approached statistical significance. For each fluid ounce increase in the intake of flavored fruit drinks, the BMI is estimated to increases by .01 points, while each fluid ounce of sports drink consumed would reduce BMI by an estimated value of .01. Also, increases in milk consumption tended to increase BMI (b = .006). Table 10 provides how standardized coefficients for each of the beverage categories and the effects on BMI, results of the independent sample t-test, and p-values.
Table 10: Standardized Coefficients for each Beverage Category based on BMI

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>18.812</td>
<td>.686</td>
</tr>
<tr>
<td>Regular Soda consumption</td>
<td>.010</td>
<td>.007</td>
</tr>
<tr>
<td>Diet Soda consumption</td>
<td>.017</td>
<td>.015</td>
</tr>
<tr>
<td>Fountain Drinks</td>
<td>-.010</td>
<td>.009</td>
</tr>
<tr>
<td>100% Fruit Juice</td>
<td>.001</td>
<td>.003</td>
</tr>
<tr>
<td>Flavored Drinks</td>
<td>.012</td>
<td>.005</td>
</tr>
<tr>
<td>Sports Drinks</td>
<td>-.013</td>
<td>.006</td>
</tr>
<tr>
<td>Low Calorie Drinks</td>
<td>-.003</td>
<td>.017</td>
</tr>
<tr>
<td>Energy Drinks</td>
<td>.020</td>
<td>.071</td>
</tr>
<tr>
<td>Milk</td>
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<td>Flavored Water Drinks</td>
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<td>.029</td>
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</table>

Summary

The results of this study did not show any statistical significant findings for each of the six hypotheses. However, as preadolescents increased in age they tended to decrease their intakes of sugar-sweetened beverages. This could be related to gaining more knowledge about the health effects of sugar-sweetened beverages or increases in physical activity (variable that were not included in the study). Discussion of the significance of the results will follow in Chapter 5.
CHAPTER V

DISCUSSION

The purpose of this study was to determine the relationship between beverage consumption of sixth to seventh graders (ages 11 to 13) and its effect on body mass index (BMI). The variables that the researcher looked at were the types and amounts of sugar-sweetened beverages consumed, and gender in preadolescents (11-13 years old) attending a Region 10 middle school in Burlington, Connecticut.

There were six hypothesis examined in this study. The hypotheses examined were:

- Preadolescents (11 to 13) consuming more than 12 fluid oz of sugar-sweetened beverages per day will have higher BMI than those consuming less than 12 fluid ounces per day.
- Irrespective of gender, older preadolescents (13 year olds) will consume greater amounts (fluid ounces) of sugar-sweetened beverages than younger (11 and 12 year olds) adolescents.
- Males will consume greater amounts (fluid ounces) of sugar-sweetened beverages than females.
- Preadolescents consuming regular soda will have higher BMI’s compared with those who drink diet soda.
• Preadolescents who drink greater fluid ounces of regular soda will have higher BMI’s than those who consume less.

• Preadolescents who consume flavored fruit drinks will have a higher BMI than those who consume 100% fruit juice.

**Beverage Consumption and Obesity**

Childhood overweight and obesity in the United States has been increasing over the last several decades. Obesity has risen nearly five-fold from the years 1973-2009 in 5-17 year old children. In 1973 obesity was at 5.6% and in 2009 it was reported as 30.8% (Kavey et al, 2010). It has been found that carbonated sweetened beverages, sport drinks, fruit drinks, and energy drinks are the primary beverages that contribute to added sugars in American diets (Kavey et al, 2010; LaRowe et al., 2007, Rajeshwari et al., 2005). With the rise in overweight and obesity, there is also an increased risk for heart disease, hypertension, and diabetes (LaRowe et al, 2007; Garnett et al., 2007, Baker et al., 2007, Malik et al., 2006).

Total overall energy intake from sugar-sweetened beverages has dramatically increased over the last several decades (Kavey et al., 2010; Rajeshwari et al. 2005; Fiorito et al., 2010; Lim et al., 2009). Both portion sizes and number of servings of sugar-sweetened beverages have increased in children and adolescents (Gomez-Martinez et al., 2009). Significant increases in sugar-sweetened beverage consumption have made these beverages the primary source of added sugars. The excess empty calories have been a contributing factor in the obesity epidemic resulting in children and preadolescents having higher BMI (LaRowe et al., 2007; Lim et al., 2009; Gomez-Martinez et al., 2009).
Sugar-sweetened beverage consumption also tends to change from young childhood through adolescents. In younger children (6 to 11 years) milk is the primary beverage of choice, while carbonated soft drink consumption is the predominant beverage of choice in 12 to 19 year old adolescents (Forshee et al., 2003).

