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The Implications of Carbonated Drinks on Weight Gain: A Purposive Approach on a Group of Civil Servants in Aba, Abia State, Nigeria

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Abstract
The implications of carbonated drinks on weight gain were carried out by purposively selecting a total of 35 (16 males and 19 females) volunteer human adults. Questionnaires were used to assess the dietary habit while standard biochemical methods were employed for the lipid profile. The results from the anthropometric measurements showed that the mean weights (kg), heights (m), and body mass indices (BMI) (kg/m^2) were 80.13 ± 13.41, 1.66 ± 0.18, and 26.98 ± 5.17 respectively for the males and 79.00 ± 16.14, 1.61 ± 0.12, and 26.89 ± 4.78 respectively for the females. The desirable BMI for both males and females are 18.5 to 24.9. Lipid profile result showed that the mean total cholesterol (TCH) was within desirable range of 188.13 ± 45.04 for the males and 196.42 ± 42.39 for the females and the mean high density lipoprotein cholesterol (HDL-C) was within low range of 44.87 ± 10.83 and 43.26±8.58 for the males and the females respectively. However, the mean low density lipoprotein cholesterol (LDL-C) was within the optimal range of 95.56 ± 38.86 and 114.37 ± 30.75 for males and females respectively. The mean triacylglycerols (TG) was within the borderline range of 173.63 ± 113.41 for the males and within normal range of 149.32 ± 100.28 for females. The total cholesterol/high density lipoprotein ratio (TCHDL ratio) showed that the mean values for males and females were 4.64 ± 1.13 and 4.56 ± 2.02 respectively. The desirable range of TCHDL ratio for both males and females are 3.5 to 6.0. Correlation analysis showed positive correlations between BMI and LDL-C, Waist to hip ratio (WHR) and TAG, Waist circumference (WaistCir) and TAG. The implications of these findings as it relates nutrition and health are discussed.
Keywords: Obesity, overweight, carbonated drinks, lipid profile, and anthropometry.

1. Introduction

Obesity is one of the major cardiovascular diseases are the second leading cause of preventable death in the United State, close behind the use of tobacco (national Institutes of Health, National Heart, Lung, and Blood Institute, 1998). An estimated 300,000 deaths per year are due to the obesity epidemic (U.S Department of Health and Human Services, 2001).

The prevalence of obesity in Nigeria has been reported to be between 8.9% - 22.2% (Ijezie*et al*. 2013).

World Health Organization however, reports that the prevalence of overweight and obesity in Nigeria are 26.8% and 6.5% respectively (WHO, 2011). Aba is a major industrialized city of Abia State, Nigeria. It is fast growing in terms of population, modernization, and industrialization. These growth indices could lead to CVD predisposition due to accompanied lifestyle changes. Callabero reports that the increase in the prevalence of obesity is associated with continuous modernization and technological advancement of the developing world (Callabero, 2001). This in turn has led to rapid lifestyle changes which include sedentary lifestyles (WHO, 2006), changing methods of transportation due to urbanization (Trembly*et al.* 2002), consumption of heavy calorie diets, use of tobacco, and alcohol intake (Callabero, 2001).

Civil servants in Aba especially those in administrative functions usually have lesser time for exercise due to the nature of their job could be more predisposed to patronizing carbonated drinks may be for quick energy replenishment or as a form of habit.

Anthropometry is employed for easier identification of any changes in lipid concentration in human body (Briel, 2009). The anthropometry factors that have been recommended for cardiovascular risk factors identification include the body mass index (BMI), and waist to hip ratio (WHR) (Rexrode*et al*, 2001). BMI values of anthropometric significance are BMI of <18.49 kg/m^2 for underweight, BMI of 18.5 – 24.99 kg/m^2 for normal weight, BMI of 25 – 29.99 kg/m^2 for overweight, BMI of 30 – 35 kg/m^2 for obese, and BMI of > 35 kg/m^2 for severely obese (Theonen*et al,* 2002).

This study is aimed at assessing the implications of drinking carbonated (35cl and above) drinks at least thrice a week and it was investigated by purposively selecting a total of 35 civil servants in 5 major parastatals of the city.

2. Justification

Obesity is a chronic metabolic disorder associated with cardiovascular disease and increased morbidity and mortality (Paul *et al* 2006). According to the National Institutes of Health, Obesity and Overweight are the second leading cause of preventable death in the United States, close behind the use of tobacco (National Institutes of Health, National Heart, Lung, and Blood Institutes, 1998). An estimated 300,000 deaths per year are due to the obesity epidemic (US Department of Health and Human Services Prevention Report, 2006). The prevalence of obesity in Nigeria has been has been reported to be between 8.1% - 22.2% (Ijezie*et al*, 2013).
Excessive intake of carbonated drinks can predispose an individual to overweight and obesity and civil servants in Aba especially those in administrative functions usually have lesser time for exercise due to the nature of their job and could be more predisposed to patronizing carbonated drinks may be as a means of quick energy replenishment or as a form of habit.

2.1 Objective and Scope of Work

The primary objective of this work is aimed at assessing the implications of drinking carbonated drinks at least thrice a week. However, the following will be taken into consideration:

- Assessment of lipid profile of the subjects
- Assessment of their nutritional/dietary intake.

3. Materials and Methods

A total of 35 volunteers (16 males and 19 females) were purposively selected from five parastatals of the city of Aba. Informed consents were obtained from the subjects and requirements for the study were fully explained to them. Inclusion criteria included civil servants that were asymptomatic, not taking chronic medications, and were willing to participate in the study and were grouped into middle and upper classes depending on their socio-economic status which was based on income per month (Ijezie *et al.*, 2013). There is no consensus on various socioeconomic classifications in Nigeria, because of the unstructured nature of the society (Ijezie *et al.*, 2013). Thus, there is paucity of data from Nigeria on the association between socioeconomic status and cardiovascular disease. However, monthly income which includes all possible sources of income available to the individual was used as a major independent determinant of socioeconomic status. Therefore, for the purpose of this study, respondents were categorized into two classes, according to their reported income. The classes are the middle and the upper classes. Middle income earners received between ₦18,500 and ₦199,999 per month while the upper income earners received above ₦200,000 per month. The anthropometry aspect of the data collection was taken in duplicates according to WHO standard protocol (WHO, 1995).. Questionnaires were issued to them and their nutritional status was assessed with anthropometry (weight (cm), height (metre), hip and waist circumference (cm)) in duplicates according to WHO protocol, 1995. Dietary intake was assessed with a 24 – hour dietary recall. Fasting blood samples were collected intravenously from volunteers and the biochemical assays for the lipid profile of the subjects were carried out using standard cholesterol kits purchased from RANDOX laboratory Ltd, United Kingdom. Serum cholesterols of interests were serum total cholesterol (TC), serum high density cholesterol (HDL-C), serum low density cholesterol (LDL-C), and serum triacylglycerol (TG).

