Consumption Pattern of Sugar Sweetened Beverages and the Relationship with Anthropometric Indices and Fasting Blood Sugar of Undergraduates in the University of Nigeria, Nsukka

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ABSTRACT

Background:

Sugar sweetened beverages (SSB) are drinks with added sugars that are increasingly popular among young people. Consumption of SSB is associated with increased energy intake, weight gain, overweight and obesity, development of several non-communicable diseases and poor oral health. ***Objectives:*** *The study aimed to assess the consumption of SSB among university students and determine its relationship with body mass index (BMI), waist hip ratio (WHR) and fasting blood glucose (FBG).* ***Methods:*** *A cross-sectional institution-based survey was conducted among 400 undergraduates selected through multistage random sampling from sixteen departments in the University of Nigeria, Nsukka. Questionnaire, anthropometric and FBG measurements were data collection methods used. Data were analysed using Statistical Product and Service Solutions, version 20. Relationships among categorical variables were analysed through chi square. Significance was accepted at P< 0.05.* ***Results:*** *Most (97.0%) of the respondents consumed SSB. Carbonated drinks were the most commonly consumed (81.0%). Occasional (43.1%) and 4-6 times weekly (37.6%) consumption were observed; 39.7% consumed 350 ml at a time. SSB replaced meals for 39.0% and the meal often replaced was lunch (65.1%). Biscuit (61.8%), bread (57.3%) and buns (56.3%) were snacks consumed with SSB. Overweight (33.3%), obesity (6.1%), high risk WHR (8.5%) and impaired FBG (2.3%) were observed. BMI, WHR and FBG were not significantly (P>0.05) associated with SSB consumption. Conclusion: Consumption of SSB was high, however, no significant relationship was observed between BMI, WHR, FBG and consumption of SSB. This notwithstanding, excessive consumption should be discouraged through nutrition education on the consequences of long term consumption.*

Keywords: Sugar sweetened beverages, body mass index, waist hip ratio, fasting blood glucose, undergraduates.

Introduction

Overweight and obesity prevalence have tripled globally over the years [1]. Adeloye et al. [2] estimated that there were 21 million and 12 million overweight and obese persons in the Nigerian population aged 15 years or more in 2020, accounting for an age-adjusted prevalence of 20.3% and 11.6%, respectively. This is further worsened by nutrition transition especially among adolescents and young adults. Transition from traditional/indigenous nutrient dense complex carbohydrate foods to refined foods and drinks that contain added monosaccharides and disaccharides have been associated with excess energy intake, weight gain, obesity and several non- communicable diseases [3]. According to Malik and Hu [4], excess weight is the leading risk factor for type 2 diabetes mellitus and can also lead to a number of related chronic conditions, including

coronary heart disease, stroke and many cancers. Sugar-sweetened beverages (SSB) or sugary drinks is defined by WHO [5] as all types of beverages containing free sugars and these include carbonated or non-carbonated soft drinks, fruit/vegetable juices and drinks, liquid and powder concentrates, flavoured water, energy and sports drinks, ready-to-drink tea, ready-to-drink coffee, and flavoured milk drinks. Free sugars refer to monosaccharides (such as glucose, fructose) and disaccharides (such as sucrose or table sugar) added to foods and drinks by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates
[5]. WHO guidelines limited intake of added sugar or free sugar from all foods and beverages to not more than 10% of the total daily energy intake [4] in order to reduce the associated health hazards. This is equivalent to around 12 teaspoons of table sugar for adults. A further reduction to below 5% of daily energy intake (around 6 teaspoons of table sugar for adults) is recommended for additional health benefits [5].
High consumption of sugar-sweetened beverages among the adolescents and young adults in universities have been reported [7, 8, 9, 10]. Oroniran *et al.* reported that 88.9% of Nigerian students in a private university had consumed carbonated drinks [7] and Iduma *et al.* [8] showed that Coke and Fanta were the most commonly consumed. Strong evidence from cohort studies on clinical outcomes and clinical trials assessing cardiometabolic risk factors supports an aetiological role of SSB in relation to weight gain and cardiometabolic diseases [4]. Globally, it has been estimated that 184,000 deaths per year could be attributable to SSB consumption [11].
With reduced physical activities, there is high propensity of steady increase in weight especially around the waist. Few data exist on the relationship of SSB consumption with body mass index, waist hip ratio and fasting blood glucose of university students. Given the high caloric density of sugar sweetened beverages, this study was designed to investigate the association between consumption of sugar sweetened beverages and anthropometric indices as well as fasting blood glucose of the University of Nigeria, Nsukka undergraduate students.