Demographics

In the current study conducted, grades 6 and 7 were examined to determine the number of subjects who were underweight, normal weight, overweight, or obese. From a total of 61 subjects, 17 were underweight (28%), 39 were a normal weight (64%), and 5 were overweight (8%). This was evaluated using the standardized assessment of BMI. Of the 36 females included in the study, 10 were underweight (28%), 24 were a normal weight (67%), and 2 were overweight (5.5%). Out of the 25 males, 7 were underweight (28%), 15 were a normal weight (60%), and 3 were overweight (12%).

Hypothesis One: Preadolescents consuming greater than 12 fluid ounces per day of sugar-sweetened beverages will have a higher BMI than those consuming less than 12 fluid ounce daily.

For hypothesis one, there were no significant differences between preadolescents consuming greater than or less than 12 fluid ounces of sugar-sweetened beverages (t = - .958, df = 59, p = .34). BMI was similar between the two groups, indicating that total fluid ounces consumed from sugar-sweetened beverages did not affect BMI. Fluid ounces of sugar-sweetened beverages were self-reported. There could possibly be error in under
or over-reporting of beverages consumed, biasing the results of sugar-sweetened beverage consumption on BMI.

The Bogalusa Heart Study conducted by Rajeshwari et al., (2005) provided results that agreed with findings from the current study in their research with 10 year olds. Rajewshari et al., (2005) did not find an association between increased sugar-sweetened beverage consumption from baseline and an increased BMI. Each of the sugar-sweetened beverage groups (none, low, medium, and high consumers) examined had similar BMI’s (18.3 ± 0.3), indicating that sugar-sweetened beverage consumption did not affect BMI (Rajeshwari et al., 2005). In the current study, mean BMI was 19.3 ± 3.2 regardless of how many fluid ounces of sugar-sweetened beverages were consumed per day, revealing that amounts of sugar-sweetened beverages consumed does not affect BMI.

Disagreeing with Rajeswari et al., (2005) and the current study was Ludwig et al., (2001). Results from Ludwig and colleagues (2001), longitudinal study showed that for each additional fluid ounce of sugar-sweetened beverage consumed from baseline, there was an increase in BMI. Results were considered to be statistically significant (p < .05). On the other hand, the current study did not find any statistically significant differences based on the total amount of sugar-sweetened beverages consumed and BMI (p > .05). Unlike the present study (n = 61), Ludwig et al., (2001), had a larger number of subjects (n = 548). This allowed for a greater power in detecting moderate effect sizes for how the total fluid ounces of sugar-sweetened beverages consumed daily can influence BMI score (Ludwig et al., 2001). Unfortunately, with the smaller number of subjects, it was difficult to determine if total amount of sugar-sweetened beverages consumed per day had an effect on BMI. In addition to having a large sample size, if there was an even distribution
in the number of subjects across gender, there could have possibly have been a strong relationship between consumption of sugar-sweetened beverages, BMI, and gender.

The research conducted by Blum et al., (2005) was one of the first studies to actually find that increased consumption of diet soda caused increased BMI. In this study, diet soda was the only beverage examined that showed a positive association with increased BMI. It was suggested that for each additional 12 fluid ounce serving from baseline, there was a 0.156 increase in BMI (Blum et al., 2005).

**Hypothesis Two: Irrespective of gender, older preadolescents (13 year olds) will consume greater amounts (fluid ounces) of sugar-sweetened beverages than younger (11 and 12 year old) adolescents.**

In terms of age, younger preadolescents (11 and 12 year olds) tended to consume greater amounts of sugar-sweetened beverages than older preadolescents (13 year olds). Eleven year olds (n = 16), on average consumed 33 ounces of sugar-sweetened beverage while 13 year olds (n = 23) consumed about 27 fluid ounces of sugar-sweetened beverages per day. A possible explanation to this could be that environmental factors including home, childcare, school, peer pressure, and the media can influence sugar-sweetened beverage consumption patterns (Ritchie et al., 2005; Briefel et al., 2009; Perkins et al., 2010).