Life-style assessment of the subjects was done using daily activity questionnaire which included leisure time physical activity (for example, dancing, swimming, gardening), transportation (e.g. driving, walking, cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily exercise. The number of times the individuals indulge in these activities in a week gives an idea of how sedentary or not an individual's lifestyle is, according to World Health Organization recommended levels of physical activity for adults aged 18 - 64 years (WHO, 2010).

Nutritional status was assessed with anthropometric measurements such as weight, height, hip and waist circumferences, BMI, and WHR (WHO, 1988). Weight was measured with Hanson H61 mechanical bathroom scale manufactured by Hanson, USA. Respondents were asked to remove their shoes and wrist watches and were made to stand on the scale and reading taken to the nearest 0.1kg. Height was measured with heightometer and respondents were made to stand erect with their shoes taken off and the measurement was done to the nearest 0.1 cm. Waist circumference was measured with a tape. The subjects stood with his or her weight evenly distributed on both feet which were about 25 – 30 cm apart. The measurement was taken midway between the upper hip bone and the uppermost border of the right iliac crest. The tape was placed around the abdomen at the level of this midway point and a reading taken when the tape was snug but does not compress the skin and underlying soft tissues. The circumference was measured to the nearest 0.1 cm. Three measurements were taken and the mean calculated. Hip circumference was measured when the subject stood erect with arms at the sides and feet together. Measurement is only taken when the maximum extension of the buttocks was seen and this can be seen by standing at the side of the subject. The tape was placed around the buttocks in a horizontal plane. The tape was sung against the skin but does not compress the soft tissues. The measurement was recorded to the nearest

0.1 cm with the subject wearing light dressing around the hip. Dietary intake was assessed with a 24-hour dietary recall, and food record. BMI was generated from the ratio of weight (kg) to height (m^2) of the subjects.
Waist to hip ratio (WHR) was also determined. All anthropometric measurements were determined using the methods described by World Health Organization (1995).

3.1 Classifications

Total cholesterol (TC) (mg/dl)
Desirable < 200
Borderline high 200 - 239
High ≥ 240
High density lipoprotein (HDL) (mg/dl)
Desirable ≥ 60
Normal 40 - 59
Low < 40
Low density lipoprotein (LDL) (mg/dl)
Optimal < 100
Near Optimal 100 - 129
Borderline high 130 - 159
High 160 - 189
Very high ≥ 190
Triacylglycerol (TG) (mg/dl)
Normal < 150
Borderline high 150 - 199
High 200 - 499
TC/HDL-C ratio (mg/dl)
Male
Normal range 4.0 - 6.0
At risk > 6.0
Female
Normal range 3.7 - 5.7
At risk > 5.7
Body mass index (BMI) (kg/m^2)
Underweight < 18.49
Normal weight 18.5 - 24.99
Overweight 25 - 29.99
Obese 30 - 35
Severely obese > 35
Waist to hip ratio (WHR)
Males
Safe < 0.95
At risk > 0.95
Females
Safe < 0.80
At risk > 0.80
Source: Ene-Obong, *et al*., (2001); NCEP (2001); WHO (2001); Theonen*et al.,* (2002); Birtcher and Ballantyne (2004).

3.2 Statistical Analysis

Data collected were analyzed using Statistical Package for Social Sciences (SPSS) version 16. Variables were assessed with descriptive statistics such as frequencies, percentages, and means. Student's T-test was used to determine differences between male and female adults. Pearson's correlation coefficient was employed in the determination of the association between numerical variables, whereas Chi square (χ_2) was employed for categorical variables. $P < 0.05$ was regarded as statistically significant.

