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ORIGINAL ARTICLE

THE LINK BETWEEN THE CONSUMPTION OF SWEETENED BEVERAGES AND THE DEVELOPMENT OF OVERWEIGHT AND OBESITY AMONG STUDENTS OF THE UNIVERSITY OF THE WEST INDIES, ST AUGUSTINE CAMPUS IN TRINIDAD AND TOBAGO

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ABSTRACT

Background. Many risk factors, which contribute to the development of overweight and/or obesity have been investigated and identified. However, one of the largest independent contributors to the obesity epidemic, which is often overlooked, is the increased consumption of sweetened beverages, particularly among the adolescents and young adults.

Objective. The purpose of this study was to investigate the relationship between sweetened beverage consumption and the development of overweight and obesity among the students of The University of the West Indies, St. Augustine campus in the Republic of Trinidad and Tobago.

Material and methods. A cross-sectional study design was used, with a non-probability sampling method. The target population were the students of the University of the West Indies, St Augustine aged ≥18 years of age. The research data were collected through the distribution of a self-administered questionnaire, which was completed by each participant while anthropometric and clinical measurements were completed by the researchers. A total of 161 questionnaires were distributed to the students of participants. Out of 161 questionnaires distributed, 137 were collected, but only 133 were fully completed, which gave a response rate of 83%. Statistical analyses were conducted using IBM SPSS Statistics 19.0 (IBM Corporation, Chicago, IL, USA).

Results. 97.1% of the participants stated that they consumed sweetened beverages while only 2.9% said that they did not. Based on the results generated from chi-squared statistic test, there was no association between BMI and gender, age group, ethnicity, and the frequency of the consumption of sweetened beverages and their quantities.

Conclusion. No association between the intakes of sweetened beverages and overweight and/or obesity was found among the participants, but a very high prevalence of the consumption of these beverages was observed in the subjects.

Key words: *sweetened beverages, overweight, obesity, students, anthropometrics*

INTRODUCTION

Obesity, defined as an excess of adipose tissue when body mass index is >30 kg/m^2, is due to an imbalance between energy intake and energy expenditure. Obesity is a major health problem in the industrialized world and it has reached epidemic proportions globally. The World Health Organization estimates that worldwide, obesity has more than tripled since 1975. In 2016, more than 1.9 billion adults, 18 years and older, were overweight. Of these, over 650 million were obese. 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese. Overall, about 13% of the world's adult populations (11% of men and 15% of women) were obese in 2016. 41 million children under the age of 5 were overweight or obese in 2016. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016. Most of the world's populations live in countries where overweight and obesity kills more people than underweight [16].

Obesity, once developed, is difficult to reverse. This is caused not only by biological resistance to weight loss in the form of decrease in energy expenditure [6] and increase in appetite, but also because the large behavior changes needed to sustain weight loss [15] are difficult for most people to sustain in what is termed a toxic environment, that is, where food is abundant, and where little physical activity is required in daily living [10].

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Many risk factors which contribute to the development of overweight and/or obesity have been investigated and identified. However, one of the largest independent contributors to the obesity epidemic, which is often overlooked, is the increased consumption of sugar sweetened beverages (SSBs), particularly among adolescents and young adults. Although argued that sweetened beverages do not contribute to weight gain and thus the obesity epidemic, a calorie, regardless of the source has the same effect and the extra calories that these beverages add to the diet might be a significant link to overweight and obesity [1, 13]. Thus, the purpose of this study was to investigate the relationship between sweetened beverages consumption and the development of overweight and obesity among the students of the University of the West Indies, St. Augustine campus.

MATERIAL AND METHODS

The scopes of this study were: a) to assess the frequency and quantity of the consumption of SSBs among the subjects; b) to examine the relationship between SSBs consumption and BMI; c) to compare the consumption of SSBs between males and females.

A cross-sectional study design was used, with a non-probability sampling method. The target population were the students of the University of the West Indies, St Augustine aged ≥18 years of age.

The sample size of the study was determined based on the precision of the study as follows:

$$n = Z^2\ pxq/e^2, \text{ where:}$$

n = sample size; z = standard normal value of Z-Score which has a value of 1.96 and 2.58 at the 95% and 99% confidence level respectively; p = the proportion of the population with the attribute of interest (expressed as a decimal); e = level of precision or confidence interval. The sample size which was calculated with a margin of error of 5% came to a sum of 322 students as the target population.

The research data were collected through the distribution of a self-administered questionnaire, which was completed by each participant and anthropometric and clinical measurements, which were performed by the researcher. The questionnaire was pre-tested, where 15 questionnaires were distributed to students of The University of the West Indies, St Augustine to obtain a feedback aimed at improving the study design. After the pre-test, adjustments were made to the structure of the questions and a total of 161 questionnaires were distributed to the participants. Out of 161 questionnaires distributed, 137 were collected, but only 133 were fully completed, which gave a response rate of 83%.