In young children, the home environment plays a major role in the establishment of food and beverage patterns and preferences. Parents can influence what children consume based on foods bought and cooked, beliefs, attitudes, dietary habits, behavior and role-modeling (O’Connor et al., 2006; Ritchie et al., 2005; LaRowe et al., 2007).
Peer pressure, especially in school aged children and adolescents can influence sugar-sweetened beverage consumption patterns (Blum et al., 2005; Rajeshwari et al., 2005; Perkins et al., 2010). Preadolescents and adolescents tend to conform to social norms, which can influence dietary habits, attitudes and behaviors (Perkins et al., 2010).

The media has a large influence on food and beverage choices. Children and adolescents view approximately 40,000 commercials per year, with fast foods, and high sugar food and snacks heavily advertised on children’s television programs. Children’s television viewing has been linked to increased consumption of sweets, salty snacks, fats, fast food, and decreased intakes of fruits and vegetables (Ritchie et al., 2005). Wiecha et al., (2006) showed that for each additional hour of television watched from baseline, there was an increase of 167 calories/day and increased consumption of foods and beverages that were advertised on television (Wiecha et al., 2006).

Research observations congruent to the present study were observed by Gomez-Martinez et al., (2009). As preadolescents grew older, they appeared to decrease consumption of sugar-sweetened beverages. From 13 to 19 years, females (n= 755) decreased sugar-sweetened beverage consumption per day from 113.5 g to 71.6 grams. Similar observations were note in the male counterparts, in terms of lower intakes of sugar-sweetened beverages as they grew older. Older male adolescents (n = 768) decreased their intake of sugar-sweetened beverage consumption from 164.5 grams to 160.0 g per day. However, even though sugar-sweetened beverage consumption decreased daily from 13 years to 19 years in both males and females, the results were not statistically significant (p > .05). These observations were similar to those found in the present study current study (p > .05).
LaRowe et al. (2007) conducted a sugar-sweetened beverage consumption study with elementary and school-aged children. This population comprised of children in two age groups, namely 2 to 5 years and 6 to 11 years. Sugar-sweetened beverage consumption in 2 to 5 year olds ranged from 70.9 to 79.0 grams per day and ranged from 63.2 to 69.9 grams per day in 6 to 11 year olds (LaRowe et al., 2007), indicating younger children had a greater tendency to consumer larger amounts of sugar-sweetened beverages when compared to older children. This could possibly be due to parents influence over young children’s beverage choices, availability of low nutrient dense beverages at day care facilities, and media’s (e.g. TV, radio, computer, video games) influence younger children’s food and beverage consumption patterns (O’Connor et al., 2006; Ritchie et al., 2005; Wiecha et al., 2006; Briefel et al., 2009).

**Hypothesis Three: Males will consume greater amounts (fluid ounces) of sugar-sweetened beverages than females**

In terms of gender, results of the independent sample t-test showed no statistically significant differences in the amount of sugar-sweetened beverages consumed per day ($t = -.286$, $df = 59$, $p = .78$). On average, males consumed approximately 28 fluid ounces of sugar-sweetened beverages per day while females consumed approximately 26 fluid ounces per day. A two fluid ounce variation in amount of sugar-sweetened beverages consumed may have been due to under or overestimating by both age groups in total amount of beverages consumed per day.

Likewise, Gomez-Martinez et al., (2009) results showed males ($n = 768$) consumed greater amounts of sugar-sweetened beverages than females ($n = 755$), with
mean intakes of 157.8 ± 164.5 and 71.6 ± 113.5 for females respectively. Males may have possibly consumed greater amounts of sugar-sweetened beverages than females due to increases in physical activity, higher body weight, and less conscious about body image than females (Perkins et al., 2010; Fiorito et al., 2010). Also, corresponding to the investigator’s study, results from Gomez-Martinez et al., (2009) were not statistically significant (p > 0.05). However, Gomez-Martinez et al., (2009) had a larger sample size (n = 1523) than the current investigators study (n=61), allowing for greater power to detect moderate affect sizes to determine how sugar-sweetened beverages consumed per day affects BMI for each gender.

