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Sugar Consumption in Adolescents through Beverage Intake

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Abstract:

Recent studies have found that adolescents, aged 12-18 years old, are the highest consumers of sugar-sweetened beverages in the United States today (Vos, 2008; Welsh, 2008). An assortment of diseases and other health related issues have been the result of excess sugar consumption. Students at a small secondary school in the northeastern region of the United States were tested to see how much sugar they consumed in the form of beverages. This study looked at how much adolescents (aged 15-18 years old) are consuming on a daily basis and where they are consuming these beverages. It also serves to compare how much each gender, grade, and ethnicity consumed on a daily basis. The values found were then compared to national averages to test their level of significance (Welsh, 2008 and Vos, 2008).

The occurrence of metabolic syndrome, a number of factors that increase one's risk of getting health related diseases (ie: stroke, heart disease, diabetes, etc), among this group of students was also observed to see if another connection could be made between the prevalence of obesity and whether or not the students possess this disorder. Body mass index (BMI) was also observed in this study to see if most students were considered underweight, normal weight, overweight, or obese.

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Introduction:

Being obese and overweight are two very different conditions that Americans today often mix up. The Center for Disease Control (CDC) defines being overweight as having a Body Mass Index (BMI) between 18.5 and 24.9. The term “obese” is defined by the CDC as having a BMI greater than 30. In the United States today, one third of the children and adolescents are obese (*Lavizzo-Mourey, 2006; Facts for Families, May 2008*). In 2007-2008, approximately 18% of adolescents aged 12-19 years of age were considered obese according to the CDC. Moreover, the United States has witnessed obesity among children and adolescents more than triple in the last 30 years. Experts say that the obesity epidemic can be attributed to an increased consumption of junk food, a lack of aerobic exercise, genetics, and the increased popularity of sugar sweetened beverages (SSB's) (*Teen Help, 2011*). Although all of these factors play a significant role in teen obesity, the increase in the availability of sugar-sweetened beverages has been shown to be one of the leading causes of obesity today (Wang et al, 2009).

Severe health related issues have been linked to an increased exposure to sugar-sweetened products. Due to obesity, tests of children and adolescents across the U.S. have shown an increased risk of heart disease, stroke, diabetes, asthma, and various forms of cancer that could possibly develop later in life (*Lavizzo-Mourey, 2006*). Metabolic syndrome is characterized by one or more metabolic conditions, such as diabetes, insulin resistance, hypertension, and high blood pressure. It has been observed that there is a positive correlation between metabolic syndrome and the amount of SSB's an adolescent consumes daily (Wang 2008).

Results of a study conducted by Vos (2008), indicated that through the consumption of sugar-sweetened beverages, more adolescents are beginning to develop obesity and a variety of

other health related issues. When looking at fructose consumption, researchers in this study found that 30% of the average adolescents' diet was coming from sugar sweetened beverages. In addition, another study completed by Wang suggests that from 1996-1997 approximately 85% of children and adolescents consumed SSB's on any given day (2008). The dietary guidelines released by the National Heart Association and the United States Department of Agriculture (USDA) state that children and adolescents between seven to 18 years of age should limit their consumption of sweetened beverages or naturally sweetened beverages to between eight and twelve ounces per day (2008). Organizations around the country are promoting this advice and are implementing new ways to limit what is being consumed by children and adolescents. For example, Michelle Obama, the first lady of the United States, kicked off the *Let's Move* campaign in 2008.

The obesity epidemic in America has caught the attention of policy makers, public health officials, school and community leaders, and the food and beverage industry (*Lavizzo-Mourey, 2006*). Many school districts are revising their district policies to eliminate the availability of HFCS-containing products. Within schools, school and community leaders are organizing groups to keep students' minds away from food and more toward healthier alternatives such as exercise, extracurricular activities, positive decision making, etc. The food and beverage industries are working toward making their products United States Department of Agriculture (USDA) approved and offering HFCS free products. Washington, Texas, and New York are just some of the states have begun to take part in this change (*Johnson. Et al., 2009; Lavizzo-Mourey, 2006*). School districts within these states continue to focus their attention toward the amount consumed by the varying age groups, the amount of SSB exposure children and adolescents are surrounded

by at school and in their communities, the correlation between the ethnicity of an individual to what they are consuming, etc.

