Body Mass Index and Soft Drink Consumption Among Adolescents

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BODY MASS INDEX AND SOFT DRINK CONSUMPTION AMONG ADOLESCENTS

by

Olivia Love McCord

A thesis submitted to the faculty of
Brigham Young University
In partial fulfillment of the requirements for the degree of

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of a thesis submitted by

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This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

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ABSTRACT

BODY MASS INDEX AND SOFT DRINK CONSUMPTION AMONG ADOLESCENTS

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Department of Nutrition, Dietetics, and Food Science
Master of Science

Objective: To determine the relationship between body mass index (BMI) and soft drink consumption among adolescents. It is hypothesized that soft drink consumption contributes to overweight and obesity among adolescents.

Background: Research examining the relationship between body mass index and soft drink consumption is inconsistent. Several studies have found a negative association between total sugar intake and BMI; however, others have found a link between sugar-sweetened drinks and obesity. There are no known studies that have controlled for physical activity.

Data and Methods: Data on approximately 225 adolescents were used. Frequency of soft drink consumption, type of milk, and calcium intake were assessed using the Youth and Adolescent Questionnaire (YAQ). Body Mass Index was calculated from height and weight measurements and adjusted for age. Physical activity levels were
assessed using data recorded from the My Life Stepper 2515 digital pedometer. Age, birthday, grade, sex, and ethnicity were reported on the consent form.

**Results:** When treated as a categorical variable, soft drink consumption was a marginal predictor of adjusted BMI (p = 0.0802). The relationship between soft drink consumption and adjusted BMI is not linear and does not follow a monotonic trend. Other variables found to significantly influence BMI were type of milk, total step mean, and calcium.

**Discussion and Conclusions:** The results of this study conclude that soft drink consumption is related to BMI among adolescents. This relationship is marginally significant; it is significant at the 0.10 level but not at the 0.05 level. Those who were in the highest soft drink consumption category had a higher mean BMI than those in the other soft drink consumption categories. Soft drink consumption, type of milk, total step mean, and calcium together predict about 10% of the variability in BMI.

**Keywords:** Soft drinks, obesity, adolescents, body mass index, dietary intake, nutrition, physical activity, pedometers
ACKNOWLEDGMENTS

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Introduction

A major health concern in the United States is overweight and obesity and the health consequences associated with these conditions [1-6]. Of particular interest are children and adolescents, given that overweight adolescents have a 70% chance of becoming overweight or obese adults [1]. Obesity is currently the most serious dietary problem affecting the health of American children [7]. Risk factors for heart disease, such as high cholesterol and high blood pressure, are found with increased incidence among overweight children and adolescents in comparison to children with a healthy weight [1]. The epidemic of obesity can be seen in several studies that track the increasing prevalence of overweight. Ogden et al. [3] noted that the prevalence of overweight adolescents between the 1960s and 1988-1994 increased from 5% to 11%; in 1999-2000 this percentage jumped to 15.5%.

This continual increase in overweight prevalence reveals a population shift toward positive energy balance [2]. The percentage of calories from fat has continued to decrease since the mid-1960s [7], whereas the percentage of energy from sugars has been increasing [8]. The effects of an increased intake of total sugar on energy intake are not clear, but the increased intake of added sugars is often linked with increased energy intake [9]. The term “sugars” refers to all forms of caloric sweeteners. "Sugar" refers only to sucrose that comes from sugar cane and sugar beets [10].

One major source of added sugars is soft drinks, which are sodas made from carbonated water, added sugar, and flavors [11]. In fact, a 12-ounce can of nondiet soda holds 40 grams of added sugar and contributes about 160 calories. Nondiet soft drinks
are the leading source of added sugars in Americans’ diets, accounting for one-third of added sugars intake [10].

Consumption of soft drinks is increasing. Data from the 1977-1979 and 1994 Continuing Survey of Food Intakes by Individuals (CSFII) show that the proportion of adolescent boys and girls drinking soft drinks increased by 74% and 65% respectively [12]. Current trends influencing increased soft drink consumption among adolescents are increased portion sizes, frequency of fast food consumption, and marketing [6, 10, 13-15].

It is because of the increasing prevalence of overweight and obesity among adolescents and the associated health risks of these conditions, coupled with increasing soft drink consumption, that I examine the relationship between body mass index and soft drink consumption. The research question is “What is the relationship between body mass index and soft drink consumption among adolescents?”

Several studies have examined the relationship between body mass index and soft drink consumption; however, their results have not been consistent. For example, Ludwig et al. [16] examined this relationship among children and discovered that for each additional serving of sugars-sweetened drink consumed, the chance of becoming obese increased by 60%. However, Forshee and Story [17] utilized data from the CSFII 1994-1996, 98 and found no relationship between BMI and the consumption of regular carbonated beverages. Furthermore, a consistent negative association between total sugar intake and BMI has been found for children and adults [8, 18-23].

What sets this study apart from previous research is the ability to objectively control for physical activity through the use of pedometers. The Surgeon General
indicated the causes of overweight in children and adolescents to be lack of physical activity, unhealthy eating patterns, or a combination of the two [1]. By controlling for physical activity, soft drink consumption is further isolated as an independent variable.
Chapter 1

Literature Review

Obesity

Definition

In 1998, an expert panel convened by the National Institutes of Health (NIH) utilized Body Mass Index (BMI) for defining overweight and obesity, therefore adopting a common public health measure of these states [1]. Body Mass Index can be calculated by dividing weight in kilograms by the square of height in meters [1].

In children and adolescents, BMI varies with age and gender. As children grow older, BMI increases [27]. Thus, BMI is plotted on a chart for the appropriate gender, relative to the child’s age. Body Mass Index is evaluated using percentile cutoff points to compare values for a given child with other children of the same age and gender from a national reference sample. Using the 2000 Centers for Disease Control and Prevention (CDC) growth charts, “at risk of overweight” for ages 2 to 20 years is defined as a BMI-for-age between the 85th and the 95th percentiles. “Overweight” is defined as a BMI-for-age at or above the 95th percentile on the charts [24].

Measuring adiposity using BMI

Studies have shown that BMI is significantly correlated with total body fat content for the majority of individuals [25]. The use of BMI as a measure of body fatness is appropriate due to the ease of acquiring reliable results [26]. Pietrobelli et al. [27] found that BMI accounted for approximately 85% to 89% of the variance of fatness between boys and girls, respectively. Some limitations of BMI include overestimation of
body fat in persons who are very muscular and underestimation of body fat in persons who have lost muscle mass, such as many elderly [1].

BMI-for-age is the only indicator that allows a measure of weight and height with age to be plotted on the same chart. It is the measure that is consistent with the adult index so it can be used continuously from two years of age to adulthood [24]. BMI-for-age compares well with both weight-for-stature measurements and measures of body fat [28]. It is also significantly correlated with subcutaneous and total body fatness in children and adolescents [29].

**Prevalence**

The prevalence of obesity in the United States is increasing in both genders and among all age groups, in fact U.S. society is increasingly being described as “obesogenic” [30]. In 1999, approximately 13% of children and adolescents were overweight and 61% of adults were overweight or obese. This is a significant increase from 1980, when there were half as many overweight children and three times fewer overweight adolescents [1]. Data from the National Health Examination Survey (NHES) and the National Health and Nutrition Examination Surveys (NHANES I,II,III) indicated the increasing prevalence of overweight among adolescents. Between the 1960s and 1988-1994, overweight adolescents aged 12 through 19 increased from 5% to 11% (figure 1) [3]. Also, an additional 14% had a BMI between the 85th and 95th percentiles [2]. Today, it is estimated that one in four children in the United States is at risk of overweight [31].
Figure 1 Overweight and obesity, United States, 1988–94. [Source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Health and Nutrition Examination Survey. 1988–94.]

* In those aged 6 to 19 years, overweight or obesity is defined as at or above the sex- and age-specific 95th percentile of Body Mass Index (BMI) based on CDC Growth Charts: United States.

** In adults, obesity is defined as a BMI of 30 kg/m\(^2\) or more; overweight is a BMI of 25 kg/m\(^2\) or more.

Health Consequences

Healthy People 2010, the nation’s health objectives for the first decade of the 21\(^{st}\) Century, has indicated overweight and obesity as one of the Leading Health Indicators [32]. Obese individuals have a 50 to 100% increased risk of premature death from all causes in comparison to individuals with a BMI between 20 to 25 [33]. Many complications associated with obesity have been documented and the list continues to
grow. Cancer, osteoarthritis, gallstones, sleep apnea, reproductive disorders, complications in pregnancy, psychological disorders, and social penalties are all connected with obesity. Obesity has also been linked to an increased incidence of coronary heart disease and non-insulin dependent diabetes mellitus [34]. One study found that, among 112 obese adolescents aged 11-18 years who had BMIs above the 95th percentile, 21% had impaired glucose tolerance and 4 adolescents had silent type 2 diabetes [35]. In 2001, approximately 300,000 deaths a year in the United States were linked to overweight and obesity [36].

Factors influencing overweight and obesity

Overweight and obesity are influenced by many factors. A combination of genetic, metabolic, behavioral, environmental, cultural, and socioeconomic factors affect body weight for each individual. Behavioral and environmental factors are large contributors to overweight and obesity, therefore they provide the greatest chance for intervention [1]. The onset of obesity can be ascribed to two major factors: excessive energy intake and lack of physical exercise [37-38].

Dietary intake

Dietary intake as a cause of obesity is complex and not well understood [39]. The increase in overweight prevalence indicates a population shift toward positive energy balance [2]. Ogden et al. [3] suggested that increasing food portion sizes and intake of high-fat, energy-dense fast foods contribute to the increase in overweight youth. In examining the overweight status and eating patterns among adolescents, Neumark-Sztainer et al. [40] noted that dietary patterns developed during adolescence may be a factor in obesity. The Surgeon General [1] has indicated unhealthy eating patterns as one
of the causes of overweight in children and adolescents and suggests fat-free or low-fat milk, fresh fruit, and vegetables in place of soft drinks or snacks that are high in fat, calories, or added sugars and low in essential nutrients. Percentage of calories from fat has continued to decrease since the mid-1960s [7]; however the percentage of calories from sugars has been increasing [8].