Congruent with the investigator’s study and Gomez-Martinez et al., (2009) was research conducted by Forshee et al., (2003). Results showed adolescents (12 to 19 years) consumed greater amounts of sugar-sweetened beverages than younger children (6 to 11 years). Males in both age groups consumed greater amounts of sugar-sweetened beverages than females. In younger children (6 to 11 years) males consumed 776 grams/day and females consumed 692 grams/day of sugar-sweetened beverages. In adolescents (12 to 19 years) males consumed approximately 1196 grams/day while females consumed 799 grams/day of sugar-sweetened beverages. Similar to the investigator’s study and Gomez-Martinez et al., (2009), the results of Forshee et al., (2003) were not statistically significant (p > .05).
Hypothesis Four: Preadolescents consuming regular soda will have higher BMI’s compared with those who consume diet soda

Based on the results of an independent sample t-test, there was no statistically significant results with type of soda consumed and BMI ($t = .529$, $df = 58$, $p = .60$). There was a larger number of preadolescents who consumed regular soda ($n = 53$) than diet soda ($n = 7$). These results were self-reported, and there can be error in under or over-reporting of beverages consumed. This may also have been influenced taste, cost, availability, media advertising, and peer pressure (Ritchie et al., 2005; Wiecha et al., 2006; Briefel et al., 2009; Park et al., 2012).

Results from Park et al., (2012) suggested that factors such as poor academics, inadequate amounts of sleep (less than 8 hours on school nights), watching television or playing video games two or more hours a day, less than 60 minutes of physical activity per day, and cigarette smoking were associated with increased soda consumption in adolescents (Park et al., 2012).

Similarly to the current study, results of Forshee et al., (2003) did not find a relationship between regular soda consumption and BMI in children and adolescents, but showed a weak relationship between diet soda consumption and increases in BMI. Results were not statistically significant ($p > .05$), as were the results of the investigators study ($p > .05$).

In disagreements with the results of the current study and Forshee et al., (2003) was Blum et al., (2005). In this study, diet soda was the only beverage examined that showed a positive association with increased BMI. It was found from baseline that each
additional 12 fluid ounce serving consumed, there was a 0.156 increase in BMI (Blum et al., 2005).

Fiorito et al., (2010) took her investigation on sugar-sweetened beverages a step further to determine if beverage consumption patterns at age 5 years would predict beverage consumption at age 15 in females. Results showed significant changes in the types of beverages consumed as their age increased. Decreased beverage consumption occurred in the following beverages: milk (90% to 61%), 100% fruit juice (67% to 37%), and fruit drinks (78% to 57%). Soda consumption tended to increase from ages 5 to 15 (23% to 42%) according to Fiorito et al, (2010).

**Hypothesis Five: Preadolescents who drink greater fluid ounces of regular soda will have higher BMI’s than those who consume less**

With examination of the amount of regular soda consumed and its effects on BMI, results of the correlation coefficient test were not statistically significant (Pearsons correlation $r = .202$, $p = .12$). Explanations for why there were no differences in BMI could be due to under or over-reporting of beverages consumed. Other factors influencing beverage consumption could be related to peer pressure, media advertising, and availability (Ritchie et al., 2005; Wiecha et al., 2006; Briefel et al., 2009; Park et al., 2012).

Beverage consumption patterns have also shown to change from young childhood through adulthood. In younger children (6 to 11 years) milk is the primary beverage of choice, while carbonated soft drink consumption is the predominant beverage of choice in 12 to 19 year old adolescents (Forshee et al., 2003).
Congruent with the investigator’s study, results of Gomez-Martinez et al., (2009) did not show an association between increased sugar-sweetened beverage consumption and increased obesity in this Spanish population (Gomez-Martinez et al., 2009). Like the investigator’s study, results were not statistically significant (p > 0.05).

Findings from Parks et al. (2012) would refute Gomez-Martinez et al., (2009) and the investigator’s study. Parks looked at a variety of factors influencing beverage consumption including academics, sleep, television viewing, physical activity, and cigarette smoking. Results suggested that factors such as poor academics, inadequate amounts of sleep (less than 8 hours on school nights), watching television or playing video games two or more hours a day, less than 60 minutes of physical activity per day, and cigarette smoking were associated with increased soda consumption in adolescents (Park et al., 2012).