4. Results

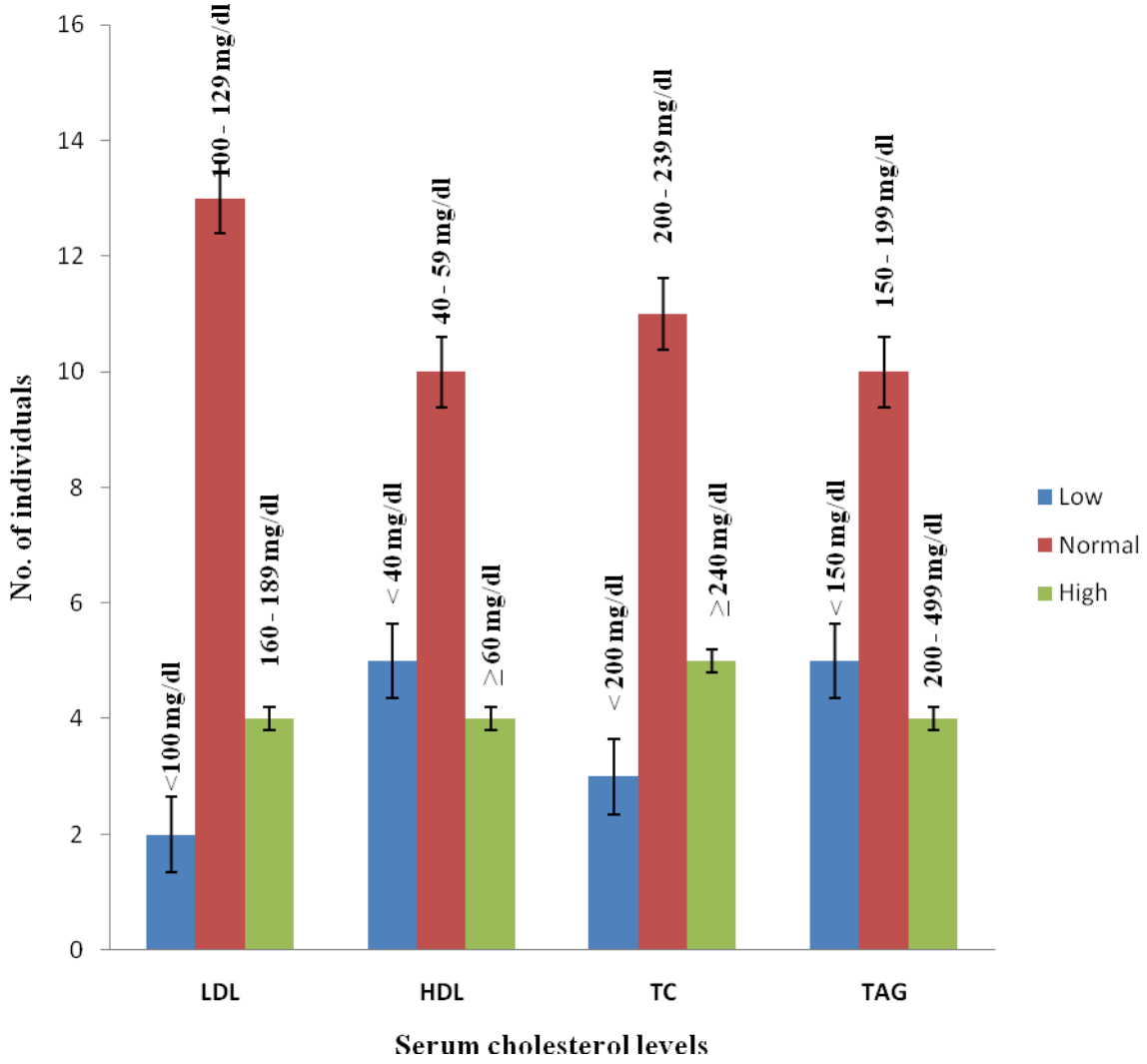

Fig. 1. Mean serum lipid profile for females
LDL = Low Density Lipoprotein
HDL = High Density Lipoprotein
TC = Total Cholesterol
TAG = Triacylglycerol

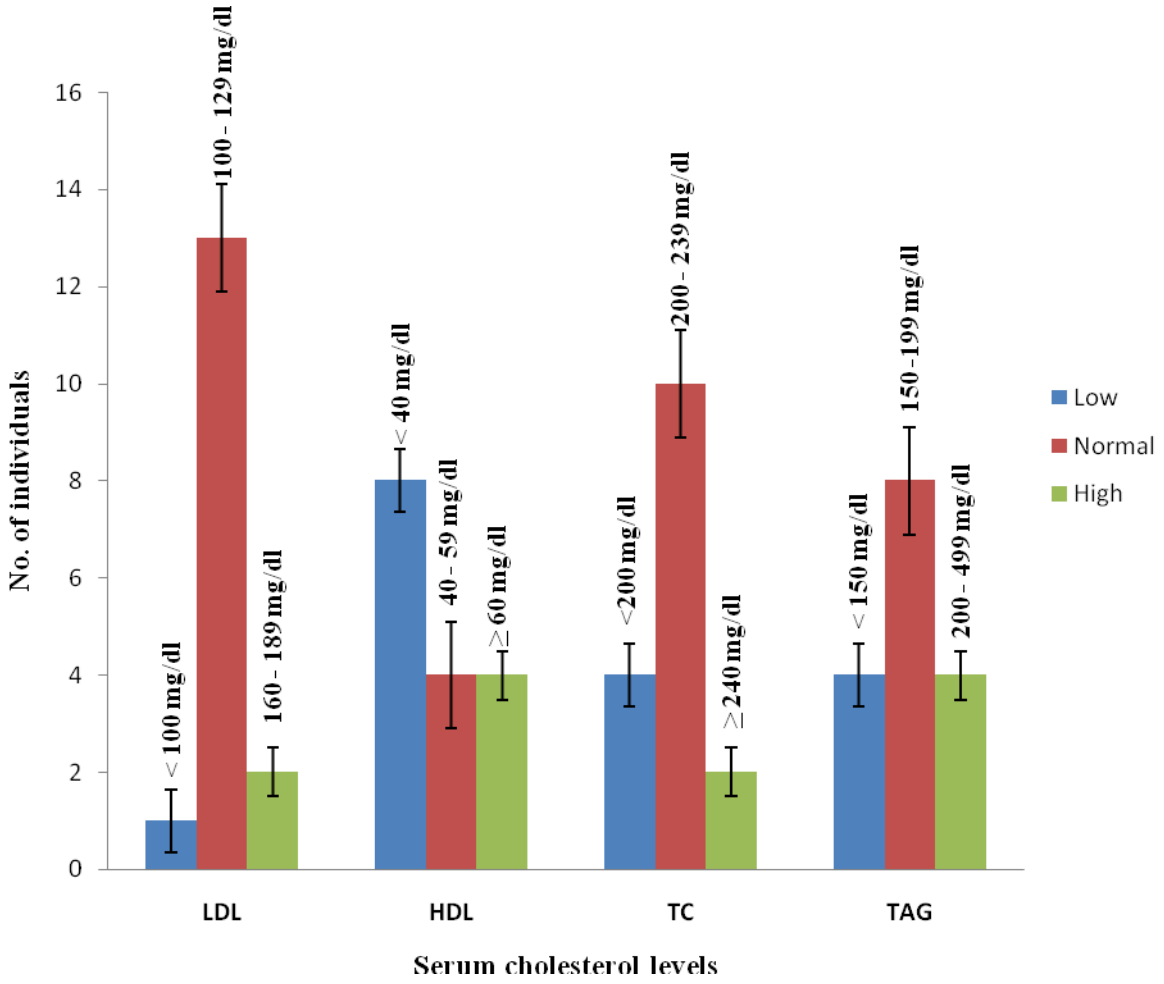

Fig. 2. Mean serum lipid profile for males

LDL = Low Density Lipoprotein
HDL = High Density Lipoprotein
TC = Total Cholesterol
TAG = Triacylglycerol