**Physical activity**

The Surgeon General [41] reported that involvement in all types of activity declines considerably as age or grade in school increases and added that including physical activity in daily routine will aid in the control of healthy weight. Blair and Brodney [42] found that regular physical activity reduces health risks associated with overweight and obesity. In addition, they found that fit individuals, regardless of weight level, have lower rates of mortality and morbidity than unfit individuals. Research done by Sallis and Patrick [43] indicated that adolescents should engage in regular physical activity in order to reduce the risk of, or protect themselves against, diseases later in life. Specifically, they suggest that adolescents should be physically active daily and they should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that require moderate to vigorous levels of exertion. Luepker [44] suggests that increasing physical activity levels among youth in the US may reduce obesity levels.

**Measuring dietary intake using a dietary survey**

Underreporting of food intake is a known dilemma with dietary surveys [45]. Moreover, foods high in added sugars are selectively underreported [46]. Consequently, it may be difficult to deduce the relationship between sugars intake and BMI by using
self-reported data. The Youth and Adolescent Questionnaire (YAQ) is a self-reported food frequency questionnaire that was developed to assess the eating habits of older children and adolescents. Validity and reliability of the YAQ were tested among a random sample of children of participants in the Nurses’ Health Study and demonstrated to be within the allowable ranges for dietary assessment tools. This questionnaire was found to have reasonable ability to assess the eating habits of older children and adolescents over time [47-48].

**Measuring physical activity using pedometers**

Pedometers objectively monitor physical activity patterns by measuring step counts, an indicator of total volume of activity [49]. Pedometers are useful in distinguishing between groups with various levels of walking and they provide valid data on the number of steps per day; however, they are unable to measure frequency and intensity of physical activity [50]. They are small, light weight, unobtrusive, and can be worn comfortably at the waist [51]. The My Life Stepper 2515 digital pedometer is a valid and reliable tool to measure step counts.

**Energy from sugar**

**Dietary intake**

The term “sugars” refers to all forms of caloric sweeteners. "Sugar" refers only to sucrose that comes from sugar cane and sugar beets [11]. The median intake of added sugar ranges from 10 to 30 teaspoons (40 to 120 grams) per day for adults, based on data from NHANES III. According to data from the 1994-1996, 1998 CSFII, the mean intake
of added sugars in the U.S. population age 2 and older was 82 grams, accounting for
15.8% of the total energy intake [11].

**Energy Intake and Obesity**

Varying results have been reported in studies of an association between total
(intrinsic plus added) and added sugars intake and energy intake. The Department of
Health Survey of British School Children found that as total sugar intake increased from
less than 20.7% of energy to up to 25.2% of energy, total energy intake increased by
approximately 100 kcal/day [8]. In addition, one study found that obese subjects
obtained a greater percentage (38.0 to 47.9%) of their sugar intake from added sugars in
contrast to lean subjects (25.2 to 31.4%), although actual sugar intake in grams was
similar for lean and obese subjects of the same gender [52].

In contrast to those two studies, other studies have shown a negative association
between total sugar intake and BMI for children and adults [8,18-23]. Data from the
Bogalusa Heart Study [53] showed a significant decrease in energy intake when total
sugar intake was increased.

The effects of increased intake of total sugar on energy intake are not clear;
however, the increased intake of added sugars is often linked with increased energy
intake [9]. There is no Upper Limit for either added or total sugars because data do not
show a clear or consistent relationship between increased intake of added sugars and BMI
[9].
Soft Drinks

Definition

Soft drinks do not contain alcohol as opposed to “hard drinks” such as distilled spirits, beer, or wine, which do contain alcohol [54]. A soft drink is a soda made from carbonated water, added sugar, and flavors [10]. A 12-ounce can of nondiet soda holds 40 grams of added sugar and contributes about 160 calories. The Center for Science in the Public Interest has dubbed soft drinks “liquid candy.” [55]. Table 1 displays the nutrient composition of some soft drinks compared to orange juice and 1% milk.

Table 1 The nutrient composition of soft drinks, compared with frozen orange juice from concentrate and 1% milk, per 12-ounce serving.

<table>
<thead>
<tr>
<th></th>
<th>Coca-Cola</th>
<th>Pepsi-Cola</th>
<th>Orange juice</th>
<th>1% milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories (kcal)</td>
<td>144</td>
<td>160</td>
<td>168</td>
<td>153</td>
</tr>
<tr>
<td>Sugar (g)</td>
<td>38</td>
<td>40</td>
<td>40</td>
<td>18</td>
</tr>
<tr>
<td>Vitamin A (IU)</td>
<td>0</td>
<td>0</td>
<td>291</td>
<td>750</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>0</td>
<td>0</td>
<td>146</td>
<td>3</td>
</tr>
<tr>
<td>Folate (µg)</td>
<td>0</td>
<td>0</td>
<td>164</td>
<td>18</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>0</td>
<td>0</td>
<td>33</td>
<td>450</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>0</td>
<td>0</td>
<td>711</td>
<td>352</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>0</td>
<td>0</td>
<td>36</td>
<td>51</td>
</tr>
<tr>
<td>Phosphate (mg)</td>
<td>60</td>
<td>55</td>
<td>60</td>
<td>353</td>
</tr>
</tbody>
</table>


Consumption

Carbonated soft drinks account for more than 27% of Americans' beverage consumption. In 1997, Americans spent over $54 billion to buy 14 billion gallons of soft drinks [54]. One of every four beverages consumed in the United States is a carbonated soft drink, averaging about 53 gallons of soft drinks per year for every man, woman and child [54].
Consumption of soft drinks has increased steadily throughout the years. Data from the 1977-1979 and 1994 CSFII show that the proportion of adolescent boys and girls drinking soft drinks increased by 74% and 65% respectively [12]. French et al. [56] utilized the Nationwide Food Consumption Survey 1977/1978, the combined CFSII 1994/1996 and the Supplemental Children’s Survey 1998 to analyze national trends in soft drink consumption among children and adolescents age 6 to 17 years. They found the prevalence of soft drink consumption increased 48% from 1977/1978 to 1994/1998 and that the mean intake of soft drinks increased from 5 fluid ounces to 12 fluid ounces per day during this same time period. Table 2 shows that the consumption of non-diet soft drinks and the percent of caloric intakes by 12- to 19-year olds have significantly increased over two decades.

Table 2 Consumption of non-diet soft drinks by 12- to 19-year-olds (ounces per day) and percent of caloric intakes (all figures include non-drinkers). [Source: http://www.cspinet.org/sodapop/liquid_candy.htm, accessed on 2/2/04]

<table>
<thead>
<tr>
<th>Year</th>
<th>Ounces per day</th>
<th>% of calories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>boys</td>
<td>girls</td>
</tr>
<tr>
<td>1977-78</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>1987-88</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>1994-96</td>
<td>19</td>
<td>12</td>
</tr>
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Children ages 2-17 increased their average daily intake of soft drinks from under 7 ounces to 9.5 ounces in the short time span from 1989-1991 to 1994-1995 [57]. From 1985 to 1987, school districts decreased the quantity of milk they purchased by almost
30% and increased their purchases of carbonated sodas by 1,100% [58]. Figure 2 shows an inverse relationship between soft drink consumption and milk consumption.

**Figure 2** Teens' (ages 12-19) consumption of milk and soft drinks (ounces per day). [Source: [http://www.cspinet.org/sodapop/liquid_candy.htm](http://www.cspinet.org/sodapop/liquid_candy.htm), accessed 2/2/04]

USDA data from 1995 indicated that children begin consuming soft drinks at a young age and consistently increase the amounts they drink through adolescence and young adulthood [59].

**Current Trends Related to Soft Drink Consumption**

**Fast food**

The trend of eating away from home may contribute to the increased consumption of soft drinks. Fast food is defined as food purchased in self-service or carry-out eating...
places without waiter service [60-61]. Money spent on away-from-home foods increased from 25% of total food spending in 1970 to 40% of total food spending in 1995. By 1999 47% of total food spending was used on away-from-home foods, 49% in 2003, and by 2010, it is projected that 53% of the food dollar will be spent away from home [60]. The percentage of meals and snacks eaten at fast food restaurants increased 200% between 1977 and 1995. Adolescents frequent fast food restaurants twice a week on average and fast food restaurants are the source of about one-third of the away-from-home meals consumed by adolescents [62-63].

French et al. [15] used the Frequency of Fast Food Restaurant Use (FFFRU) survey and found that females who reported eating at a fast food restaurant three or more times during the past week reported 45% greater soft drink consumption compared with females who reported never eating at a fast food restaurant during the past week. In addition, males who reported eating at a fast food restaurant three or more times during the past week reported 42% greater soft drink consumption compared with males who reported never eating at a fast food restaurant during the past week. There was a positive relationship between FFFRU and daily servings of soft drinks.

**Portion Sizes**

Data from the National Food Consumption Survey 1977 (NFCS77) and the CFSII for 1989 and for 1996 were used to determine patterns and trends in food portion sizes, 1977-1998 [13]. The energy intake and portion size of soft drinks increased by 49 kcal (13.1 to 19.9 fluid ounces) during this time period. A similar study that examined changing portion sizes, but looked at a smaller time period from 1989-1991 to 1994-1996, found that greater soft drink consumption was reported in the latter survey [14].
In the 1950s, the standard serving for a Coca-cola was a 6.5 ounce serving, which later developed into the 12-ounce can. Today, 20-ounce bottles are the standard, but it is not uncommon to find much larger sizes such as the 64-ounce Double Gulp at 7-Eleven stores [55].