This study looked at the trends of sugar consumption among adolescents in a metropolitan area just north of New York City. Some of the factors identified in this study include the locations where the beverages were consumed, the serving size of each beverage, the ethnicity of the participants, the amount (in ounces) consumed, and the popularity of each beverage. BMI and occurrence of metabolic syndrome were also obtained to assess any possible correlation to their daily consumption of SSB's. The results of this study were then compared to research completed at a national level (*Vos, 2008 & Wang, 2008*). The results of this study can be used to determine if sugar-sweetened beverage consumption at the high school surveyed varies from the national average consumption rate; and if a school-based nutrition program is warranted in helping adolescents reduce their SSB consumption. This study also looked at the BMI results of the participants as well as the prevalence of metabolic syndrome to determine if either of these factors correlate to SSB consumption. Finally, demographics of participants, types of beverages and location of SSB consumption were all studied for trends.

Statement of Purpose: To compare national averages of sugar consumption throughout sugar sweetened beverages to the consumption in a small public high school in the northeastern region of the United States.

Materials and Methods:

Similar methods were used to conduct this study as that of Vos (2008). While Vos sampled 21,483 children and adults in the United States using the NHANES1988-1994 system,

| <u>Demographics Breakdown</u> | | | | | | | | |
|--------------------------------------|---------------|--------------|-----------|-----------|------------------|-----------|----------|----------|
| Gender | | Grade | | | Ethnicity | | | |
| Male | Female | 10 | 11 | 12 | W | AA | H | A |
| 25 | 29 | 13 | 33 | 8 | 36 | 5 | 6 | 7 |

Table 1: Demographics include gender, grade, and ethnicity breakdown of all 15-18 year old participants.

this study looked at a sample size of 54 adolescents that were obtained through a convenience sample. The subjects were placed into general categories based on their gender, grade, and ethnicity (table 1). All participants in this study attended the same secondary school in the northeastern region of the United States.

One thing that remained constant between this study and that of Vos (2008) was the three-week duration of the survey procedures. In order to look at a wide range of factors (ie: location, name of beverage, serving size, etc) a beverage-tracking sheet was distributed at the beginning of this study, and an after-completion survey was distributed at the end of this study. The students were asked to record every beverage (excluding water) that they consumed for this 21-day period on the beverage-tracking sheet. They were also asked to write down how many servings they had and the amount in ounces of each serving on this sheet. The surveys were distributed to the students' health classes in late March of 2011 and collected in early April of 2011.

The following factors were looked at in this study: name of student, grade, ethnicity, gender, beverages consumed, where each beverage was consumed, amount (ounces) consumed, and the grams of sugar in each beverage. The BMI and metabolic syndrome information were acquired by the school nurse using an anonymous coding system to preserve confidentiality among the students. Each BMI number was calculated by multiplying one's height (in inches) by itself, then dividing that number by his/her weight and then multiplying that answer by 703. The data on metabolic syndrome was retrieved by the information each student's pediatrician gave to the school nurse. A convenience sample was used to ensure that a represented cross-section of the student body was surveyed. After surveys were distributed to the health classes, the students were allowed to take the paperwork home and complete the beverage log on their own, thus

eliminating the Hawthorne Effect. With the notion of someone else observing the beverages each subject consumed, the data may have become skewed if the subject thought that they were being judged based on their dietary choices. The amount of sugar in each individual beverage was tabulated (<http://nutritiondata.self.com/>, <http://www.foodfacts.com/>, and <http://caloriecount.about.com/>.) Applying these values to the beverage-intake surveys, the total amount of sugar consumed in grams and kilocalories from beverage consumption was calculated.

Results:

Two studies that both evaluate and assess the average amounts of sugar consumed through beverages in the United States are Vos (2008) & Wang (2008). The national averages found in these studies were compared to the results found in this study (table 2). When comparing the results of fructose consumption through beverages to that of Vos (2008) there was only a difference of 1.8 grams per day. On the other end of this, the caloric contribution from beverages was seen to be moderately different between what was observed by Wang (2008) and the experiment performed in this study. Something that may have accounted for the difference of caloric contribution of 137 may have been because of the greater age range used in Wang (2008). Ultimately, it was noticed that the amount of sugar consumed was less than the national average of Vos (2008).