MATERIALS AND METHOD

Area of study:

The study was carried out in the University of Nigeria, Nsukka campus. The University of Nigeria, commonly referred to as UNN is a federal university located in Nsukka, Enugu State, Nigeria.

Study design: The study adopted a cross-sectional survey design.

Sample size determination: A sample size of 400 adolescents was determined using Cochran's formula (Z2Pq/e2) at 95% confidence interval (Z is equivalent to 1.96 and q is 1-p.) and 0.5% error margin (e). P value was obesity prevalence of 21.0% [12]. The figure obtained from this calculation was multiplied by a design effect of 1.5 and an additional 5% was added to account for non-response.

Sampling technique: The study adopted a multistage random sampling technique in selecting the samples. In the first stage, four faculties out of 10 faculties in the University of Nigeria, Nsukka campus were selected using simple random sampling technique by balloting without replacement. The second stage involved the selection of four departments by simple random sampling technique using balloting without replacement from each of the selected four faculties giving a total of sixteen departments. Probability proportional to size (PPS) was used in the third stage to allocate a proportion of the sample size to each of the selected departments. In the fourth stage, simple random sampling by balloting without replacement was used to select the respondents from the sixteen departments irrespective of the level of study of the students.

Ethical approval and informed consent: This was obtained from Health Research Ethics Committee, University of Nigeria Teaching Hospital (UNTH) Ituku- Ozalla, Enugu State (NHREC/05/01/2008B-FWA0000245 8-1RB00002323). An inform consent was signed by each respondent after a detailed explanation of the study and its objectives.

Data collection methods

Questionnaire:

A validated questionnaire comprising socio-demographic information, knowledge of sugar sweetened beverages and consumption pattern of sugar sweetened beverages was self-administered with the researcher available to answer questions and clear areas that respondents did not understand. Responses to knowledge questions were scored and individual scores totalled and graded in percent as very good (70 and above), good (50 - 69), fair (40 - 49) and

poor (<40). Response rate was 100%.

Anthropometric measurements: Body weight, height and waist and hip circumferences were measured by trained research assistants using standard methods [13]. Weight was measured with Hanson's bathroom scale of 120 kg capacity with respondents in light clothing and without shoes. They stood on the scale in an upright position and weight was taken to the nearest 0.1 kg. Height was measured to the nearest 0.1 cm using a meter rule with the respondents standing without foot wears on a flat surface and looking straight forward. With the subject standing erect, abdominal muscles released, arms at the sides and feet together, waist and hip circumferences were measured to the nearest 0.1 cm using a flexible and inelastic measuring tape. Waist circumference was measured around the smallest area below the rib cage and at the level of the belly button round the waist. Hip measurement was measured around the wildest part of the hips. Body mass index (BMI) was calculated as weight in kg/height in meter squared and expressed as kg/m2. Waist hip ratio (WHR) was calculated as waist circumference/hip circumference. For adult respondents above 19 years, the BMI (kg/m2) result was classified as underweight (<18.5), normal (18.5-24.99), overweight (25.0-29.99) and obesity (≥30.0) [11]. For those aged 16-19 years, WHO [14] child growth standard was used to interpret their BMI-for-age as moderate underweight (-2 SD), severe underweight (-3SD); overweight (+2SD) and obesity (+3SD). WHR of ≥0.85 in females and ≥0.90 in males denote high risk [15].