Food frequency questionnaire (FFQ) for the assessment of habitual dietary intake was used. Food consumption was estimated in 2 ways: as energy intake in kilocalories and amount of beverages consumed in ounces (0.035 oz = 1.0 g). The questionnaire comprised of twenty-six (26) questions the majority of which were in close-ended format. The questions were categorized into five (5) sections: Section 1 - demographics, Section 2 - behaviours/habits, Section 3 – access/availability of beverages, Section 4 - frequency of beverage consumption and Section 5 – 24-hour recall.

After the questionnaire was completed, anthropometric and clinical measurements, including body composition with the use of bioimpedance analyzer (BIA) were conducted.

The height of each participant was taken using a stadiometer. Body mass index (BMI) and percentage body fat were computed by BIA. Waist circumference (WC) was measured to the nearest 0.5 inch (1 cm) with a stretch resistant cloth tape measure. A standardization protocol was used; observing waist as the midpoint between the lowest rib and the top of the iliac crest [14]. This procedure was repeated for all participants. The 'adult' cut-offs for high WC circumference based on classifications were 35 inches (88 cm) for females and 44 inches (102 cm) for males.

Statistical analyses were conducted using IBM SPSS Statistics 19.0 (IBM Corporation, Chicago, IL, USA). Descriptive statistics such as ANOVA were used to calculate the frequencies, percentages and mean values of data collected. Chi-squared tests, independent t-tests and regression analysis were used to compare variables and to find associations between variables. The statistical significance for all tests was $p<0.05$.

RESULTS

Table 1 shows the frequency distribution of selected demographic characteristics of the respondents. As can be seen, participants were predominantly female (n=100; 73%); aged between 20-22 years (n=72; 52.6%) and Afro-Trinidadian (n=64; 46.7%).

A total of 133 students (97.1 %) said that they consumed SSBs and only 2.9% (n=4) said that they did not. 130 respondents (94.9%) declared that they drank water at least 'Once per Week while 6 (4.1%) said they 'Rarely or Never' drank water and only 1 student (0.7 %) did not respond to this question. Figure 1 below shows the prevalence of water and SSBs consumption among the participants of the study. As seen among the beverages, the prevalence is highest for 100% fruit Juice (n = 113; 84.3%) while energy drinks had the lowest prevalence (n = 20; 14.7%).

Table 1. Selected demographic characteristics and anthropometrics of the respondents

Variable	n	%
Gender		
Male	37	27
Female	100	73
Age Group		
17-19	23	16.8
20-22	72	52.6
23-25	23	16.8
>25	19	13.9
Ethnicity		
Afro-Trinidadian	64	46.7
Indo-Trinidadian	28	20.4
Mixed	45	32.8
Anthropometrics		
Body weight (pounds)	145 ± 35	
BMI	24.04 ± 4.5	
Mean body fat (%)	31.34 ± 9.8	
Mean muscle mass (%)	24.92 ± 6.5	

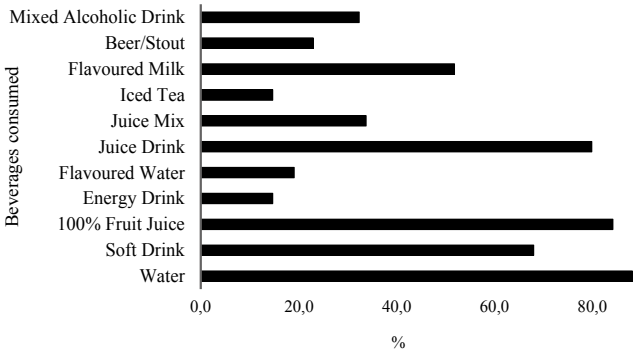

Figure 1. Prevalence of the consumption of different beverages

Independent statistical samples t-tests revealed that male students consumed more soft drinks than their female counterparts on any given occasion (p=0.025). There was no statistically significant difference in the ingestion of other beverages between males and females on any given occasion. Table 2 shows the p-values associated with comparisons of male-female frequency of consumption of different beverages. As seen, males consumed soft drinks, 100% fruit drinks, beer or stout and mixed alcoholic drinks more often than females.

Based on results generated from linear regressions, no associations between the potential risk factors and BMI were found as illustrated in Table 3.

As can be seen from Table 3 above, the consumption of SSBs was not associated with BMI. However, a trend towards statistical significance was observed between the frequency of the consumption of SSBs and BMI.