**Hypothesis Six: Preadolescents who consume flavored fruit drinks will have a higher BMI than those who consume 100% fruit juice**

Flavored fruit drinks seem to be gaining popularity due to media advertising, cost, availability, and peer influence (Ritchie et al., 2005; Wiecha et al., 2006; Briefel et al., 2009; Park et al., 2012). With examination of 100% fruit juice versus flavored fruit drink consumption on BMI, results of the independent sample t-test did not show statistical significance (t = .710, df = 59, p = .48).

To the investigator’s knowledge, there have been few studies examining how different types of juice (100% fruit juice versus flavored fruit drinks) affect BMI. Other studies have focused on trends affecting beverage consumption, but not specifically for
100% fruit juice and flavored fruit drinks. In the Bogalusa Heart Study, findings showed significant decreases in the percentage of children who consumed soft drinks (83% to 81%) and coffee (9% to 3%). Even though there was a decrease in the percentage of children consuming sweetened beverages as they became adults, the mean amounts (grams) of sweetened beverages increased from 1973 to 1994. Like the investigator’s study, results of the Bogalusa Heart Study did not support a relationship between increased sweetened beverage consumption and increased BMI, as the mean BMI for each of the consumption groups examined was 18.3 ± 0.3 (Rajeshwari et al., 2005).

Fiorito et al., (2010) also reported results that showed significant changes in the types of beverages consumed as age increased. Decreased beverage consumption occurred in the following beverages: milk (90% to 61%), 100% fruit juice (67% to 37%), and fruit drinks (78% to 57%). Soda consumption tended to increase from ages 5 to 15 (23% to 42%). Similar to the investigator’s study the results were not statistically significant (p < .05).

Peer pressure plays a role in these beverage trends. Perkins et al., (2010) reported a strong relationship between subject’s misperceptions regarding peers sugar-sweetened beverage consumption and their own reported sugar-sweetened beverage consumption. The subjects tended to overestimate the amount of sugar-sweetened beverages consumed by their peers, which can cause increased consumption of sugar-sweetened beverages (Perkins et al., 2010).
Summary

There were no significant findings seen for any of the six hypotheses examined in the study. However, there were tendencies towards flavored fruit drinks and BMI. Sugar-sweetened beverage consumption also tended to decrease with age. The small sample size could be contributing to the fact that there were not significant findings for sugar-sweetened beverages consumed and increases in BMI in this preadolescent population. Further research needs to be conducted to determine the effects of sugar-sweetened beverages on BMI in preadolescents. Conclusions and recommendations will follow in Chapter 6.
CHAPTER VI

CONCLUSIONS

Obesity continues to be a major health concern. Obesity has quadrupled in 6 to 11 year olds (from 4 percent to 15.3 percent), and tripled among 12 to 19 year old adolescents; from 6.1 percent to 15.5% (Story et al., 2009). Children who are overweight or obese during childhood are more likely to remain overweight and obese into adolescence and adulthood (LaRowe et al., 2007; Rajeshwari et al., 2005).

Environmental and genetic factors may also influence sugar-sweetened consumption patterns include home, childcare, school, peer pressure, and the media (DuBois et al., 2007; Story et al., 2009; Ritchie et al., 2005).

As weight increases in childhood, it also causes a rise in BMI. Having a higher BMI has been linked with increased risk for a variety of medical conditions. These include hypertension, cardiovascular disease, dyslipidemia, hyperinsulemia, and Type 2 Diabetes (LaRowe et al., 2007; Story et al., 2009; Kavey et al., 2010). Consumption of sugar-sweetened beverages may directly lead to the development of type 2 diabetes (Kavey et al., 2010).

Total energy intake from sugar-sweetened beverages has dramatically increased over the last several decades, while energy expenditure has decreased (Wiecha et al., 2006). Portion sizes and number of servings of sugar-sweetened beverages continue to
increase (Gomez-Martinez et al., 2009). Sugar-sweetened beverages have become the primary source of added sugars and excess empty calories in the diet, which is contributing to the obesity epidemic (LaRowe et al., 2007; Lim et al., 2009; Gomez-Martinez et al., 2009).

**Purpose**

The purpose of this study was to determine the relationship between beverage consumption of sixth to seventh graders (ages 11 to 13) and its effect on body mass index (BMI). The variables that the researcher looked at were the types and amounts of sugar-sweetened beverages consumed, and gender in middle school aged children (11-13 years old) attending a Region 10 middle school in Burlington, Connecticut.