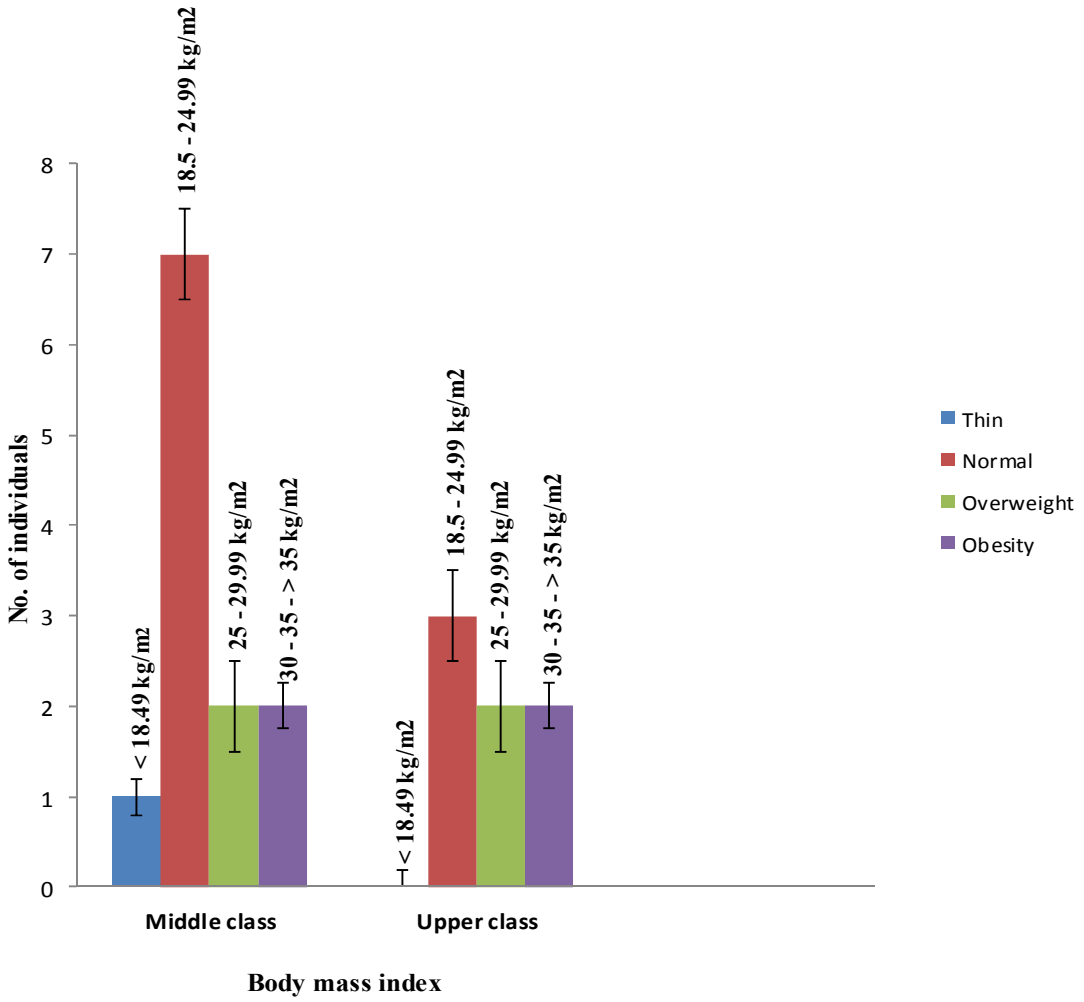

Fig 3. Mean body mass index of females

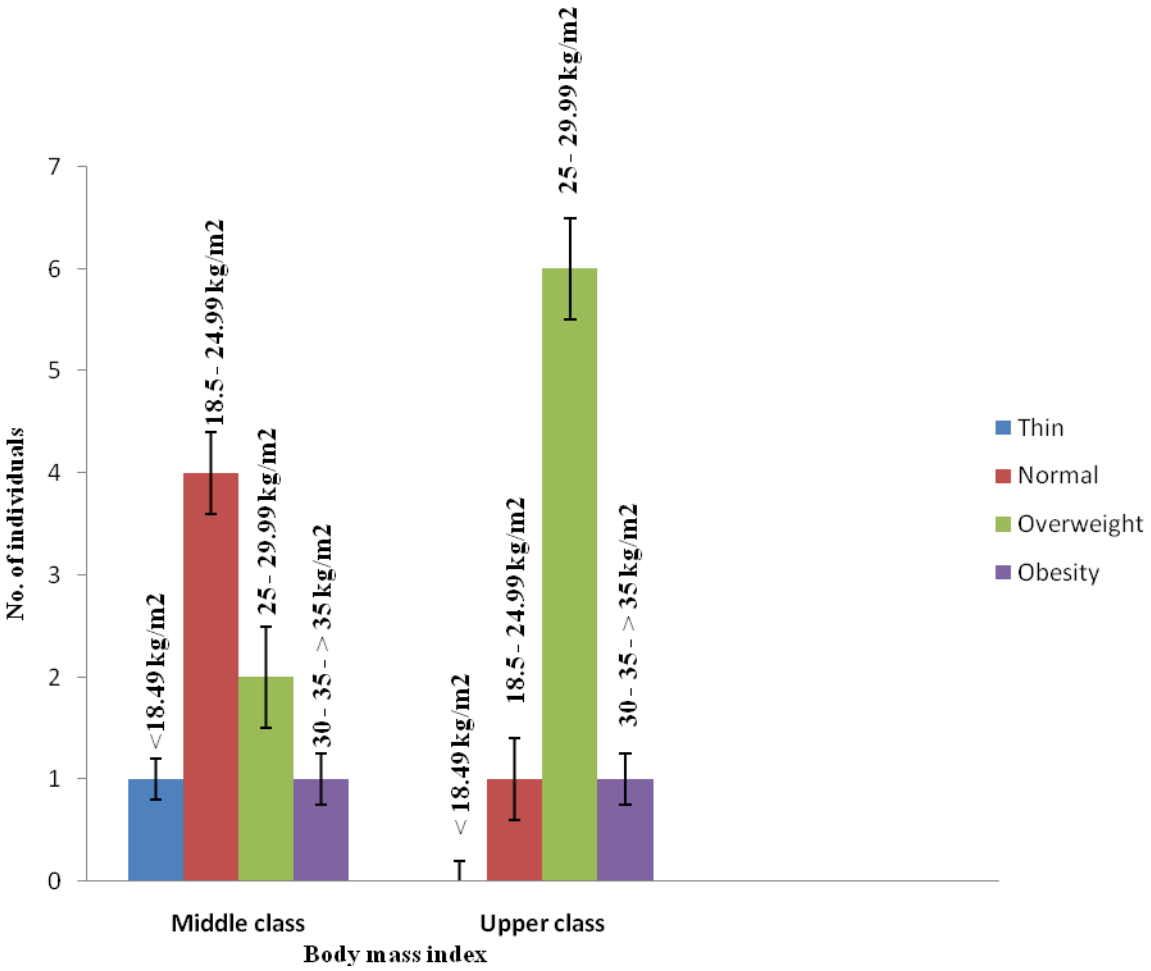

Fig. 4. Mean body mass index of males

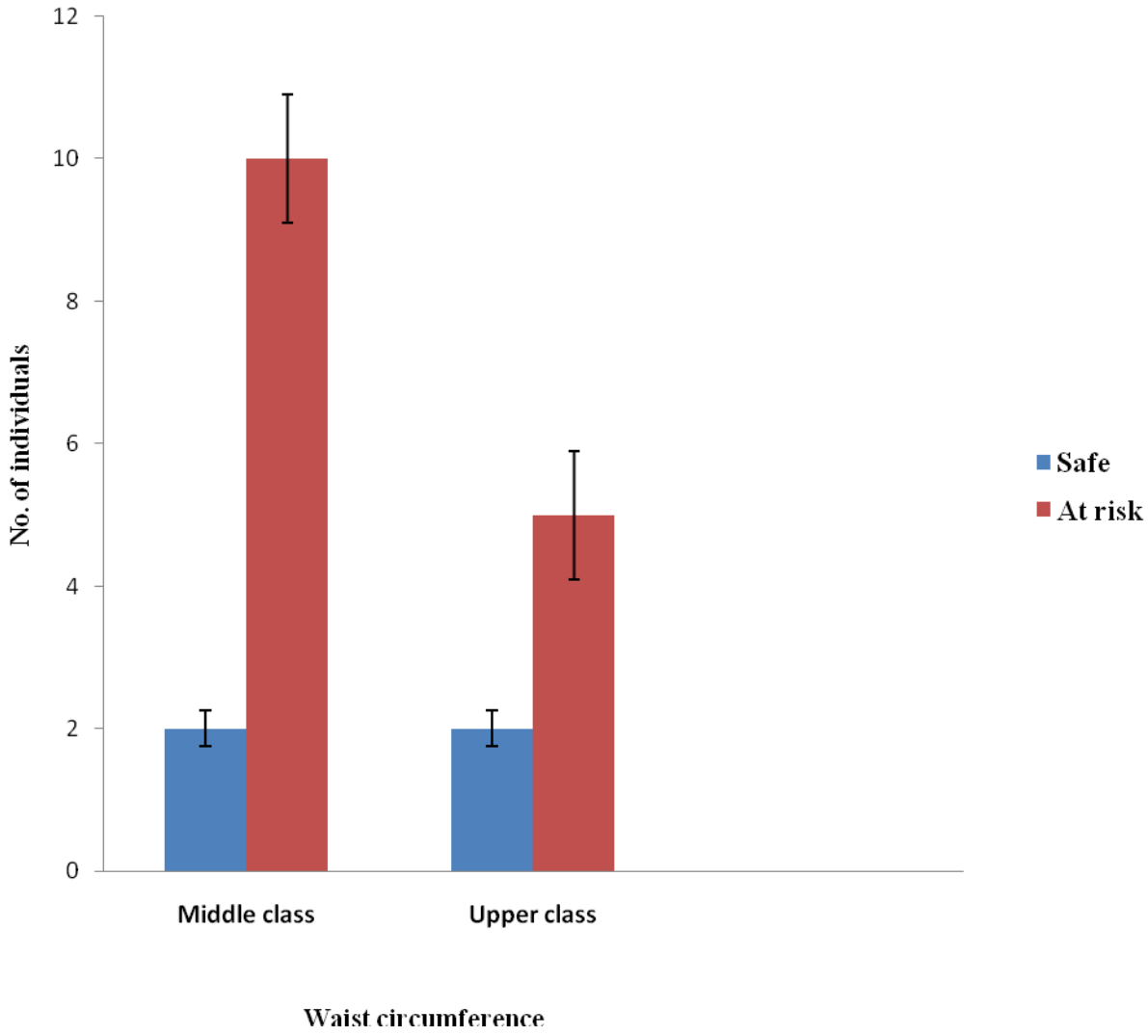