Comparison of Survey Results to National Results:

| | High School Survey [15-18yrs] | NHANES III (Vos, 2008) [12-18yrs] | NHANES: 1999-2004 (Wang, 2008) [12-19yrs] | P-value: Comparing the survey results to Vos, 2008 & Wang 2008 |
|-------------------------------------|-------------------------------|-----------------------------------|---|--|
| Fructose from beverages, g/day | 40.6 | 42.4 | — | .6510 |
| Caloric contribution from beverages | 162 | — | 301 | <.0001 |

Table 2: This table shows a comparison of the results obtained in this study to those obtained in Vos, 2008 & Wang, 2008. The column stating the p-values on the right illustrates the level of statistical significance when compared to Vos, 2008 & Wang, 2008.

The data collected in this study describing the genders, grades, and ethnicities, proved to be significant and are shown in table 3. Both the t-test and the p-values determine the level of significance between all of the data listed below.

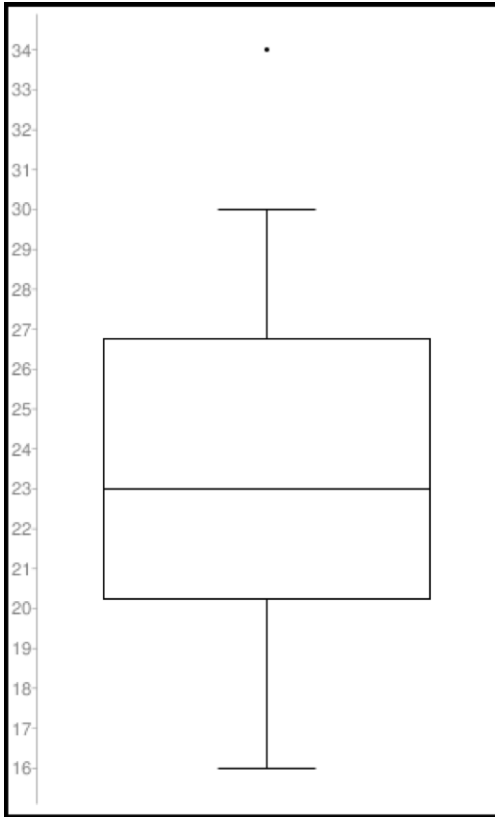
| Summary of Data | | | | | | | | | | |
|------------------------|------------------|-------------|---------------|---------------|-----------------|----------------|--------------------|-------------------------|-----------------|--------------|
| | Genders | | | Grades | | | Ethnicities | | | |
| | Total SSB | Male | Female | Tenth | Eleventh | Twelfth | White | African American | Hispanic | Asian |
| Average grams per day | 40.6 | 48.1 | 34.2 | 51 | 37.2 | 38.0 | 39.7 | 47.4 | 53.6 | 29.2 |
| Standard Deviation | 29.1 | 33.5 | 23.3 | 21.6 | 32.3 | 24.1 | 27.4 | 9.3 | 54.5 | 14.0 |
| Standard Error | 4.0 | 6.7 | 4.3 | 6.0 | 5.6 | 8.5 | 4.6 | 4.2 | 22.3 | 5.3 |
| T-test | | 1.1 | -1.5 | 1.7 | -0.6 | -0.3 | -0.2 | 1.6 | 0.6 | -2.2 |
| P-value | | 0.3 | 0.1 | 0.1 | 0.5 | 0.8 | 0.8 | 0.2 | 0.6 | 0.1 |

Table 3: This table displays a summary of values to help determine the significance of each piece of data. The standard deviation, standard error, t-test, and p-value help to determine the level of significance for the following categories: Gender, grade, and ethnicity.