**Effects of Sugar-Sweetened Beverages on BMI**

There were no significant differences between sugar-sweetened beverages and BMI in preadolescents who participated in the study. Due to a small number (n = 61) of preadolescents participating in the study, there was not sufficient statistical power to detect moderate effect sizes between sugar-sweetened beverages and BMI.

However, there were tendencies for fruit drink consumption and increases in BMI. Also, there were also decreases in fluid ounces of sugar-sweetened beverages consumed from age 11 years to 13 years, which could be related to knowledge gained about sugar-sweetened beverages consumed, peer pressure, and the media (Ritchie et al., 2005; Wiecha et al., 2006; Briefel et al., 2009; Park et al., 2012). With a larger sample
size, there may have been greater differences seen between sugar-sweetened beverages consumed and BMI for each of the six hypotheses examined.

**Strengths**

- This research study looked at preadolescents (11 to 13 years). In the past, the majority of research has been conducted in young children, adolescents, and adults.
- This was one of the few studies conducted comparing if 100% fruit juice versus flavored fruit drink and the effects on BMI.
- This study compared regular soda and diet soda and how these beverages would affect BMI. Soda consumption has tended to increase in preadolescents.

**Weaknesses**

- This sample limited to one suburban school district in Burlington, CT not allowing for generalization to the general public.
- Since the sample size was small, (n = 61) it made it difficult to detect how sugar-sweetened beverage consumption effects BMI.
- Preadolescent beverage consumption was self-reported data, and there may be errors related to under or over-reporting of sugar-sweetened beverages consumed.
- Since this was a cross-sectional study design rather than longitudinal study design, it was unable to determine changes in beverage consumption patterns and their effects on BMI over a period of time.
Implications for Future Research

Based on the findings from this study, listed below are future recommendations:

- It would be helpful to replicate of the investigator’s study with a larger sample size to provide sufficient power to detect moderate effect sizes on how sugar-sweetened beverages affect BMI.
- Using a longitudinal study design rather than a cross-sectional study design in the investigator’s study may help to determine changes in beverage consumption over a period of time and to see how these changes influence BMI.
- In addition to replicating the investigator’s study, it will be important to include other factors besides gender. Other factors include peer pressure, media, parental influence, and physical activity as they can all relate to BMI.
- By modifying the Block Kids FFQ to include additional new beverages in the market to determine if they have an effect on BMI.
- It would be beneficial for future research to investigate how the amount and types of juice (100% fruit juice versus flavored fruit drinks) affect BMI, as they beverages tend to be higher in calories and lower in nutrients
- Future research could possibly focus on investigating sugar-sweetened beverage consumption on adolescents and its relation to varying ages.

Summary

Overweight and obesity continues to be a growing problem in children and adolescents in the United States (Story et al., 2009; Kavey et al., 2010, LaRowe et al; 2007). Children who are overweight or obese during childhood are more likely to remain
overweight and obese into adolescence and adulthood, which can affect self-esteem and well-being (LaRowe et al., 2007; Rajeshwari et al., 2005). Also, a higher BMI can put a person at a greater risk for hypertension, cardiovascular disease, dyslipidemia, hyperinsulemia, and type 2 diabetes (LaRowe et al., 2007; Story et al., 2009; Johnson et al., 2010; Kavey et al., 2010). Findings from the investigator’s study did not find a relationship between sugar-sweetened beverage consumption and BMI in preadolescents. However, there were tendencies that indicated that fruit juice may cause increases in BMI in preadolescents. Future research is needed to determine the full extent to which sugar-sweetened beverage consumption can affect BMI.
Reference List


APPENDIX A:

PERMISSION FROM HAR-BUR MIDDLE SCHOOL
March 2, 2010

Institution Review Board

To Whom It May Concern:

Victoria Zielinski, a graduate student at Ball State University, has contacted me regarding a study she would like to conduct at Har-Bur Middle School regarding student consumption of certain beverages. We have discussed the protocol for the study, and scheduled the pilot test, as well as the actual study itself.

This letter is an official notification of my understanding and acceptance for the study to take place.

If you have any questions or need further comment, please feel free to contact me at (860) 673-6163 ext. 7758 or email me at smithkm@region10ct.org.