Fig. 5. Mean waist circumference of females

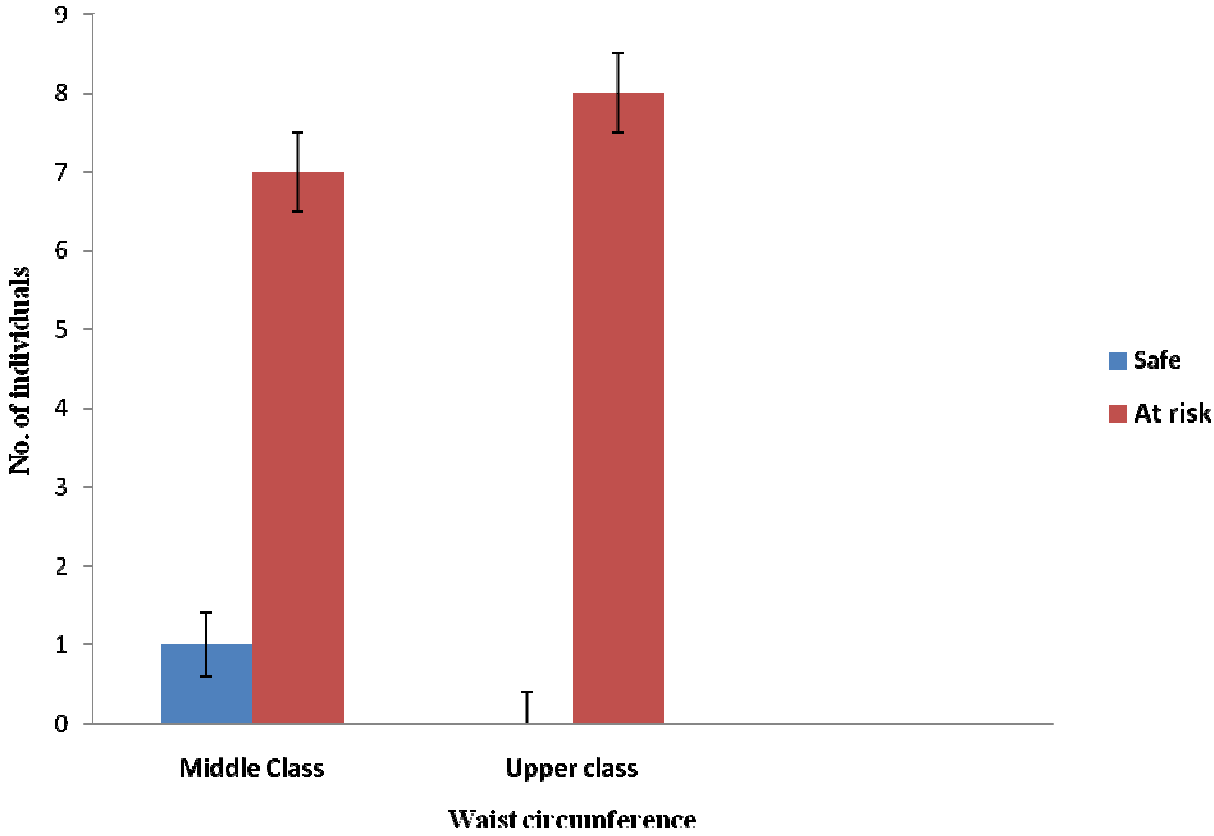

Fig. 6. Mean waist circumference of males

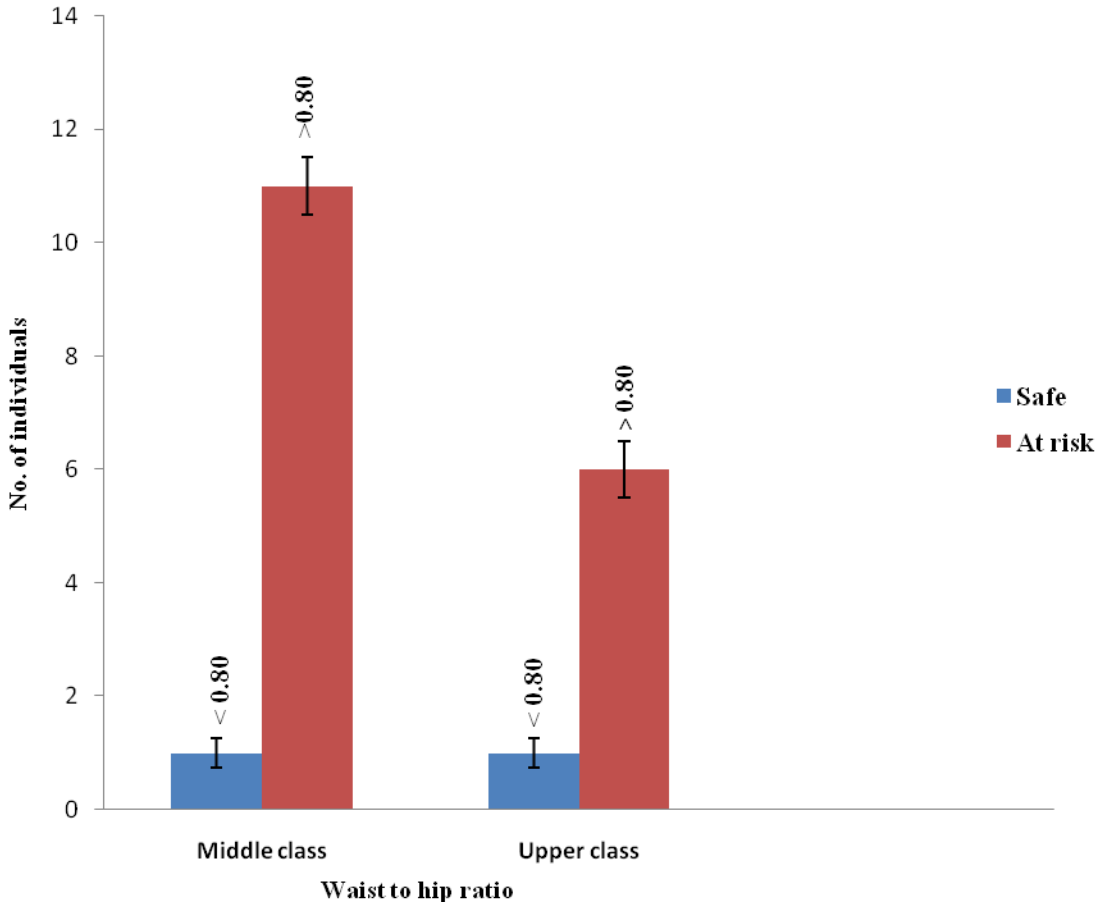