Figures 1 and 2 illustrate BMI trends for females and males respectively. According to the female (figure 1) and male (figure 2) box plots, outliers were observed for each gender. These outliers lie beyond the maximum therefore suggesting that some students with these higher BMI ranges are either on the cusp of being overweight or are already overweight or obese. When a student appears to be on this cusp of being overweight or obese, doctors and pediatricians often look for a specific metabolic syndrome trait called Impaired Glucose Tolerance. This condition is often referred to a pre-diabetic state because one's blood glucose levels are above normal. Although some outliers do exist as shown in the box plots below, only one male subject was seen to actually have metabolic syndrome. When looking back on this data,

this male subject was seen to be in 12th grade and white with a BMI of 22, is considered to be of normal weight.

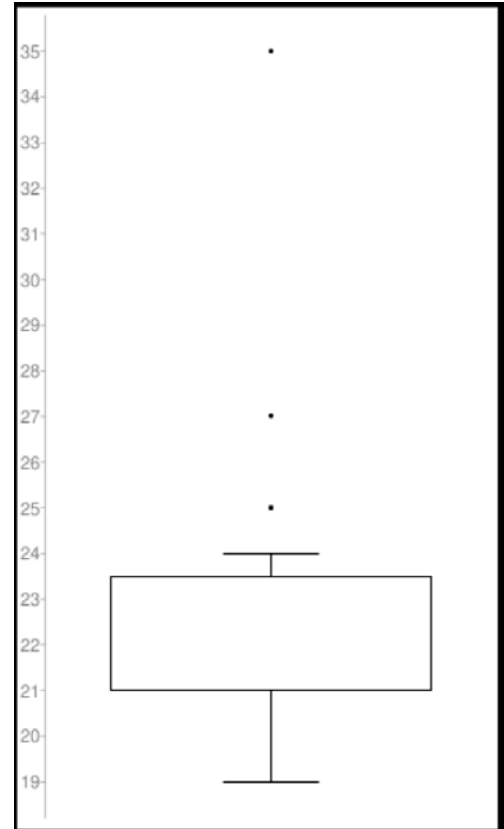
Box Plot: Data Showing All Female BMI Results



Sample size: 28
Median: 23
Minimum: 16
Maximum: 34
First quartile: 20.25
Third quartile: 26.75
Interquartile Range: 6.5
Outlier: 34

Figure 1: This box plot shows the minimum, maximum, median, first quartile and second quartile for all of the female subjects. One outlier is found at 34 because it exceeds the maximum of about 30.

Box Plot: Data Showing All Male BMI Results



Sample size: 25
Median: 21
Minimum: 19
Maximum: 35
First quartile: 21
Third quartile: 23.5
Interquartile Range: 2.5
Outliers: 35 27 25 25

Figure 2: This box plot shows the minimum, maximum, median, first quartile and second quartile for all of the male subjects.

Out of the 13 tenth graders tested, an average of 50.7 grams of sugar from SSB's were consumed each day per capita, which was the most out of all three grades. It was also observed that the eleventh graders consumed an average of 37.8 grams of sugar. The twelfth graders were

seen to have only consumed a total of 33.6 grams of sugar on average each day. The greatest difference was seen when looking at the tenth graders compared to the eleventh and twelfth graders. However, when looking at the standard deviation data for each of the grades, the eleventh grade students were shown to have the greatest deviation whereas the twelfth graders had the least (table 3). This may be due to the fact that the 11th graders were the largest sample size, whereas the 12th graders were the smallest.