**Marketing and Production**

Coca-Cola aims to put a can of Coke within arm’s reach of as many people in the world as possible [64]. This example of market strategy may explain the huge advertising budgets of the soft drink industry. Classic Coke was allotted $115.5 million as the company’s advertising expenditure in the United States in 1998. That year, Pepsi spent $82.7 million in advertising. According to the National Soft Drink Foundation, the retail sale of carbonated soft drinks amounted to over $61 billion in 2002, up from $54 billion in sales in 1998 [65].

In an effort to seek new markets among younger age groups, Pepsi, Dr Pepper, and Seven-Up promote feeding soft drinks to babies by licensing their logos to a major maker of baby bottles, Munchkin Bottling, Inc. Infants and toddlers are four times likelier to be fed soft drinks out of bottles with logos than out of unmarked baby bottles [66].

In order to supply the increasing demand for soft drinks, manufacturers produce immense quantities, enough regular soda to supply every American daily with 1.2 12-ounce drinks [10]. Figure 3 shows the increasing annual soft drink production in the U.S. from 1947 to 1997.
Figure 3 Annual soft drink production in the U.S. (12-ounce cans per person). [Source: http://www.cspinet.org/sodapop/liquid_candy.htm, accessed 2/2/04]

From 1970 to 1997, soft drink production increased from 22.2 to 41.1 gallons per person per year [67-68].

Pouring Rights

Pouring rights are marketing agreements, or contracts, that usually involve lump-sum payments to school districts and additional payments over 5 to 10 years in exchange for sole sales of one company’s products in vending machines and at all school events [10]. This marketing technique helps to establish brand loyalty early in life and allows constant advertising of soft drink companies through logos on vending machines, cups, and other paraphernalia [10]. In 2001, soft drink companies were consistently selling 20-ounce sodas in vending machines and charging $1-1.50. They contain 250 calories a piece and are considered by many to be a better value then the 12-ounce cans. Despite
the large sums of money that soft drink companies pay the schools, they are still turning a profit on the deals. Nestle estimates that sales for soft drinks amount to more than $25,000 per week [69].

As indicated by the General Accounting Office, approximately 200 school districts in the United States were involved in contracts in 2000 [70]. Still, some school districts are already deciding that there is no place for pouring rights in their schools. School administrators in Los Angeles voted unanimously in 2002 to ban the sale of soft drinks on school grounds that began to be enforced in January of 2004 [71]. Most recently, a judge in New York is deciding whether a contract Coca-cola signed with a school district is constitutional. The outcome will affirm or call to question the legality of pouring rights in seventy other districts throughout the state [72].

School Policy

The Healthy People 2010 objective aimed to reduce the proportion of overweight and obese youth in the United States necessitates an increase in “the proportion of children and adolescents aged 6 to 19 years whose intake of meals and snacks at schools contributes proportionally to good overall dietary quality” [10].

The regulatory history of soft drink sales and other foods of minimal nutritional value is not a constant one. For the past half of a century, Congress has frequently changed the policies governing the school lunch and breakfast programs [10]. In 1979, the USDA proposed rules restricting the sales of foods of minimal nutritional value (soft drinks, water ices, chewing gum, certain candies) from the beginning of the school day until after the last lunch period [10]. In 1983, the US Appeals Court ruled that the USDA cannot require “time-and-place” restrictions on sales of competitive foods after the
National Soft Drink Association sued to overturn regulations. The Competitive Food Service Rule, which was passed by Congress in 1985, prohibits the sale of foods of minimal nutritional value in the school foodservice area during school meal periods; however, foods of minimal nutritional value may be sold outside the cafeteria at any time during the school day [10].

Story et al. [73] conducted a survey of 55 Minnesota high schools and found that 95% of schools that had vending machines left them unlocked and therefore available during some school hours, 29% left them unlocked all day, and 15% of them left them unlocked during the lunch period regardless of state regulations that discouraged sales of soft drinks during lunch periods. The study also discovered that 60% of the vending machines were placed in cafeterias and another 33% near cafeterias. The federal General Accounting Office [74] reported that 20% of US schools gave students access to vended snacks and drinks during lunch periods and two-thirds allowed other competitive food sales during lunch.

On January 1, 2004, the American Academy of Pediatrics released a policy statement regarding nutritional concerns about soft drinks in schools. The aim of the statement was to inform school officials and parents about potential health problems associated with high consumption of sweetened drinks so that a knowledge base could be established before a decision regarding student access to them is made. Specifically mentioned were overweight and obesity from additional calories in the diet, displacement of milk consumption, and dental caries [76].
Soft Drinks and Obesity

The relationship between consumption of sugar-sweetened drinks and obesity among adolescents needs to be further explored. The following studies found a relationship between soft drink consumption and increased energy intake, however, a relationship between soft drink consumption and BMI has not been consistently shown.

Ludwig et al. [16] examined this relationship among children and reported that for each additional serving of sugars-sweetened drink consumed, the chance of becoming obese increased by 60%. The relationship between these caloric beverages and obesity may be due to inadequate reduction in calories at succeeding meals than occurs with calories from solid foods [76]. Among adolescents, nonconsumers of soft drinks consumed 1,984 kcal/day compared to 2,604 kcal/day for those adolescents who consumed 26 or more ounces of soft drinks per day [12]. In the 1989-1991 and 1994-1996 CSFII respondents reported an increase of 2 ounces of soft drinks, the equivalent of about 25 kcal/day. Nestle [77] argued that this increase of 25 kcal/day from soft drinks alone comes to more than 9,000 kcal per year, which could amount to a 3-pound weight gain. Data from NHANES III indicated that soft drinks contributed a higher percentage of daily energy intake for overweight adolescents than for nonoverweight adolescents [2]. Kant [78] found a positive association between energy-dense, micronutrient-poor food and beverage consumption and energy intake among adults.

Summary

The prevalence of overweight and obesity among adolescents continues to be a major health concern. Overweight and obesity are associated with the development of many risk factors for chronic disease as well as a decrease in the quality of life as a consequence of social discrimination [1]. Several factors influence overweight and obesity, such as the behavioral factor of dietary intake [37-38].

The increasing prevalence of overweight and obesity in the United States indicates a shift toward positive energy balance in the population. One source of these extra calories is added sugars, which have been linked to extra energy intake. The leading source of added sugars in Americans’ diets are soft drinks, accounting for one-third of added sugars intake [11].

Consumption of soft drinks is increasing, which may be partly attributed to current trends such as increased portion sizes, more frequent fast food consumption, and marketing [6,10,13-15].

The relationship between BMI and soft drink consumption is unclear. One reason for conflicting conclusions in previous studies may be the lack of control for physical activity as an independent variable.

Information about the association between body mass index and soft drink consumption may lead to changes in school policy. Currently, schools across the country are deliberating the use of vending machines. The high school where most of our data was gathered is actively debating limiting access of soft drinks in vending machines. Results from this study may help school officials make the choice between profit from vending machines and more nutritious food choices for students.
Chapter 2

Data and Methods

Subjects

The data for this research was collected from a junior high school and a high school in Utah County in the fall of 2003. Within the boundaries of the city in which our data was collected there are 17 elementary schools, 3 junior high schools, and 3 high schools [79].

The junior high school enrolled approximately 1209 students in grades 7-9 in the fall of 2003 and the high school enrolled approximately 1555 students in grades 10-12 in the fall of 2003. Approximately 600 students in grades 7-12 from the aforementioned schools were asked to participate. This study was conducted in the early fall season. Permission to conduct the study and human subjects approval was obtained from the public school district, the school principals, and the University Institutional Review Board.

Methods

In order to participate in the study, students needed to return a consent form (Appendix A) to their teacher. The consent form thoroughly described the study and its purpose and required signatures from both a parent or guardian and the participating adolescent. On the consent form, the parent or guardian of the participant reported age, birthday, grade, sex, and ethnicity.

The Youth and Adolescent Questionnaire ( YAQ) (Appendix B) is a validated, semiquantitative food frequency questionnaire designed for children ages 9-18. The survey contained 152 questions and took approximately 20-30 minutes to complete. The
YAQ is based on foods eaten in the last year, thus the students had frequency categories for the amount eaten of specific foods. For soft drinks, the frequency categories for one can or glass ranged from “never or less than once per month” to “two or more cans per day.” Researchers took a few minutes before administering the YAQ to explain that the questionnaire was not a test, that it was confidential, and to answer any questions students had. Number 2 pencils were provided and silence was encouraged until all of the students finished filling out the questionnaire. Once the students began, researchers assigned a code number on the YAQ previously assigned to each student in order to preserve anonymity. Data available from the YAQ included average daily intake and/or frequency of consumption for the following variables: aspartame, beer, caffeine, calories, carbohydrates, chocolate milk, coffee, fructose, iced tea, liquor, phosphorus, sucrose, fat, wine, punch, lactose, milk, diet soda. Data derived from the YAQ and used in the final model included frequency of soft drink consumption, type of milk consumed, and calcium intake.

A researcher measured height and weight for each participating student, one at a time, in a private section of the hallway outside of the classroom at the beginning of the data collection period. Height was measured using a standard measuring tape attached to the wall. A level was used to ensure that the wall was level and the measuring tape was perfectly vertical. The students removed their shoes, placed their heels to the wall and a tri square with an inset level was used to make the final measurement. Next, the students were weighed in pounds without shoes or heavy clothing using the Tanita Body Composition Analyzer BF-350 bioelectrical impedance scale. The researcher recorded each student’s height and weight according to their code number.
Physical activity patterns were assessed using pedometers to measure daily step count. In this study, the My Life Stepper 2515 digital pedometer was used to measure step count as well as exercise time. Prior to data collection, researchers introduced pedometers to the students in order to instruct them on their use and to allow them to experiment with the various functions. This enabled the students to practice with the pedometers as well as give them a chance to become comfortable wearing them.