KMS/cnb
To Determine the Relationship Between Sugar-Sweetened Beverages and BMI in 6th-8th Graders

You have been recruited to participate in the study entitled: To Determine the Relationship between Sugar-Sweetened Beverages and BMI in 6th-8th Graders. If you choose to participate in the study you will be asked to fill out a questionnaire in regards to the types and amounts of beverages that you consume.
Participation in this study is voluntary.
Prior to participation, you will need to return the parental consent form to your teacher.
If you have any questions or concerns about your participation in the study, you can contact Vicki Zielinski or Dr. Jay Kandiah.

Contact Information

Researcher
Vicki Zielinski  
Family and Consumer Sciences-Dietetics  
Ball State University  
Harwinton, CT
Email: vazielinski@bsu.edu  
Phone: 860-485-0437

Faculty Advisor
Dr. Jay Kandiah  
Family and Consumer Sciences  
Ball State University  
Muncie, IN
Email: jkandiah@bsu.edu  
Phone: 765-285-5922
APPENDIX C:

LETTERS OF CONSENT
Parental Consent

I am a dietetic graduate student at Ball State University, conducting a research study as part of my Masters Degree. The title of this study is To Determine the Relationship between Sugar-Sweetened Beverages as a predictor of BMI in 6th-8th graders (11-14 years). The purpose of this study is to look at the relationship between sugar-sweetened beverage consumption as a predictor of BMI in 6th-8th grade children attending Har-bur Middle School.

Body Mass Index (BMI) is a measure used to classify people as being underweight, normal weight, overweight, or obese depending on a person’s height and weight.

If you agree to allow your child to participate in this study they will be asked to complete a questionnaire about the beverages that they consume. The questionnaire will take between 15 and 20 minutes to complete. The investigator will be collecting the heights and weights of your child. Height will be measured using a stadiometer and weight will be assessed using a SECA™ digital scale. This information will be used to determine BMI. Once the results are complete, the researcher will have an education session with the students to share the results, and the students will learn the relationship between sugar-sweetened beverage consumption and BMI.

The child’s participation is voluntary, and your child can withdraw from the study at any time. There is no penalty for choosing not to participate or withdrawing from the study. There will be no costs to you for allowing your child to participate.

The data collected will be anonymous, and only the researcher and her thesis committee will be the only ones who will have access to the data. The data will be stored on the researcher’s computer in a locked data file that will be password protected. The data will be destroyed within two years after it has been published in a journal, so no one will have access to it. Only group data will be disclosed, and no identifiable individual responses will be disclosed.

Benefits for participation in this study will be that the children will learn the relationship between sugar-sweetened beverage consumption as a predictor of BMI, and how BMI can affect their health status. This study will contribute to scientific research, and will better educate the public on sugar consumption in beverages as a predictor of BMI. There are no perceived risks for participating in this study.

Victoria Zielinski will be conducting the study and Dr. Jay Kandiah will be the mentor overseeing the project through Ball State University. Dr. Jay Kandiah may be reached at 765-285-5922 or jkandiah@bsu.edu for questions or complaints. Vicki can be reached at 860-485-0437 or at vazielinski@bsu.edu.

For questions about your rights as a research subject, please contact the Office of Research Compliance, Sponsored Programs Office, Ball State University, Muncie, IN, 47306 at (765)-285-5070 or irb@bsu.edu.

This project has been reviewed by the Institutional Review Board at Ball State University.
**Parental Consent:**

My child can participate (give your child’s name which will only be used to determine who is or is not participating in the study) in the study on how sugar-sweetened beverages affect BMI in 6th-8th graders. I have had a chance to ask questions and the questions have been answered to my satisfaction by the investigator.

Child’s name(s): ____________________

Parents Signature__________________   Date____________________

**Child Assent:** This research project has been explained to me and I know what I’m being asked to do as a participant. I have had a chance to ask questions and the questions have been answered to my satisfaction by the investigator. I agree to participate in this study.