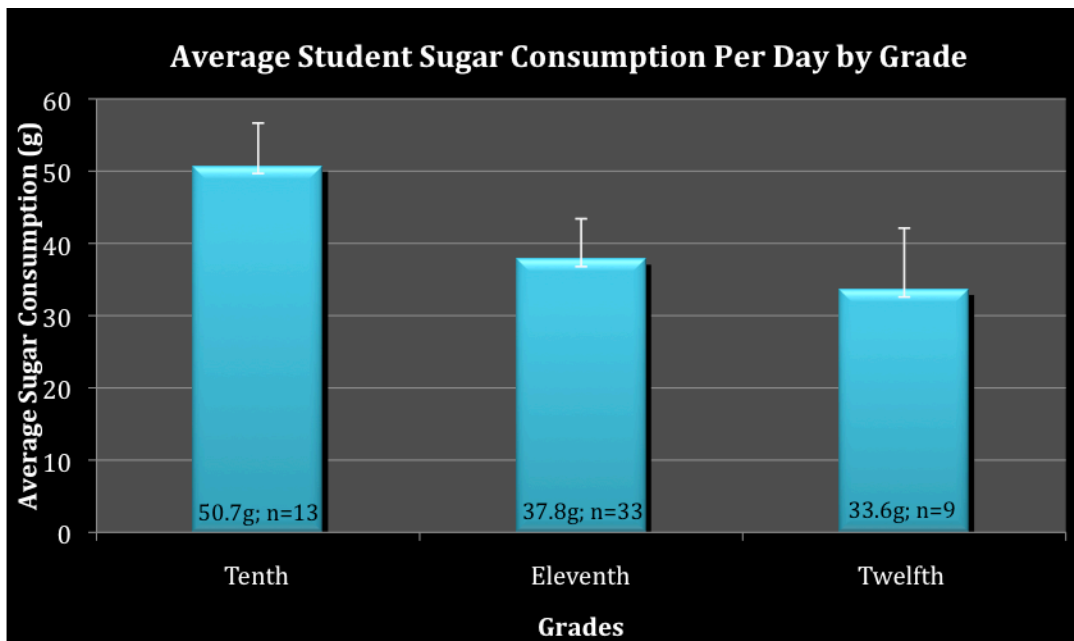


Figure 3: This graph displays the average amount of sugar consumed each day by each grade.

Figure 4 shows the mean sugar consumption by ethnicity. The results showed that on average, Hispanics consumed the most sugar through beverage consumption, while the Asian subjects consumed the least. Although Caucasian and African Americans were very close in consuming the same amount of sugar per day, African American subjects consumed about 7 grams more than African Americans. The standard error seemed to fluctuate between the ethnicities. Taking into account that the standard error bars were constructed using the square

roots of the sample populations for each ethnicity, the difference may be attributed to the sample size of each category.