Each participant was given a pedometer and a log sheet (Appendix C) at the beginning of the ten-day data collection period. The pedometers were numbered for identification purposes. The pedometers were distributed during the same class period as the administration of the YAQ. The students were instructed to record their code number and pedometer number on their log sheets and to attach the pedometer to their waistband above their right knee. The participants were directed to wear their pedometers each day from the time they got dressed in the morning until the time they went to bed. On the log sheet, they were asked to record their step counts, exercise time, if they removed their pedometer and for how long, if they participated in physical education class, and what sedentary or physical activity they participated in for that day. Participants reset the pedometers each morning to begin a new day of step counts. Researchers were available during the ten-day data collection period to answer questions.

Analysis

Analyses were done using Epi Info 3.2.2 and the SAS 8.2 and SPSS 12.0 statistical software programs.

Analysis of variance (ANOVA) is a statistical tool used to “uncover the main and interaction effects of categorical independent variables on an interval dependent variable.
A ‘main effect’ is the direct effect of an independent variable on the dependent variable” [80]. The ANOVA was used to measure the main effect of the independent variable soft drink consumption on the dependent variable BMI-for age. Analysis of covariance (ANCOVA) is used to “test the main and interaction effects of categorical variables on a continuous dependent variable, controlling for the effects of selected other continuous variables which covary with the dependent variable” [80]. The ANCOVA was used with BMI as the dependent variable and soft drink consumption, calcium intake, type of milk, and total step mean as the independent variables. Soft drink consumption and type of milk were treated as a categorical variables (P < 0.10) whereas calcium intake and total step mean (P < 0.05) were treated as continuous variables. The variables were significant at the P < 0.05 level and marginally significant at the P < 0.10 level. Due to the descriptive nature of this study, and the relatively small number of subjects at the higher levels of soda consumption, a P-value < 0.10 was considered acceptable.

NutStat is a nutrition anthropometry program in Epi Info that calculates percentiles and z-scores using the 2000 Centers for Disease Control growth reference values [81]. NutStat was used to convert the height, weight, and age of the participants into BMI-for-age percentiles.

Of the approximately 600 students who were invited to participate in the study, 408 returned consent forms to their teachers. Data were removed if any recorded daily step count was below 1000 steps, because step counts below this number indicated that the pedometer was not worn for the entire day and thus was not an accurate measure of the day’s activity. Data were also removed if they were greater than two standard deviations away from the mean of the corresponding gender and age group [82-84].
Reliability analysis showed that the minimum number of days that could be accepted as valid data for total step counts was three weekdays and two weekend days ($R = 0.7721$). Thus, participants who did not have three weekdays and two weekend days were eliminated. All together, the data from about 176 students were not used for the aforementioned reasons. Data were also removed if the participant did not fill in the questions on soft drink consumption frequency (question 19) or on type of milk (question 27). This eliminated seven of the participants. Overall, 225 of the invited participants were included in the data analysis.
Chapter 3

Results

Sample

Data were used from 67 students from the junior high school (24 males and 43 females) and 158 students from the high school (73 males and 85 females), a total sample size of 225 students (97 males and 128 females). The ethnicity of the participants was 87.6% Caucasian, 7.1% Hispanic, 4.4% Pacific Islander/Asian, 0.4% African American, and 0.4% Native American.

Descriptive Statistics

Descriptive statistics for soft drink consumption can be found in Table 3. The largest percentage of boys (26.8%) drank 2-6 cans per week followed closely by 1-3 cans per month (25.8%). This compared to the largest percentage of girls (32.8%) who drank soda less than once a month or never followed closely by 1-3 cans per month (31.3%). The smallest percentage of boys (4.1%) and the smallest percentage of girls (3.9%) drank 2 or more cans of soda per day. Only 20 of the participants (9%) drank one or more cans of soda per day. More than half of the participants (56.4%) drank 1-3 cans of soda per month or less. A chi square analysis indicates that there is a marginal difference between frequency of soft drink consumption between males and females (P = 0.0788).

Type of milk consumed (Table 4) shows that the largest percentage of boys (45.4%) drank 2% milk compared to the largest percentage of girls (36.7%) who drank 1% milk, but for girls followed closely by 2% milk (35.2%). On the other hand, there were few participants who drank whole milk (3.5%) or did not drink milk at all (4%).
chi square analysis indicates that there is no significant difference in types of milk consumed between males and females ($P = 0.1186$).

Table 3 *Frequency of soft drink consumption*

<table>
<thead>
<tr>
<th>Group</th>
<th>Soda Consumption</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>Percent</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>Never/less than 1 a month</td>
<td>20</td>
<td>20.6</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>1-3 cans per month</td>
<td>25</td>
<td>25.8</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>1 can per week</td>
<td>17</td>
<td>17.5</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>2-6 cans per week</td>
<td>26</td>
<td>26.8</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>1 can per day</td>
<td>5</td>
<td>5.2</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>2 or more cans per day</td>
<td>4</td>
<td>4.1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
<td>97</td>
<td>100.0</td>
<td>128</td>
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</tbody>
</table>

Table 4 *Types of milk consumed*

<table>
<thead>
<tr>
<th>Group</th>
<th>Type of Milk</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>Percent</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>Whole milk</td>
<td>6</td>
<td>6.2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2% milk</td>
<td>44</td>
<td>45.4</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>1% milk</td>
<td>26</td>
<td>26.8</td>
<td>47</td>
</tr>
<tr>
<td>4</td>
<td>Skim/nonfat milk</td>
<td>16</td>
<td>16.5</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Don’t know</td>
<td>3</td>
<td>3.1</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Don’t drink milk</td>
<td>2</td>
<td>2.1</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
<td>97</td>
<td>100.0</td>
<td>128</td>
</tr>
</tbody>
</table>
Descriptive statistics for BMI, BMI-for-age, mean step count, and calcium intake are displayed in Table 5. The average BMI was 22.25 for boys and 22.22 for girls. The average BMI-for-age percentile was 59.10 for boys and 60.59 for girls. The average step count was 12,276.73 for boys and 9,486.21 for girls. These step count averages are typical for adolescent boys but a little low for girls in the United States; it is also common that the average step count for boys is about 2,000 steps greater than for girls [84]. The average calcium intake was 1,379.09 mg for boys and 1,024.83 mg for girls. The Adequate Intake for calcium for children and adolescents ages 9-18 is 1,300 mg per day [9]. On average, the boys consumed the recommended calcium intake; however, the girls did not consume the recommended amount of calcium.

Weight-for-age percentiles are shown in Table 6. Based on BMI-for-age percentiles, most boys (75.3%) and girls (75%) were at a normal weight. Of the boys, 12.4% were at risk of overweight (85th to 95th percentile) and 12.4% were overweight (>95th percentile). Of the girls, 14.8% were at risk of overweight and 10.2% were overweight. A chi square analysis indicates that there is no significant difference in BMI-for age percentiles between boys and girls (P = 0.7831). These percentages are consistent with data from the NHANES III, where 14% of adolescents aged 12-19 were at risk for becoming overweight and 11% were overweight in 1988-94 [2-3]. However, results from the 1999-2000 NHANES indicated that an estimated 15% of children and adolescents ages 6-19 years are overweight, and a percent of children at risk for overweight was not reported [85].
Table 5 Mean BMI, BMI-for-age, step count, and calcium intake

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
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<tr>
<td></td>
<td>Mean</td>
<td>Stand. Dev.</td>
<td>Mean</td>
<td>Stand. Dev.</td>
</tr>
<tr>
<td>BMI-for-age</td>
<td>59.10</td>
<td>29.01</td>
<td>60.59</td>
<td>28.07</td>
</tr>
<tr>
<td>Step count</td>
<td>12276.73</td>
<td>3405.56</td>
<td>9486.21</td>
<td>2505.12</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>1379.09</td>
<td>717.72</td>
<td>1024.83</td>
<td>490.61</td>
</tr>
<tr>
<td>AI – calcium (mg)</td>
<td>1300.00</td>
<td></td>
<td>1300.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 6 BMI-for-age percentiles

<table>
<thead>
<tr>
<th>Percentile group</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percent</td>
<td>N</td>
<td>Percent</td>
<td>N</td>
<td>Percent</td>
</tr>
<tr>
<td>&lt; 85th percentile</td>
<td>73</td>
<td>75.3</td>
<td>96</td>
<td>75.0</td>
<td>169</td>
<td>75.1</td>
</tr>
<tr>
<td>85th-95th percentile</td>
<td>12</td>
<td>12.4</td>
<td>19</td>
<td>14.8</td>
<td>31</td>
<td>13.8</td>
</tr>
<tr>
<td>&gt;95th percentile</td>
<td>12</td>
<td>12.4</td>
<td>13</td>
<td>10.2</td>
<td>25</td>
<td>11.1</td>
</tr>
<tr>
<td>Total</td>
<td>97</td>
<td>100.1</td>
<td>128</td>
<td>100.0</td>
<td>225</td>
<td>100.0</td>
</tr>
</tbody>
</table>

ANOVA

ANOVA was used to measure the effect of the independent variable soft drink consumption on the dependent variable BMI-for age. Results indicate that the categorical variable soda consumption is a reasonable predictor of adjusted BMI (p = 0.0802). The relationship is shown graphically in Figure 4. Soda consumption Group 1 corresponds with drinking non-diet soda “never/less than 1 per month,” Group 2 is “1-3 cans per month,” Group 3 is “1 can per week,” Group 4 is “2-6 cans per week,” Group 5 is “1 can per day,” and Group 6 is “2 or more cans per day.” The last boxplot is of all groups combined. The relationship between soda consumption and adjusted BMI is not linear.
(note the variation in centers, i.e. medians, of the boxes). In some regards this is not unexpected, as the distance between soda consumption groups is not equal. Still, it does not even follow a monotonic trend, as the members of the sequence do not consistently increase or decrease, rather they oscillate in relative value.