Child’s Signature____________________  Date____________________

Sincerely,

Victoria Zielinski

Research Contact Information

Primary Investigator  Faculty Supervisor

Victoria Zielinski  Dr. Jay Kandiah
Family and Consumer Sciences- Dietetics  Family and Consumer Sciences
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Harwinton, CT  Muncie, IN
vazielinski@bsu.edu  jkandiah@bsu.edu
860-485-0437  765-285-5922
APPENDIX D:

MODIFIED BLOCK KIDS FFQ
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<th>How Many Servings of Drinks in One Day</th>
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<td>0 1 2 3 4 5+</td>
</tr>
<tr>
<td>Soda's like Coke, Pepsi, Dr. Pepper, 7-Up, Sprite, Mountain Dew, Orange (not diet sodas)</td>
<td></td>
</tr>
<tr>
<td>What size soda do you usually drink?</td>
<td>&lt;8 fl. oz. 8 fl. oz 12 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Diet Sodas like Diet Coke, Diet Pepsi, Diet Dr. Pepper, Diet Orange, Diet Sprite</td>
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</tr>
<tr>
<td>What size do you usually drink?</td>
<td>&lt;8 fl. oz. 8 fl. oz 12 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Fountain Drinks</td>
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<tr>
<td>What size do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>100% Fruit Juice- Orange Juice, Apple Juice, Cranberry Juice, Grape Juice, Tomato Juice, V8 Juice</td>
<td></td>
</tr>
<tr>
<td>What size do you usually drink</td>
<td>fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
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<tr>
<td>What size do you usually drink</td>
<td>fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Sports Drinks like Gatorade, Powerade, and Propel</td>
<td></td>
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<tr>
<td>What size sport drink do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
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<tr>
<td>Low Calorie Sports Drinks such as G2, Powerade 0</td>
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<tr>
<td>What size do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Energy Drinks such as Redbull, Monster, Amp, Rockstar Energy</td>
<td></td>
</tr>
<tr>
<td>What size do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Milk</td>
<td></td>
</tr>
<tr>
<td>What kind of milk do you drink?</td>
<td>fat-free 1% 2% whole chocolate strawberry soy lactaid</td>
</tr>
<tr>
<td>How much milk do you drink</td>
<td>fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Water</td>
<td></td>
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<tr>
<td>What size do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
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<tr>
<td>Flavored Water</td>
<td></td>
</tr>
<tr>
<td>What size do you usually drink</td>
<td>&lt; 8 fl. oz. 8 fl. oz 12 fl. oz 16 fl. oz 20 fl. oz 32 fl. oz &gt;32 fl. oz</td>
</tr>
<tr>
<td>Other: Specify</td>
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For Researcher Use Only

| Height | Weight | BMI |

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APPENDIX E:

VISUAL MODELS FOR SUGAR-SWEETENED BEVERAGES
Beverage Sizes
Less than 8 fl. oz
8 fl. oz
12 fl. oz.
20 fl. oz.
20 fl. ounces
32 fl. ounces
Institutional Review Board

DATE: June 8, 2010
TO: Victoria Zielinski
FROM: Ball State University IRB
RE: IRB protocol # 150636-5
TITLE: To Determine the Relationship Between Sugar-Sweetened Beverages and BMI in 6th-8th Graders (11-14 year olds)
SUBMISSION TYPE: Amendment/Modification
ACTION: APPROVED
DECISION DATE: June 8, 2010
EXPIRATION DATE: June 7, 2011
REVIEW TYPE: Expedited Review

The Institutional Review Board has approved your Amendment/Modification for the above protocol, effective June 8, 2010 through June 7, 2011. All research under this protocol must be conducted in accordance with the approved submission.

As a reminder, it is the responsibility of the P.I. and/or faculty sponsor to inform the IRB in a timely manner:

- when the project is completed,
- if the project is to be continued beyond the approved end date,
- if the project is to be modified,
- if the project encounters problems, or
- if the project is discontinued.

Any of the above notifications should be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb). Please reference the IRB protocol number given above in any communication to the IRB regarding this project. Be sure to allow sufficient time for review and approval of requests for modification or continuation. If you have questions, please contact Chris Mangelli at (765) 285-5070 or cmangelli@bsu.edu.
APPENDIX G:

NIH HUMAN SUBJECTS MODULE
**IRB Members - Basic/Refresher Curriculum Completion Report**

**Learner:** Victoria Zielinski (username: Victoria88)

**Institution:** Ball State University

**Contact Information**
- Department: Family and Consumer Sciences
- Email: vazielinski@bsu.edu

**IRB Members - Basic/Refresher:** This Basic Course is appropriate for IRB or Ethics Committee.

### Stage 1. Basic Course Passed on 01/10/10 (Ref # 3956227)

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<td>You want to be an IRB Community Member, Now what?</td>
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For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Course Coordinator