Table 2. Amount of beverages consumed stratified by gender

Variable	Gender	n	Mean	Standard Deviation	p-value
Water	Male	36	2.17	1.540	
	Female	100	2.49	2.149	0.409
Soft drink	Male	36	2.08	1.977	
	Female	98	1.34	1.566	**0.025**
100% Fruit juice	Male	36	1.94	1.492	
	Female	100	1.61	1.569	0.269
Energy drinks	Male	36	0.92	1.628	
	Female	100	0.76	1.799	0.647
Flavoured water	Male	36	0.97	1.630	
	Female	100	0.89	1.974	0.823
Juice drinks	Male	36	1.69	1.508	
	Female	100	1.58	1.996	0.755
Juice mix	Male	36	1.17	1.648	
	Female	100	1.16	2.009	0.986
Sweetened ice-tea	Male	36	0.89	1.635	
	Female	100	0.90	2.130	0.977
Flavoured milk	Male	36	1.39	1.554	
	Female	100	1.31	2.205	0.844
Beer/Stout	Male	36	1.42	1.826	
	Female	100	1.14	2.045	0.476
Mixed alcohol drinks	Male	36	1.92	2.130	
	Female	100	1.24	2.036	0.093

Table 3. Factors affecting BMI

Variable	Statistical significance
Age	0.108
Gender	0.612
Age Group	0.828
Ethnicity	0.565
Frequency of beverage consumption	0.087
Quantity of beverage consumption	0.780

DISCUSSION

The ingestion of 100% fruit juice was found to be the highest (n = 113; 84.3%) while energy drinks have the smallest prevalence (n = 20; 14.7%). The results of the present studies are partially in concordance with the data obtained by many investigators. A multitude of demographic factors have been examined in relationship to sugar-sweetened beverages (SSB) consumption patterns. Findings suggest multifactorial factors may relate to consumption patterns, particularly among younger adults. Overweight men aged 18-24 and individuals with less than a college degree have been found more likely to be frequent SSBs consumers [11].

Gender differences were observed in the consumption trends – significantly more number of male students consumed sodas and sports drinks than

female students – which conforms to findings from studies by *Park* et al. [9]. However, these data are not in full agreement with the results obtained by *O'leary* et al. [7], who found that males and females drank similar amounts of sugary drinks, with carbonated soft drinks and fruit-based drinks most popular. Females preferred sweetened milk- and fruit-based beverages. The measured drink records showed both genders drank most of their sugary beverages at home followed by social settings. The differences between males and females in types of sugary drinks chosen and the settings in which these are consumed have important implications for developing targeted and effective interventions. Caloric carbonated soft drinks continue to represent a significant proportion of sugary drink intake among males, while young females prefer sweetened milk-based drinks, 100% fruit juice and fruit-based drinks. Fruit-based drinks, particularly 100% fruit juice, offer some nutritional value, but they have the potential to contribute significantly to energy intakes and weight gain [12].

According to *Odegaard* et al. [8], participants with greater SSBs intake were more likely to be male and with increasing frequency of SSBs intake, they observed increases in waist circumference (WC) and the proportion of visceral to subcutaneous abdominal adipose tissue, with no change in total body fat or BMI, which is not in agreement with the results of the present study, where we demonstrated that the consumption of sweetened beverages was not associated with BMI. However, a trend towards statistical significance was observed between the frequency of the consumption of sweetened beverages and BMI. This is in concordance with the study by *Forshee* et al. [2], who on the basis of a quantitative meta-analysis and qualitative review found that the association between sweetened beverages consumption and BMI was near zero, based on the current body of scientific evidence. Certain studies have had similar findings in showing no association between SSBs and weight gain in children and adolescents [2, 3]. There could be several reasons for the lack of association between SSBs consumption and adiposity in this study. A recent review of systematic literature reviews reported that all reviews that showed a direct association between SSBs consumption and adiposity in children and adolescents involved longitudinal studies and only a few involved cross-sectional studies [5]. Although a majority of reviews showed a positive association between SSBs consumption and weight gain, the authors concluded that discrepancies in results in current literature could be due to methodological differences in study design, measures or analyses [5].

The overall effect of sweetened beverages on overweight and obesity depends primarily on 2 factors: the current distribution of consumption of these beverages and the magnitude of the effect their ingestion on BMI. It is worth mentioning that many studies, including those of a cross-sectional nature have been carried out in an attempt to find the association between SSBs consumption and obesity but still the association remains controversial.

CONCLUSIONS

No association between the intakes of sugar sweetened beverages (SSBs) and overweight and/or obesity was found among the participants, but a very high prevalence of the consumption of these beverages was observed in the subjects. Although this study does not find a significant association between SSBs intake and adiposity, possibly due to the limited range of SSBs taken into account and the study design, we should consider the totality of evidence about the harmful effects of SSBs in youth. This study's findings can provide useful considerations while developing and implementing programs or policies that target reducing SSBs consumption among adolescents. These findings about SSBs consumption trends across gender, ethnicities and physical activity groups can help guide targeted strategies to reduce SSBs consumption among high-risk populations. Ideally, a combination of measures including curbing availability, reducing targeted marketing, increasing SSBs cost, simultaneous reduction in costs of healthier alternatives, educative and informational measures through mass media, school-based policies and interventions targeted at adolescents and parents will together prove most effective in reducing SSBs consumption.

LIMITATIONS

For better detection of statistical significance, the sample size was determined to be 322 students, with 80% power and 5% significance level, which is considered to be a representative of all students, to whom results would have been generalized or transferred. In the time allowed, we could only obtain full data from 133 students, which made it difficult to find significant relationships.

Conflict of interest
The authors declare no conflict of interest.

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