**Figure 4** Adjusted BMI by soda consumption group
The ANCOVA utilized multiple independent variables to predict BMI as the dependent variable. Several criteria were used to determine which independent variables would be significantly predictive of BMI in the final model.

By fitting a model to predict adjusted BMI, other variables can be adjusted for beyond the effect of soda consumption. Since the adjusted BMI incorporates height, weight, and age, it would not be informative to include these variables in the model. They were removed from consideration. Also, many of the variables had high correlation with soda consumption. By allowing them to remain in the model, numeric instability is encouraged. Therefore, all variables with significant correlation (p<0.05) were removed from the model. Excluded variables were aspartame, beer, caffeine, calories, carbohydrates, chocolate milk, coffee, fructose, iced tea, liquor, phosphorus, sex, sucrose, total fat, and wine.

The remaining variables were total step mean, weekday step mean, weekend step mean, type of milk, calcium, diet soda, lactose, milk, and punch. The first model used all of these as predictors, but there was a collinearity problem between step mean, weekday step mean, and weekend step mean (total step mean combines the weekday and weekend data). Since total step mean appeared to be the best predictor, this variable was retained and the other two were eliminated. Also, punch, lactose, and milk consumption were highly correlated with one another. None of these seemed to be very good predictors, so they were eliminated. Diet soda did not predict well either, and was therefore not included in the model. The model, final variables, and equation for predicting BMI-for age are in Table 7.
Table 7 Overall model

Percentile BMI-for-age = 81.2 - 7.9*soda1 - 7.9*soda2 -18.1*soda3 -1.5*soda4 - 25.1*soda5 + 2.4*percent milk – 0.0*stepmean – 0.0*calcium

<table>
<thead>
<tr>
<th>F Value</th>
<th>P-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.80</td>
<td>0.0057</td>
<td>0.093932</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>f-stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>soda</td>
<td>1.98</td>
<td>0.0825</td>
</tr>
<tr>
<td>% milk</td>
<td>2.9</td>
<td>0.0898</td>
</tr>
<tr>
<td>stepmean</td>
<td>4.85</td>
<td>0.0287</td>
</tr>
<tr>
<td>calcium</td>
<td>4.73</td>
<td>0.0307</td>
</tr>
</tbody>
</table>

*not uniquely estimable

The R² value of .093932 implies that the model is not very good at predicting adjusted BMI, but because the p-values are low, it can be assumed that there are significant relationships between the predictors and BMI. The asterisks by some of the estimates indicate that they are not uniquely estimable. In this case, what is estimated is the difference between being in that soda consumption Group and Group 6 (highest amount of soda consumption). Since all of those estimates are negative, it implies that students in Group 6 are likely to have a higher BMI-for-age percentile than students in any other Group. The other three predictors (total step mean, calcium intake, and type of
milk) are treated as continuous variables, therefore the interpretation of their coefficients is a linear least squares regression interpretation.
Chapter 4

Discussion

This study was conducted to determine the relationship between soft drink consumption and BMI among adolescents. In the ANCOVA, several variables were found to significantly influence BMI including soft drink consumption, type of milk, total step mean, and calcium. When soft drink consumption is included in a regression model with type of milk, total step mean, and calcium, then these four variables predict about 9.4% variability in BMI (p = 0.0057).

Soft drink consumption and BMI

The relationship between soft drink consumption and BMI is not linear when consumption was treated as a continuous variable (p = .0802). Thus, as soft drink consumption increases among adolescents there is not a significant corresponding monotonic increase in BMI. Data from this analysis is consistent with data from Forshee and Story [17], who also found no relationship between BMI and consumption of regular carbonated beverages among children and adolescents.

Soft drink consumption as a categorical variable is a marginal predictor of BMI (p = 0.0802). Those who were in the highest soft drink consumption category in my research had a higher mean BMI compared to those in the other soft drink consumption categories. These findings are inconsistent with the findings of Ludwig et al. [16] who reported that for each additional serving of sugars-sweetened drink consumed, the chance of becoming obese increased by 60%. These findings could be attributed to greater caloric intake. Harnack et al. [12] found that among adolescents, nonconsumers of soft drinks consumed 1,984 kcal/day compared to 2,604 kcal/day for those adolescents who
consumed 26 or more ounces of soft drinks per day, but the relationship with weight was not reported.

Limited research has been reported with other age groups. James et al. [86] examined the prevention of obesity in children (aged 7-11) by reducing the consumption of carbonated drinks. After a year, children in the intervention group reported a lower intake of carbonated drinks (0.6 fewer glasses than at baseline over a 3-day reporting period; average glass size 250 ml) and there was a 0.2% decrease in the percentage of overweight and obese children. Children in the control group increased their soft drink consumption by 0.2 glasses and had a 7.6% increase in the percentage of overweight and obese children. In adults, increased likelihood of overweight and obesity was associated with greater frequency of drinking sweetened beverages such as soft drinks [87].

**Type of milk and BMI**

The type of milk consumed by participants was included in the final model because there was a weak but significant relationship between type of milk and BMI (p = 0.0898). The higher the percent of fat contained in the milk, the higher the BMI.

**Step mean and BMI**

The total step mean was included in the final model because there was a significant relationship between total step mean and BMI (p = 0.0287). The higher the total step mean, the lower the BMI.

**Calcium and BMI**

The amount of calcium consumed by participants was included in the final model because there was a significant relationship between calcium and BMI (p = 0.0307). The higher the calcium then the lower the BMI.
**Recommendations**

I recommend that further research be conducted with a larger sample size in order to better identify the relationship between soft drink consumption and BMI among adolescents.

Based on the findings of this study, I suggest that a study be designed that compares the BMI between adolescents who consume adequate calcium, drink skim or 1% milk, and consume soft drinks infrequently to the BMI of adolescents who do not consume adequate calcium, drink higher fat milk, and consume soft drinks frequently. This study might also include a method to determine milk displacement by soft drinks.
Chapter 5

Limitations and Strengths

Limitations

This study has several limitations, such as the ability of participants to correctly recall dietary information over the past year. Although the YAQ is a validated food frequency questionnaire, the accuracy of any nutritional survey is a limitation. For instance, seasonal foods are difficult to report since the participant must estimate how often the food is eaten each week throughout the year, although the food is eaten more often during certain times of the year. The question on soda consumption is stated in terms of how often someone consumes a can of soda (12 ounces), whereas sodas are often sold in 20 ounce bottles or in fountain drinks of various sizes. The students may have equated a can with a bottle or fountain drink, therefore underestimating how much soda they actually drink. Underreporting of food intake is a demonstrated problem with dietary surveys [39]. In addition, foods high in added sugars are selectively underreported [40].

Another limitation of the study is the use of BMI or BMI-for-age as an indicator of obesity. Although studies have shown that BMI is significantly correlated with total body fat content for the majority of individuals [68], some limitations of BMI include overestimation of body fat in persons who are very muscular and underestimation of body fat in persons who have lost muscle mass [1].

A small sample size was a limitation of the study. Although the total sample size was large enough to draw significant conclusions, the number of participants in each soda consumption group varied greatly. For example, there was a total of nine males and
females who reported consuming two or more cans of soda per day whereas 65
controllers reported consuming 1-3 cans of soda per month. The BMIs of the small
number of subjects who drank two or more cans of soda per day may not be
reported that one-quarter of adolescents drink 26 ounces or more of soft drinks each day.
Only 4% of participants in this study reported drinking 2 or more cans (24 ounces) per
day.

Another limitation of the study was that the participants were from a homogenous
population. Over 87% of the participants were Caucasian and all lived in Orem, Utah.
This is not representative of the U.S. population ethnically, where according to the 2000
census, 77.1 % were Caucasian, 12.9% Black or African American, 12.5% Hispanic,
1.5% Native American, 4.2% Asian, and .3% Pacific Islander [88]. Although we did not
collect data on religion, many of the participants abstained from coffee, tea, alcohol, and
caffeine due to high conformity to a religious code. The predominant religion in the area
is “Mormon” (the Church of Jesus Christ of Latter-day Saints) although only 2% of the
U.S. population is Mormon [89-90].

I did not take into consideration the stage of development of the participants, also
a limitation of the study. Puberty is divided into five stages, called Tanner Stages
(numbered 1-5). Metabolic rate and body fat differ at each stage of development. For
instance, adolescent height and weight gain is more closely correlated with sexual
maturity rating (Tanner) stage than with chronological age. Also, height and weight gain
in girls occurs earlier in Tanner staging (and chronologically) than in boys [91].
Lastly, the inability of pedometers to measure the intensity of activity is a limitation of the study. Individuals who participate in vigorous activity may not have as many steps in one day as individuals who participate in light activity, because the intensity of vigorous activity is greater but of shorter duration. Intensity also affects energy expended which contributes to BMI, thus without a measurement of intensity it is difficult to account for energy expended.

**Strengths**

A strength of this study was that physical activity as an independent variable was taken into consideration. When examining the relationship between soft drink consumption and BMI, it is necessary to control for other variables that effect BMI (the dependent variable). One major contributor to the amount of calories burned each day is physical activity level. This variable was at least partly controlled in the study through the use of pedometers. By controlling for physical activity, the effect of soft drinks on BMI was further isolated.

The use a validated food frequency questionnaire was another strength of this study. Although there are a variety of methods, it is often difficult to accurately measure dietary intake. The YAQ was tested among a random sample of children of participants in the Nurses’ Health Study and demonstrated to be within the allowable ranges for dietary assessment tools. This questionnaire was found to have reasonable ability to assess the eating habits of older children and adolescents over time [41-42].