Fasting blood glucose: This was measured after 8-10 hours' night fast using Accu-Chek active fasting blood glucometer. Results (mg/dl) were classified as normal (<100), pre-diabetes (100-125), diabetes (≥ 126) [16].

Statistical analysis: Data were entered into Microsoft excel and checked for consistencies and completeness. Statistical Product and Service Solutions (SPSS, version 20.0) was used to analyse the data. Analysed data were presented as frequencies and percentages. Chi-square was used to assess relationship among categorical variables. Significance was accepted at $P<0.05$.

RESULTS

The socio-demographic characteristics and knowledge of SSB among the respondents are shown in **Table 1**. Greater percentage of the students were aged 20 to 24 years (71.5%). Out of the 400 undergraduates sampled, majority were females (83.5%), single (98.5%) and in fourth year (32.8%). A little above half (50.8%) had an average monthly allowance of above N20,000. Although 57.3% lacked knowledge of the nutritional value of SSB, 93.3 and 65.0% were aware that consumption of SSB has been associated with high fasting blood glucose and weight increase, respectively. Most (65.3%) had very good SSB knowledge scores of 70% and above.

Table 2 illustrates the consumption pattern of SSB among the students. Majority (97.0%) of the students consumed SSB; carbonated drinks (81.0%) were consumed most often. Although occasional consumption was found among 44.8%, 36.5% consumed SSB 4-6 times a week. The students often consumed 350 ml (39.7%) and 750 ml (33.2%) at a time. Sugar sweetened beverages replaced meals for 39.2% and lunch (65.1%) was the meal most often replaced. Reasons for consuming SSB included consumption of snacks (63.0%) and a feeling of thirst (56.8%). Strength/pleasure (5.8%) was the least reason for SSB consumption. Price (63.0%) and taste (55.3%) of SSB were the commonest factors that influenced the choice and consumption of SSB.

Table 3 shows the anthropometric indices and fasting blood glucose status of the respondents. About 33.0% were overweight whereas 6.1% were obese. More males (40.9%) were overweight whereas more females (6.3%) were obese. More females (25.8%) than males (1.5%) had high risk WHR. Only 2.2% had pre-diabetes with higher prevalence of 2.4% among females.

Table 1: Sociodemographic characteristics and knowledge of SSB among the respondents

Variables	Frequenc y	Percenta ge
Age (years		
) 16 – 19	8 6	21 .5
20 – 24 25	28 6	71 .5
– 29 30 –	2 6	6 .5
35	2	0 .5
Total	400	100.0
Sex		
Female	334	83.5
Male	66	16.5
Total	400	100.0
Marital status		
Single	394	98.5
Marr ied	6	1.5
Total	400	100.0
Ye ar of study		
1st year	6 4	16.0
2nd year	8 4	21.0
3rd year	9 0	22.4
4th year	13 1	32.8
5thye ar	3 1	7.8
Total	400	100.0
Average m onthly allowance		
<N10,000	8 0	20.0
N10,000 -20,000	117	29.2
>N20,000	203	50.8
Total	400	100.0
Knowledge of nutritional value of SSB		
Yes	171	42.8
No	229	57.2
Total	400	100.0
***Knowledge of the consequences of SSB consumption**		
High fasting blood sugar	373	93.3
Weight inc rease	260	65.0
Knowledge scores		
Very good (70% and above)	26 1	65.3
Good (50 -6 9%)	8 5	21.2
Fair (40 -49%)	3 4	8.5
Poor (< 40%)	20	5.0
Total	400	100.0