Fig. 7. Mean waist to hip ratio of females

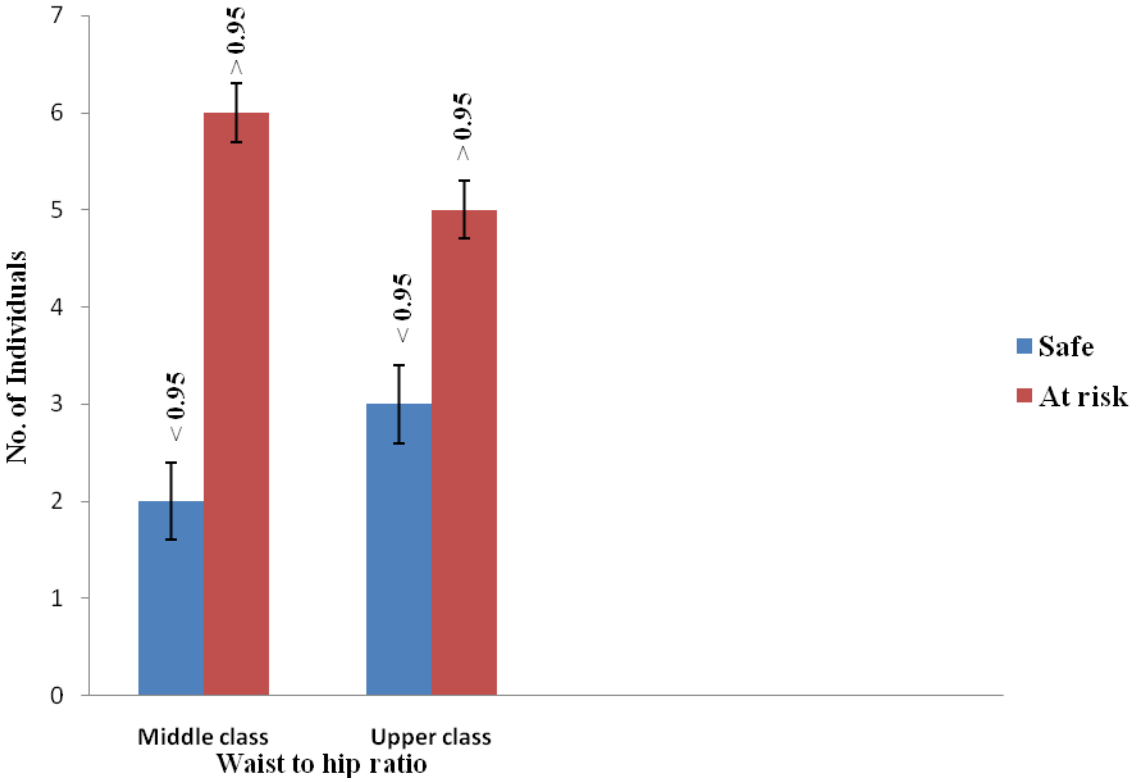

Fig. 8. Mean waist to hip ratio of males

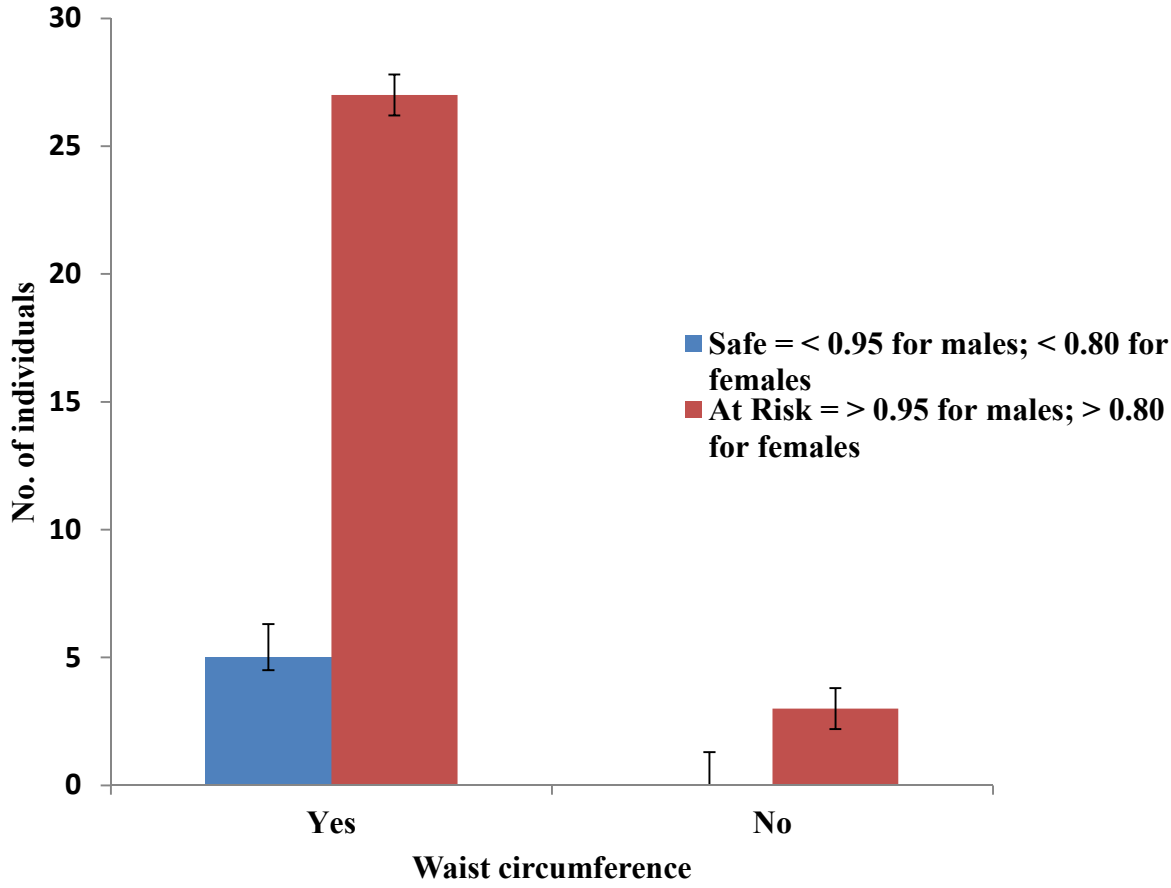

Fig. 9. Effect of taking carbonated drinks thrice/week on waist circumference

Yes = subjects who take carbonated drinks thrice a week
No = subjects who do not take carbonated drinks thrice a week