Lastly, a strength of the study was the use of adjusted BMI, or BMI-for-age percentiles. BMI-for-age is the only indicator that allows a measure of weight and stature with age to be plotted on the same chart. BMI-for-age is the measure that is consistent
with the adult index so it can be used continuously from 2 years of age to adulthood. Thus, the participants were categorized into normal weight, at risk of overweight, and overweight based on their percentile.
Chapter 6

Conclusions

The results of this study indicate that soft drink consumption is marginally related to BMI among adolescents (p < 0.10). It appears that those who were in the highest soft drink consumption category had a higher mean BMI compared to those in the other soft drink consumption categories. Still, the small number of subjects in the highest two groups of soda consumption limits confidence in this conclusion. Soft drink consumption, type of milk, total step mean, and calcium predict about 10% of the variability in BMI. As the percent of fat in milk increases than BMI increases; this relationship is significant at the 0.10 level. As total step mean increases and calcium increases (independent of each other), then BMI decreases; these relationships are significant at the 0.05 level. Rising rates of overweight and obesity in adolescents cannot be attributed to soft drinks alone. It appears that many other factors must also be affecting the “obesity epidemic” in this country.
Bibliography


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overweight and obesity in adults. HHS, Public Health Service (PHS); 1998. p. xxiii.


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Appendix A
Dear Parent/Guardian,

The overweight and obesity levels among youth in the United States continue to increase each year. Several factors contribute to becoming overweight including exercise and diet. We are conducting a research study to determine lifestyle behaviors of adolescents.

Your adolescent’s participation will involve wearing a pedometer for ten consecutive days, taking nutrition and self-esteem surveys and measuring their height and weight during the Fall of 2003. Height and weight will be measured privately and results will be known only by the researchers to determine Body Mass Index. In addition, a random sample of students will be interviewed about their attitudes toward physical activity. Two class periods will be used to administer the nutrition and self-esteem surveys. Interviews will be conducted during a third class period. A pedometer is a simple device that hooks on the waistband of your adolescent’s pants or shorts and measures vertical movement. Your child’s participation in this study is voluntary. There are minimal risks, such as discomfort from being measured, weighed and answering the questionnaires. The survey includes questions about alcohol use. Surveys will be available upon request for parental review. If you choose not to let your adolescent participate, or if you or your adolescent choose to withdraw at any time it will not affect your adolescent’s grade or standing in school in any way.

On the first day your adolescent participates, he or she will be given an activity log and a pedometer at school and asked to wear the pedometer all day until bedtime. Please, take the pedometer off if it will get wet in any way. Each evening your adolescent should record their pedometer step counts for the day on the activity log. Each morning, please, have your adolescent reset the pedometer and put it back on when they get dressed. They will wear it for the day and record their step counts before they go to bed that night. They will continue this procedure for ten days. On the tenth day the pedometer and log will be collected.

The indirect benefit of your adolescent’s participation is a better understanding of youth’s activity levels, nutrition intake, and self-esteem that will assist physical education teachers in their efforts to promote and measure physical activity. The results of this project may be published in a journal and/or presented at a professional conference. Your adolescent’s name or identity will not be revealed. In order to keep this confidential, only a code number will identify your adolescent in this project. Documents that link your child’s name with this code number will be kept separate and secured from the completed data forms.

If you have any questions concerning the research study or your child’s participation, feel free to contact Dr. Vincent at 422-6477 (address: 221-D RB, Brigham Young University, Provo, UT 84602). If you have questions regarding your adolescent’s rights as a participant in this research project, you may contact Dr. Shane Schulthies, Brigham Young University, 120B RB, Provo, UT 84602; phone (801) 422-5490; email shane_schulthies@byu.edu.

Sincerely,

Principal
(Please Initial) page 1 of 2
See other side
My parent/guardian has given permission for me to take part in a project using pedometers, a nutrition survey, a self-esteem survey, and interviews about physical activity. I understand that I will be wearing a pedometer about the size of a pager that hooks onto my waistband and measures vertical movement. I will wear the pedometer each day being careful not to get it wet and I will record my step count on my activity log each night. In order to calculate Body Mass Index, I will allow my height and weight to be measured and I understand that this will be done privately and kept confidential. I agree to fill out surveys concerning my nutrition and self-esteem during two class periods and I am under no obligation to answer questions I do not want to. I realize that there will be questions about alcohol consumption on the nutrition survey. I will possibly be interviewed about my attitudes toward physical activity during a third class period. I am participating in this study because I want to and I realize the findings of this study may help others in the future. I know that I can withdraw from this study at any time without being penalized.

_____________________________
Adolescent’s signature

Parent Consent

Please answer the following questions:

Adolescent’s birthday: _______/_______/_______   Adolescent’s age: ____ years old
month          day     year

Adolescent’s Gender: Male          Female

Adolescent’s Ethnicity:

__ African American
__ Hispanic
__ Native American
__ Pacific Island/Asian
__ White
__ Other: _____________________________

I give consent for my adolescent to participate in the above study.

_____________________________  _______________________
Signature                      Date
Appendix B
# MARKING INSTRUCTIONS

- Use a **NO. 2 PENCIL** only.
- Do not use ink or ballpoint pen.
- Darken in the circle completely.
- Erase cleanly any marks you wish to change.
- Do not make any stray marks on this form.

The **RIGHT way** to mark your answer!

The **WRONG way** to mark your answers!

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<table>
<thead>
<tr>
<th></th>
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<td>INCHES</td>
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<td>9</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

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5. Do you currently take multi-vitamins (like Flintstones, One-A-Day, etc.)?
   - **Yes**
   - **No**

   - **If yes:** a) **How many tablets do you take per week?**
     - 2 or less
     - 3 - 5
     - 6 - 9
     - 10 or more
   - b) **For how many years?**
     - 0 - 1 years
     - 2 - 4
     - 5 - 9
     - 10+ years

6. How many teaspoons of sugar do you ADD to your beverages or food each day?
   - None
   - 1 - 2 teaspoons per day
   - 3 - 4 teaspoons per day
   - 5 or more teaspoons per day

7. Which cold breakfast cereal do you usually eat?
   - **Never eat cold breakfast cereal**

---

8. Where do you usually eat breakfast?
   - At home
   - At school
   - Don't eat breakfast
   - Other

9. How many times each week (including weekdays and weekends) do you eat breakfast prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week
10. How many times each week (including weekdays and weekends) do you eat lunch prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

11. How many times each week do you eat after-school snacks or foods prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

12. How many times each week (weekdays and weekends) do you eat dinner prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

13. How many times per week do you prepare dinner for yourself (and/or others in your house)?
   - Never or almost never
   - Less than once per week
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

14. How often do you have dinner that is ready made, like frozen dinners, Spaghetti-O’s, etc.
   - Never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

15. How many times each week (including weekdays and weekends) do you eat late night snacks prepared away from home?
   - Never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

16. How often do you eat food that is fried at home, like fried chicken?
   - Less than once per week
   - 1 - 3 times per week
   - 4 - 6 times per week
   - Daily

17. How often do you eat fried food away from home (like french fries, fried chicken)?
   - Less than once per week
   - 1 - 3 times per week
   - 4 - 6 times per week
   - Daily

**Dietary Intake**

Estimate how often you eat the following foods:

**Example 1** If you drink one can of diet soda 2 - 3 times per week, then your answer should look like this:

**E1. Diet soda (1 can or glass)**
   - Never
   - 1 - 3 cans per month
   - 1 can per week
   - 2 - 6 cans per week
   - 1 can per day
   - 2 or more cans per day
### BEVERAGES

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<th>Number</th>
<th>Description</th>
<th>Frequency Options</th>
</tr>
</thead>
<tbody>
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<td>18.</td>
<td>Diet soda (1 can or glass)</td>
<td>Never, 1 - 3 cans per month, 1 can per week, 2 - 6 cans per week, 1 can per day, 2 or more cans per day</td>
</tr>
<tr>
<td>19.</td>
<td>Soda - not diet (1 can or glass)</td>
<td>Never, 1 - 3 cans per month, 1 can per week, 2 - 6 cans per week, 1 can per day, 2 or more cans per day</td>
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<tr>
<td>20.</td>
<td>Hawaiian Punch, lemonade, Koolaid or other non-carbonated fruit drink (1 glass)</td>
<td>Never, 1 - 3 glasses per month, 1 glass per week, 2 - 4 glasses per week, 5 - 6 glasses per week, 1 glass per day, 2 or more glasses per day</td>
</tr>
<tr>
<td>21.</td>
<td>Iced Tea - sweetened (1 glass)</td>
<td>Never, 1 - 3 glasses per month, 1 - 4 glasses per week, 5 or more glasses per week</td>
</tr>
<tr>
<td>22.</td>
<td>Tea (1 cup)</td>
<td>Never, 1 - 3 cups per month, 1 - 2 cups per week, 3 - 6 cups per week, 1 or more cups per day</td>
</tr>
<tr>
<td>23.</td>
<td>Coffee - not decaf. (1 cup)</td>
<td>Never, 1 - 3 cups per month, 1 - 2 cups per week, 3 - 6 cups per week, 1 or more cups per day</td>
</tr>
<tr>
<td>24.</td>
<td>Beer (1 glass, bottle or can)</td>
<td>Never, 1 - 3 cans per month, 1 can per week, 2 or more cans per week</td>
</tr>
<tr>
<td>25.</td>
<td>Wine or wine coolers (1 glass)</td>
<td>Never, 1 - 3 glasses per month, 1 glass per week, 2 or more glasses per week</td>
</tr>
<tr>
<td>26.</td>
<td>Liquor, like vodka or rum (1 drink or shot)</td>
<td>Never, 1 - 3 drinks per month, 1 drink per week, 2 or more drinks per week</td>
</tr>
</tbody>
</table>