*Multiple choice response

Table 2: Consumption pattern of SSB among the respondents

Variables	Frequency	Percentage
Consume SSB		
No	12	3.0
Yes	388	97.0
Total	400	100.0
Types of SSB often consumed (multiple response)		
Fruit juice	38	9.5
Carbonated drinks	324	81.0
Coffee and milk products	72	18.0
Consumption frequency		
< 4 times in a week	75	19.3
4-6 times in a week	146	37.6
Occasionally	167	43.1
Total	388	100.0
Quantity of SSB often consumed at a time		
350 ml	154	39.7
500 ml	81	20.9
600 ml	24	6.2
750 ml	129	33.2
Total	388	100.0
Replacement of meal		
No	236	60.8
Yes	152	39.2
Total	388	100.0
Meal often replaced		
Breakfast	19	12.5
Breakfast, supper	1	0.7
Breakfast, lunch	3	2.0
Breakfast, lunch, supper	6	3.9
Supper	19	12.5
Lunch	99	65.1
Lunch, supper	5	3.3
Total	152	100.0
Reasons for consuming SSB (multiple response)		
Feeling thirsty	227	56.8
Parties/celebrations	166	41.5
With snacks	252	63.0
Without any reason	133	33.3
Strength/pleasure	23	5.8
Snacks often consumed with SSB (multiple response)		
Biscuit	247	61.8
Bread	229	57.3
Buns	225	56.3
Cakes	19	4.8
Rolls (bread, fish)	29	7.3
Okpa	8	0.2
Factors influencing choice of SSB (multiple response)		
Price Popularity of the SSB Taste Ingredient in the beverages	252	63.0
	62	15.5
	221	55.3
	27	6.8

SSB, Sugar sweetened beverages *Steamed bambara groundnut budding

Table 3: Anthropometric indices and fasting blood glucose status of the respondents

Variables	Female N (%)	Male N (%)	Total N (%)
Body Mass index			
Underweight (<18.5 kg/m2/≤-2 SD)	6 (1.8)	0 (0.0)	6 (1.5)
Normal (18.5-24.99 kg/m2/-1 to +1 SD)	201 (60.2)	36 (54.6)	237 (59.2)
Overweight (25.0-29.99 kg/m2/+2 SD)	106 (31.7)	27 (40.9)	133 (33.2)
Obesity (≥30.0 kg/m2/>+2 SD)	21 (6.3)	3 (4.5)	24 (6.1)
Total	334 (100.0)	66 (100.0)	400 (100.0)
Waist hip ratio (WHR)			
*Low risk	248 (74.2)	65 (98.5)	313 (78.2)
**High risk	86 (25.8)	1 (1.5)	87 (21.8)
Total	334 (100.0)	66 (100.0)	400 (100.0)
Fasting blood glucose (mg/dl)			
Normal (<100)	326 (97.6)	65 (98.5)	391 (97.8)
impaired (100-125)	8 (2.4)	1 (1.5)	9 (2.2)
Total	334 (100.0)	66 (100.0)	400 (100.0)

*0.85 for females and <0.90 for males **≥0.85 for females and ≥0.90 for males

Table 4: Relationship of body mass index, waist hip ratio and fasting blood glucose of the respondents with consumption of sugar sweetened beverages

Variables	SSB consumption No N (%)	Yes N (%)	Total N (%)
Body mass index			
Underweight	0 (0.0)	6 (100.0)	6 (100.0)
Normal	7 (3.0)	230 (97.0)	237 (100.0)
Overweight	3 (2.3)	130 (97.7)	133 (100.0)
Obesity	2 (8.3)	22 (91.7)	24 (100.0)
	$\chi^2 = 3.605$, $df = 4$, P = 0.462		
Waist hip ratio (WHR)			
Low risk	10 (3.2)	303 (96.8)	313 (100.0)
High risk	2 (2.3)	85 (97.7)	87 (100.0)
	$\chi^2 = 0.267$, $df = 2$, P = 0.875		
Fasting blood glucose status			
Normal	12 (3.1)	379 (96.9)	391 (100.0)
Impaired	0 (0.0)	9 (100.0)	9 (100.0)
	$\chi^2 = 0.285$, $df = 1$, P = 0.594		

SSB=sugar sweetened beverages

The relationship of body mass index, waist hip ratio and fasting blood glucose of the respondents with consumption of sugar sweetened beverages is presented in **Table 4**. It was also observed that out of those who were overweight and obese, majority (97.7 and 91.7%) consumed SSB. Most (97.7%) of the respondents who had high risk WHR consumed SSB. All the respondents with impaired fasting blood glucose (100.0%) consumed SSB. These relationships did not attain significance (P>0.05).