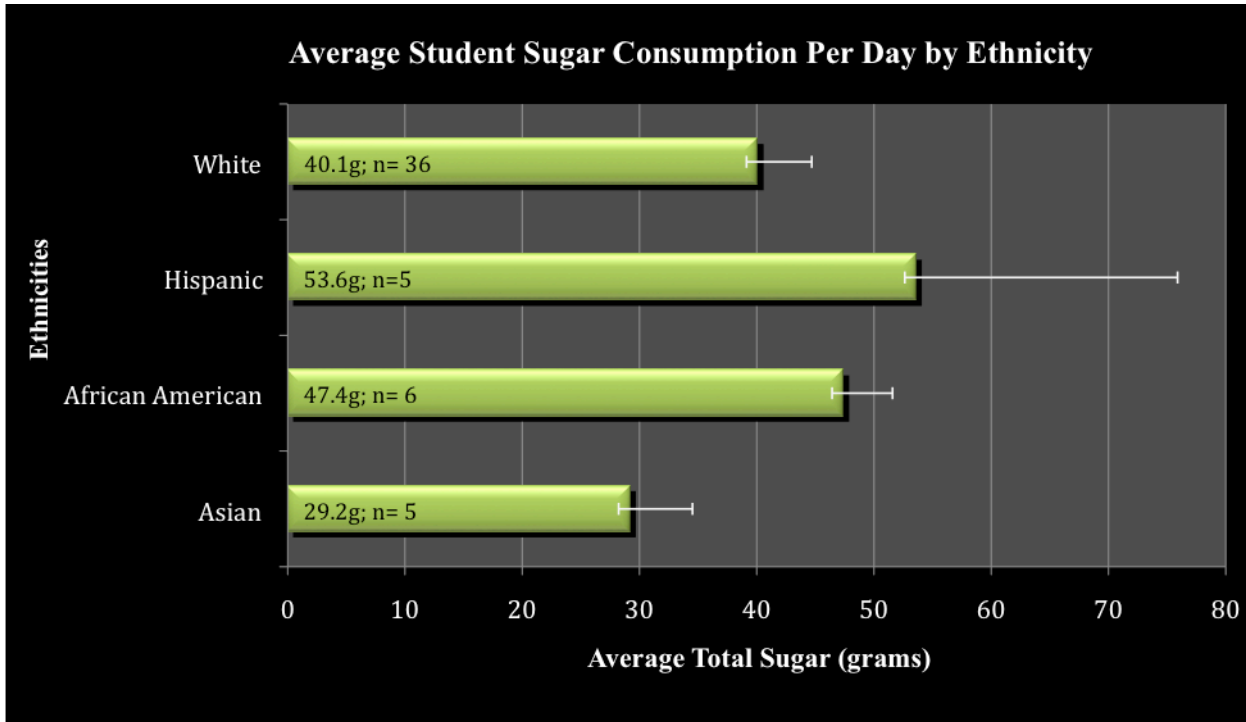


Figure 4: This graph shows the mean sugar consumption values between all ethnicities: Whites, Hispanics, African Americans, and Asians. The lines extending from each bar are standard error lines, which show the spread of this data. As shown, the longer standard error line among Hispanics implies more uncertainty.

Figure 5 compares the consumption of males and females. On average, the males had consumed about 14 grams per day more sugar through the form of SSB's than the females with the male to female, or %. The standard error lines on this graph depict a similar variation for both genders. This could be because the samples were so close in size.

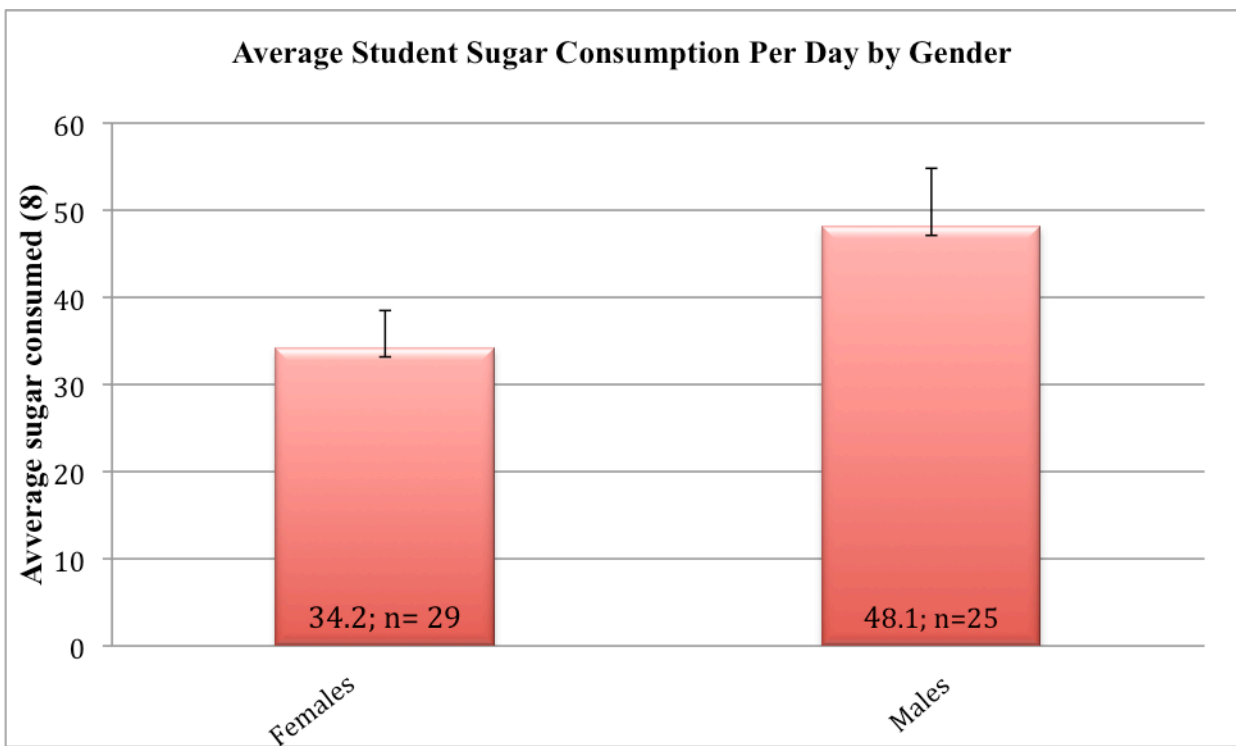


Figure 5: This bar graph displays the average grams of sugar consumed per day by both males and females.