### DAIRY PRODUCTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Question</th>
<th>Options</th>
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</thead>
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<td>27.</td>
<td>What type of milk do you usually drink?</td>
<td>Whole milk, 2% milk, 1% milk, Skim/nonfat milk, Don't know, Don't drink milk</td>
</tr>
<tr>
<td>28.</td>
<td>Milk (glass or with cereal)</td>
<td>Never, 1 glass per week or less, 2 - 6 glasses per week, 1 glass per day, 2 - 3 glasses per day, 4+ glasses per day</td>
</tr>
<tr>
<td>29.</td>
<td>Chocolate milk (glass)</td>
<td>Never, 1 - 3 glasses per month, 1 glass per week, 2 - 6 glasses per week, 1 - 2 glasses per day, 3 or more glasses per day</td>
</tr>
</tbody>
</table>

---

Example 2: If you eat:

- 2 pats of margarine on toast
- 1 - 2 pats of margarine on sandwich
- 1 pat of margarine on vegetables

5 - 6 pats total all day

Then answer this way →

E2. Margarine (1 pat) - not butter | Never, 1 - 3 pats per month, 1 pat per week, 2 - 6 pats per week, 1 pat per day, 2 - 4 pats per day, 5 or more pats per day |
### 30. Instant Breakfast Drink (1 packet)
- Never
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 31. Whipped cream
- Never
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 32. Yogurt (1 cup) - Not frozen
- Never
- 1 - 3 cups per month
- 1 cup per week
- 2 - 6 cups per week
- 1 cup per day
- 2 or more cups per day

### 33. Cottage or ricotta cheese
- Never
- 1 - 3 times per month
- Once per week
- 2 or more times per week

### 34. Cheese (1 slice)
- Never
- 1 - 3 slices per month
- 1 slice per week
- 2 - 5 slices per week
- 1 slice per day
- 2 or more slices per day

### 35. Cream cheese
- Never
- 1 - 3 times per month
- Once per week
- 2 or more times per week

### 36. What type of yogurt, cottage cheese & dairy products (besides milk) do you use mostly?
- Nonfat/Skim
- Lowfat
- Regular
- Don't know

### 37. Butter (1 pat) - NOT margarine
- Never
- 1 - 3 pats per month
- 1 pat per week
- 2 - 5 pats per week
- 1 pat per day
- 2 - 4 pats per day
- 5 or more pats per day

### 38. Margarine (1 pat) - NOT butter
- Never
- 1 - 3 pats per month
- 1 pat per week
- 2 - 6 pats per week
- 1 pat per day
- 2 - 4 pats per day
- 5 or more pats per day

### 39. What form and brand of margarine does your family usually use?
- None
- Stick
- Tub
- Squeeze (liquid)

### 40. What type of oil does your family use at home?
- Canola oil
- Corn oil
- Safflower oil
- Olive oil
- Vegetable oil
- Don't know

### MAIN DISHES

#### 41. Cheeseburger (1)
- Never
- 1 - 3 per month
- Once per week
- 2 - 4 per week
- 5 or more per week

#### 42. Hamburger (1)
- Never
- 1 - 3 per month
- Once per week
- 2 - 4 per week
- 5 or more per week

#### 43. Pizza (2 slices)
- Never
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

#### 44. Tacos/burritos (1)
- Never
- 1 - 3 per month
- Once per week
- 2 - 4 per week
- 5 or more per week

#### 45. Which taco filling do you usually have:
- Beef & beans
- Beef
- Chicken
- Beans

#### 46. Chicken nuggets (6)
- Never
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week
# Breads & Cereals

<table>
<thead>
<tr>
<th>75. Cold breakfast cereal (1 bowl)</th>
<th>76. Hot breakfast cereal, like oatmeal, grits (1 bowl)</th>
<th>77. White bread, pita bread, or toast (1 slice)</th>
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</thead>
<tbody>
<tr>
<td>Never</td>
<td>Never</td>
<td>Never</td>
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<tr>
<td>1 - 3 bowls per month</td>
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<td>2 - 3 slices per day</td>
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<tr>
<td>2 or more bowls per day</td>
<td>2 or more bowls per day</td>
<td>4+ slices per day</td>
</tr>
<tr>
<td>76. Dark bread (1 slice)</td>
<td>79. English muffins or bagels (1)</td>
<td>80. Muffin (1)</td>
</tr>
<tr>
<td>Never</td>
<td>Never</td>
<td>Never</td>
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<tr>
<td>1 slice per week or less</td>
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<td>5 or more muffins per week</td>
<td>5 or more muffins per week</td>
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<tr>
<td>4+ slices per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>81. Cornbread (1 square)</td>
<td>82. Biscuit/roll (1)</td>
<td>83. Rice</td>
</tr>
<tr>
<td>Never</td>
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<td>6 or more per week</td>
<td>5 or more times per week</td>
</tr>
<tr>
<td>84. Noodles, pasta</td>
<td>85. Tortilla - no filling (1)</td>
<td>86. Other grains, like kasha, couscous, bulgar</td>
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<tr>
<td>Never</td>
<td>Never</td>
<td>Never</td>
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<td>1 - 3 times per month</td>
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<td>6 or more per week</td>
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<tr>
<td>87. Pancakes (2) or waffles (1)</td>
<td>88. French fries (large order)</td>
<td>89. Potatoes - baked, boiled, mashed</td>
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<td>Never</td>
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### MISCELLANEOUS FOODS

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<td>Never, Once per week or less, 2 - 6 times per week, Once per day, 2 or more times per day</td>
</tr>
<tr>
<td>66. Ketchup</td>
<td>Never, 1 - 3 times per month, Once per week, 2 - 4 times per week, 5 or more times per week</td>
</tr>
<tr>
<td>67. Clear soup (with rice, noodles, vegetables)</td>
<td>1 bowl</td>
</tr>
<tr>
<td>68. Cream (milk) soups or chowder (1 bowl)</td>
<td>Never, 1 - 3 bowls per month, 1 bowl per week, 2 - 6 bowls per week, 1 or more bowls per day</td>
</tr>
<tr>
<td>69. Mayonnaise</td>
<td>Never, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once per day</td>
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<tr>
<td>70. Low calorie salad dressing</td>
<td>Never, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once or more per day</td>
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<tr>
<td>71. Salad dressing (not low calorie)</td>
<td>Never, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once or more per day</td>
</tr>
<tr>
<td>72. Salsa</td>
<td>Never, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once or more per day</td>
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<tr>
<td>73. How much fat on your beef, pork, or lamb do you eat?</td>
<td>Eat all, Eat some, Eat none, Don't eat meat</td>
</tr>
<tr>
<td>74. Do you eat the skin of the chicken or turkey?</td>
<td>Yes, No, Sometimes</td>
</tr>
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<td>No.</td>
<td>Item</td>
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<tr>
<td>-----</td>
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</tr>
<tr>
<td>75</td>
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<td>Noodles, pasta</td>
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<td>Other grains, like kasha, couscous, bulgar</td>
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<td>French fries (large order)</td>
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<td>89</td>
<td>Potatoes - baked, boiled, mashed</td>
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<td>FRUITS &amp; VEGETABLES</td>
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</tr>
<tr>
<td>90.</td>
<td>Raisins (small pack)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more times per week</td>
</tr>
<tr>
<td>91.</td>
<td>Grapes (bunch)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ Once per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more times per week</td>
</tr>
<tr>
<td>92.</td>
<td>Bananas (1)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 4 per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more per week</td>
</tr>
<tr>
<td>93.</td>
<td>Cantaloupe, melons (1/4 melon)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 or more times per week</td>
</tr>
<tr>
<td>94.</td>
<td>Apples (1) or applesauce</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 or more per day</td>
</tr>
<tr>
<td>95.</td>
<td>Pears (1)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 or more per day</td>
</tr>
<tr>
<td>96.</td>
<td>Oranges (1), grapefruit (1/2)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 or more per day</td>
</tr>
<tr>
<td>97.</td>
<td>Strawberries</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ Once per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 or more times per week</td>
</tr>
<tr>
<td>98.</td>
<td>Peaches, plums, apricots (1)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 or more per week</td>
</tr>
<tr>
<td>99.</td>
<td>Orange juice (1 glass)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 glasses per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 glass per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 glasses per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 glass per day</td>
</tr>
<tr>
<td></td>
<td>○ 2 or more glasses per day</td>
</tr>
<tr>
<td>100.</td>
<td>Apple juice and other fruit juices (1 glass)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 glasses per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 glass per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 glasses per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 glass per day</td>
</tr>
<tr>
<td></td>
<td>○ 2 or more glasses per day</td>
</tr>
<tr>
<td>101.</td>
<td>Tomatoes (1)</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 per month</td>
</tr>
<tr>
<td></td>
<td>○ 1 per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 6 per week</td>
</tr>
<tr>
<td></td>
<td>○ 1 or more per day</td>
</tr>
<tr>
<td>102.</td>
<td>Tomato/spaghetti sauce</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ Once per week</td>
</tr>
<tr>
<td></td>
<td>○ 4 - 7 times per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more times per week</td>
</tr>
<tr>
<td>103.</td>
<td>Tofu</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ Once per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more times per week</td>
</tr>
<tr>
<td>104.</td>
<td>String beans</td>
</tr>
<tr>
<td></td>
<td>○ Never</td>
</tr>
<tr>
<td></td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td></td>
<td>○ Once per week</td>
</tr>
<tr>
<td></td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td></td>
<td>○ 5 or more times per week</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>○ Never</td>
<td>○ Never</td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ Once per week or less</td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ 2 or more times per week</td>
</tr>
<tr>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>108. Peas or lima beans</th>
<th>109. Mixed vegetables</th>
<th>110. Spinach</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Never</td>
<td>○ Never</td>
<td>○ Never</td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ Once per week</td>
<td>○ Once a week</td>
</tr>
<tr>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>111. Greens/kale</th>
<th>112. Green/red peppers</th>
<th>113. Yams/sweet potatoes (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Never</td>
<td>○ Never</td>
<td>○ Never</td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ Once a week</td>
<td>○ Once a week</td>
</tr>
<tr>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Never</td>
<td>○ Never</td>
<td>○ Never</td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ Once per week</td>
<td>○ Once per week</td>
</tr>
<tr>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 4 times per week</td>
</tr>
<tr>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
<td>○ 5 or more times per week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>117. Celery</th>
<th>118. Lettuce/tossed salad</th>
<th>119. Coleslaw</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Never</td>
<td>○ Never</td>
<td>○ Never</td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
<td>○ 1 - 3 times per month</td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ Once per week</td>
<td>○ Once per week</td>
</tr>
<tr>
<td>○ 2 - 4 times per week</td>
<td>○ 2 - 6 times per week</td>
<td>○ 2 or more times per week</td>
</tr>
<tr>
<td>○ 5 or more times per week</td>
<td>○ One or more per day</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>120. Potato salad</th>
<th>121. Beans/lentils/soybeans</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Never</td>
<td>○ Never</td>
<td></td>
</tr>
<tr>
<td>○ 1 - 3 times per month</td>
<td>○ Once per week or less</td>
<td></td>
</tr>
<tr>
<td>○ Once per week</td>
<td>○ 2 - 6 times per week</td>
<td></td>
</tr>
<tr>
<td>○ 2 or more times per week</td>
<td>○ Once per day</td>
<td></td>
</tr>
</tbody>
</table>
# Snack Foods/Desserts