Discussion

This study was carried out to determine the consumption of sugar sweetened beverages and its relationship with body mass index, waist hip ratio and fasting blood sugar levels of undergraduates of University of Nigeria, Nsukka. The study showed that majority of the respondents were females, which is similar to a study carried out by Madibia, Bhayat and Nkambule [17] on self-reported knowledge, attitude and consumption of sugar sweetened beverages among undergraduate oral health students at South Africa Dental University. They reported that more than half (72%) of their respondents were females.

Majority of the students in this study had high SSB knowledge scores. The very good knowledge scores observed in this study is slightly in contrast with the report of Teng *et al.* [18] on moderate knowledge (51.8%). However, it is in line with the finding of Mmbaya *et al.* [19] who indicated that students had knowledge of sugar sweetened beverages and they were fully aware that sugar sweetened beverages contain high calories. In affirmation, another study carried out by Madibia *et al.* [17] reported that more than half (72.0%) of their respondents had acceptable level of knowledge on the types of sugar sweetened beverages and possible health condition if consumed excessively. Majority of the students in this study were aware that consumption of SSB could lead to high fasting blood glucose and weight increase. It is expected that knowledge should influence practice but this is not so in this study. The implication is continued SSB consumption which may likely have some grave health consequences over time.

This study observed that majority of the students consumed sugar sweetened beverages which were mostly carbonated drinks and the frequency of consumption was mostly occasional and 4-6 times a week. This is similar to the study carried out by Miller *et al.* [20] which reported that more than half of their participants reported they consumed SSB at least occasionally. The quantity consumed at a time is high providing about 15% of total daily energy needs which is higher than the recommended value of less than 10%. WHO [5, 6] has advised that intake of SSB be kept below 10% of total daily energy needs and reduced to less than 5% which is equivalent to less than a single serving of at least 250 ml of commonly consumed sugary drinks per day for additional health benefits.

Consumption of sugar sweetened beverages was accompanied with consumption of snacks like biscuit, bread and buns in line with earlier report [21]. These are fatty foods which add to calorie intake and increase the propensity to overweight and obesity with possible impact on fasting blood glucose and insulin resistance. Sugar sweetened beverage consumption has been related to increased blood insulin concentration, impaired fasting blood glucose, glucose intolerance, insulin resistance and high risk of type 2 diabetes [22].

Overweight, obesity and high WHR prevalence observed in this study among university students is relatively high. Oroniran *et al.* [7] had similar findings on overweight and obesity. The relationship of SSB consumption with both BMI and WHR did not attain significant proportions. This is similar to earlier findings [7]. This does not exclude the possibility of associated consequences if the respondents continue excessive and prolonged SSB consumption. Fasting blood glucose status of most respondents in this study were normal with no significant ($P>0.05$) relationship with the consumption of sugar sweetened beverages. This does not rule out the danger of insulin resistance as the effect of SSB consumption is gradual and cumulative.

Limitation of the study: The design of the study was cross sectional and could not be relied upon to reveal cause effect relationships.

Conclusion: Majority of the students consumed SSB. There is high prevalence of overweight/obesity and high waist hip ratio. Impaired fasting blood glucose prevalence was low. There was no significant relationship between consumption of SSB and the anthropometric indices and fasting blood glucose. The need for nutrition education intervention among these group of adults cannot be over emphasized.

Conflict of interest: The authors declare no conflict of interest.

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