Figure 6 depicts the location of SSB consumption. Similar to the results found by Wang (2008) the subjects consumed most of these beverages at home (65%). Following this, 16% of beverages were consumed in school. Other locations such as at practice, or being in a store were not as popular and therefore not a very significant piece of data.

Locations of Consumption

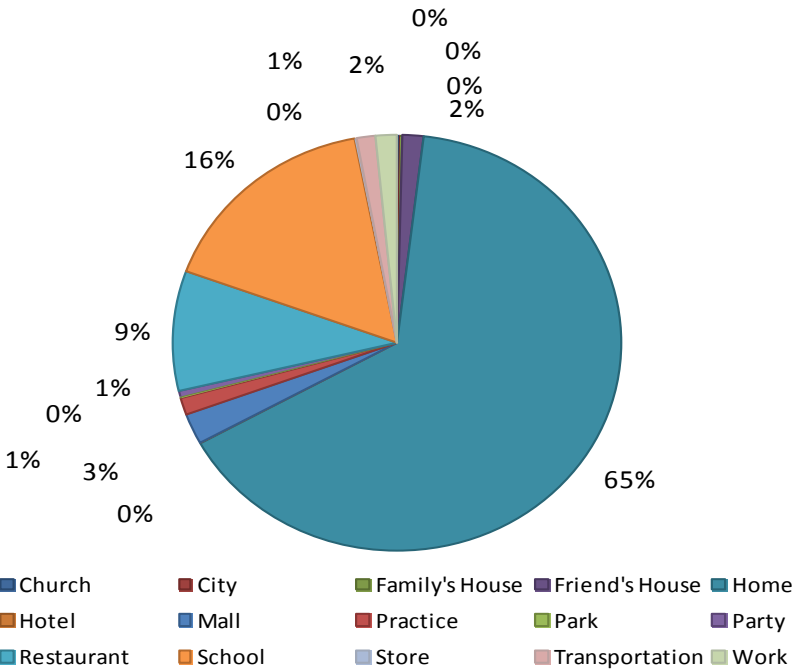


Figure 6: Chart displays where the majority of beverages that were consumed. According to this chart close to three quarters of the beverages were consumed at home.

Discussion and Conclusion:

In both Vos, 2008 and Wang, 2008, a trend was seen to develop in these national studies. Adolescents, aged 12-18, were seen to consume the most sugar-sweetened beverages compared to every other age group. By conducting this study at a small metropolitan high school in the northeast region of the US, similar results were observed. The majority of the beverages being consumed among adolescents were the drinks within the category of “sugar sweetened beverages”. In addition to this, males were seen to consume more beverages on average. One significant difference between this study and Vos, 2008, is that the consumption of SSB’s was much more prominent among non-Hispanic blacks. In this study, Hispanics consumed the most SSB’s among all other ethnicities. This information can lead this small high school to rethink educating Hispanic families within the area.

Although there is still a strong prevalence of sugar consumption through beverage intake in this high school, the students at this high school are consuming less than the national averages suggest.

A body mass index in the “underweight” category is under 18.5, a BMI over 24.9 is considered “overweight”, and when someone is between these two values they are considered of “normal weight”. According to the body mass index results, it was noticed that the majority of students, no matter what gender, grade, or ethnicity, lie in the “normal weight” category. As seen in figures 1 and 2, more females are overweight than males.

Overall, the students at this small suburban high school were seen to consume less sugar-sweetened beverages than what was consumed at a national level. Out of the total population, males consumed more SSB’s per day, on average, than females. When looking at each grade, it was noticed that the tenth graders consumed the most, and the twelfth graders consumed the

least. In addition to this, the ethnicity that consumed the most SSB's was the Hispanic population. Without taking into account the genders, grades, or ethnicities, the students consumed the majority of these beverages at their "home" setting.

Consequently, there were some shortfalls with this experiment. Because of a lack of data on metabolic syndrome no significant conclusions could be made about this population in relation to their tendency to acquire other health related diseases as they mature and grow up.

To expand upon this study even more, one could look at income levels and how they correlate to the percent of students who are on the school lunch plan. Also, larger samples can be used to further form some conclusions about BMI and metabolic syndrome.

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