122. Fill in the number of snacks (food or drinks) eaten on school days and weekends/vacation days.

## Snacks

<table>
<thead>
<tr>
<th>Between breakfast and lunch</th>
<th>School Days</th>
<th>Vacation/Weekend Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>After lunch, before dinner</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>After dinner</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Think about your usual snacks. Estimate how often you eat each type of snack food.

**Example 3** If you eat poptarts rarely (about 6 per year) then your answer should look like this:

**E3. Poptarts (1)**
- Never/less than 1 per month
- 1 - 3 per month
- 1 - 6 per week
- 1 or more per day

## 123. Potato chips (1 small bag)
- Never/less than 1 per month
- 1 - 3 small bags per month
- One small bag per week
- 2 - 6 small bags per week
- 1 or more small bags per day

## 124. Corn chips/Doritos (small bag)
- Never/less than 1 per month
- 1 - 3 small bags per month
- One small bag per week
- 2 - 6 small bags per week
- 1 or more small bags per day

## 125. Nachos with cheese (1 serving)
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 or more times per week

## 126. Popcorn (1 small bag)
- Never/less than 1 per month
- 1 - 3 small bags per month
- 1 - 4 small bags per week
- 5 or more small bags per week

## 127. Pretzels (1 small bag)
- Never/less than 1 per month
- 1 - 3 small bags per month
- 1 small bag per week
- 2 or more small bags per week

## 128. Peanuts, nuts (1 small bag)
- Never/less than 1 per month
- 1 - 3 small bags per month
- 1 - 4 small bags per week
- 5 or more small bags per week

## 129. Fun fruit (1 pack)
- Never/less than 1 per month
- 1 - 3 packs per month
- 1 - 4 packs per week
- 5 or more packs per week

## 130. Graham crackers
- Never/less than 1 per month
- 1 - 3 times per month
- 1 - 4 times per week
- 5 or more times per week

## 131. Crackers, like saltines or wheat thins
- Never/less than 1 per month
- 1 - 3 times per month
- 1 - 4 times per week
- 5 or more times per week

---

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### 132. Poptarts (1)
- Never/less than 1 per month
- 1 - 3 poptarts per month
- 1 - 6 poptarts per week
- 1 or more poptarts per day

### 133. Cake (1 slice)
- Never/less than 1 per month
- 1 - 3 slices per month
- 1 slice per week
- 2 or more slices per week

### 134. Snack cakes, Twinkies (1 package)
- Never/less than 1 per month
- 1 - 3 per month
- Once per week
- 2 - 6 per week
- 1 or more per day

### 135. Danish, sweetrolls, pastry (1)
- Never/less than 1 per month
- 1 - 3 per month
- 1 per week
- 2 - 4 per week
- 5 or more per week

### 136. Donuts (1)
- Never/less than 1 per month
- 1 - 3 donuts per month
- 1 donut per week
- 2 - 6 donuts per week
- 1 or more donuts per day

### 137. Cookies (1)
- Never/less than 1 per month
- 1 - 3 cookies per month
- 1 cookie per week
- 2 - 6 cookies per week
- 1 - 3 cookies per day
- 4 or more cookies per day

### 138. Brownies (1)
- Never/less than 1 per month
- 1 - 3 per month
- 1 per week
- 2 - 4 per week
- 5 or more per week

### 139. Pie (1 slice)
- Never/less than 1 per month
- 1 - 3 slices per month
- 1 slice per week
- 2 or more slices per week

### 140. Chocolate (1 bar or packet) like Hershey's or M & M's
- Never/less than 1 per month
- 1 - 3 per month
- 1 per week
- 2 - 6 per week
- 1 or more per day

### 141. Other candy bars (Milky Way, Snickers)
- Never/less than 1 per month
- 1 - 3 candy bars per month
- 1 candy bar per week
- 2 - 4 candy bars per week
- 5 or more candy bars per week

### 142. Other candy without chocolate (mints, LifeSavers) (1 pack)
- Never/less than 1 per month
- 1 - 3 times per month
- 1 time per month
- 2 - 4 times per week
- 5 or more times per week

### 143. Jello
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 144. Pudding
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 145. Frozen yogurt
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 146. Ice cream
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 147. Milkshake or frappe (1)
- Never/less than 1 per month
- 1 - 3 per month
- 1 per week
- 2 or more per week

### 148. Popsicles
- Never/less than 1 per month
- 1 - 3 popsicles per month
- 1 popsicle per week
- 2 - 4 popsicles per week
- 5 or more popsicles per week
149. Please list any other important foods that you usually eat at least once per week that are not listed (for example, coconut, hummus, falafel, eggroll, chili, plantains, mangoes, etc. . .)

FOODS
a) 

b) 

c) 

d) 

HOW OFTEN?

a) 

b) 

c) 

d) 

THANK YOU FOR COMPLETING THIS SURVEY!
Appendix C
## Pedometer and Activity Time Log

<table>
<thead>
<tr>
<th>Day &amp; Date</th>
<th>Step Counts</th>
<th>Exercise Time</th>
<th>Did you wear pedometer entire day?</th>
<th>Did you participate in PE today?</th>
<th>What activity did you do after school today?</th>
<th>If yes, what did you do and for how long?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, September 30</td>
<td>___________</td>
<td>___________</td>
<td>Yes No</td>
<td>Yes No</td>
<td>Physical Activity</td>
<td>What:</td>
</tr>
<tr>
<td></td>
<td>______ hr.</td>
<td>______ min.</td>
<td>If No how long was it off? ________</td>
<td></td>
<td>Sedentary Activity</td>
<td>How long:</td>
</tr>
<tr>
<td></td>
<td>______ sec.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday, October 1</td>
<td>___________</td>
<td>___________</td>
<td>Yes No</td>
<td>Yes No</td>
<td>Physical Activity</td>
<td>What:</td>
</tr>
<tr>
<td></td>
<td>______ hr.</td>
<td>______ min.</td>
<td>If No how long was it off? ________</td>
<td></td>
<td>Sedentary Activity</td>
<td>How long:</td>
</tr>
<tr>
<td></td>
<td>______ sec.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thursday, October 2</td>
<td>___________</td>
<td>___________</td>
<td>Yes No</td>
<td>Yes No</td>
<td>Physical Activity</td>
<td>What:</td>
</tr>
<tr>
<td></td>
<td>______ hr.</td>
<td>______ min.</td>
<td>If No how long was it off? ________</td>
<td></td>
<td>Sedentary Activity</td>
<td>How long:</td>
</tr>
<tr>
<td></td>
<td>______ sec.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday, October 3</td>
<td>___________</td>
<td>___________</td>
<td>Yes No</td>
<td>Yes No</td>
<td>Physical Activity</td>
<td>What:</td>
</tr>
<tr>
<td></td>
<td>______ hr.</td>
<td>______ min.</td>
<td>If No how long was it off? ________</td>
<td></td>
<td>Sedentary Activity</td>
<td>How long:</td>
</tr>
<tr>
<td></td>
<td>______ sec.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday, October 4</td>
<td>___________</td>
<td>___________</td>
<td>Yes No</td>
<td>Yes No</td>
<td>Physical Activity</td>
<td>What:</td>
</tr>
<tr>
<td></td>
<td>______ hr.</td>
<td>______ min.</td>
<td>If No how long was it off? ________</td>
<td></td>
<td>Sedentary Activity</td>
<td>How long:</td>
</tr>
<tr>
<td></td>
<td>______ sec.</td>
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<td></td>
<td></td>
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<tr>
<td>Date</td>
<td>Hours</td>
<td>Minutes</td>
<td>Sedentary Activity</td>
<td>Physical Activity</td>
<td>Activity Description</td>
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</tr>
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<td>--------------------</td>
<td>-------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>Sunday, October 5</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If No how long was it off? ______</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday, October 6</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
</tr>
<tr>
<td></td>
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<td>If No how long was it off? ______</td>
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<tr>
<td>Tuesday, October 7</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
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<td>If No how long was it off? ______</td>
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<td>Wednesday, October 8</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
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<td>If No how long was it off? ______</td>
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<tr>
<td>Thursday, October 9</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
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<td>If No how long was it off? ______</td>
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<tr>
<td>Friday, October 10</td>
<td>______ hr.</td>
<td>______ min.</td>
<td>Yes No</td>
<td>Sedentary Activity</td>
<td>TV, computer, Nintendo, homework, etc</td>
<td>Yes No</td>
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<td>If No how long was it off? ______</td>
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