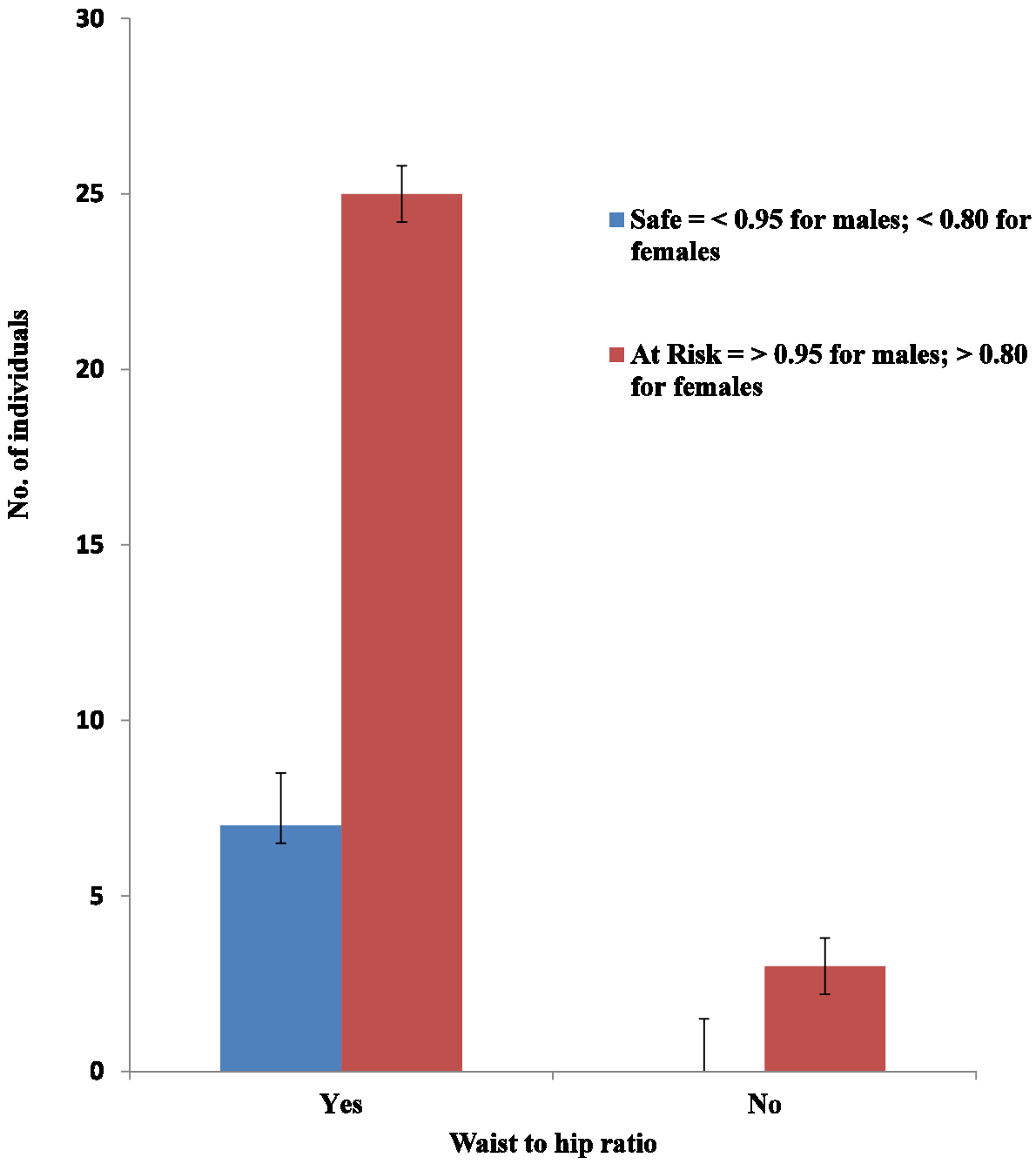

Fig. 10. Effect of taking carbonated drinks thrice/week on waist to hip ratio
Yes = subjects who take carbonated drinks thrice a week
No = subjects who do not take carbonated drinks thrice a week

Table 1. Socio-demographic characteristics of the adults

Parameters	Frequencies	Percentages
Sex		
Male	16	45.7
Female	19	54.3
Age group		
20-30	1	2.9
31-40	14	40.0
41-50	7	20.0
51-60	13	37.1
61-65	0	0
Income per month		
< N200, 000	15	42.9
> N200, 000	20	57.1

Table 2. Mean values of anthropometric measurements of the adults

Anthropometric measurements	Males	Females	Total	P-value
Weight	80.13 ± 13.41	79.00 ± 16.14	79.57 ± 14.78	0.369
Height	1.66 ± 0.18	1.61 ± 0.12	1.64 ± 0.15	0.161
BMI	26.98 ± 5.17	26.89 ± 4.78	26.98 ± 4.98	0.389
Waist circumference	78.89 ± 31.28	69.14 ± 34.18	74.02 ± 32.73	0.057
Hip circumference	83.23 ± 30.08	96.45 ± 34.83	89.84 ± 32.46	0.105
WHR	0.94 ± 0.09	1.02 ± 0.15	0.98 ± 0.12	0.002*

*Significant at $P < 0.05$

N = 35

Mean ± SD of 3

Table 3. Mean serum lipid profile of the male and female adults

Parameter	Males	Females	Total	P-value	*Normal range
TC (mg/dl)	183.13 ± 45.04	196.42 ± 42.39	189.5 ± 43.72	0.293	< 200
LDL-C (mg/dl)	95.56 ± 38.86	114.37 ± 30.75	104.97 ± 34.81	0.702	< 100
HDL-C (mg/dl)	44.87 ± 10.83	43.26 ± 8.58	44.07 ± 9.71	0.266	40 for males; 50 for females
TAG (mg/dl)	173.63 ± 113.41	149.32 ± 100.28	161.48 ± 106.85	0.367	< 150
TCHDL-C ratio	4.64 ± 1.13	4.56 ± 2.02	4.60 ± 1.58	0.212	4-6 for males; 3.7-5.7 for females

*NCEP (2001)

No = 35

Mean ± SD of 3

5. Discussion

Results obtained from this study revealed that an association exists between lipid profile, nutritional/dietary habit and lifestyle. From the statistical data obtained, serum total cholesterol (TC) was significant with serum TAG (r = 0.354; P = 0.037), serum LDL (r = 0.842; P = 0.00) and serum Total Cholesterol/HDL ratio (TC/HDL ratio) (r = 0.541; P = 0.001). However, the correlation coefficients of serum LDL and TCHDL ratio seem stronger than that of serum TAG. Figures 1 and 2 show that females had high serum LDL-C and TC than males but had the same high serum TAG level with the males. However, males had increased low serum HDL level than females. Therefore, females may seem more at risk of developing coronary heart disease (CHD) like dyslipidemia or atherosclerosis than males but males are also at risk of developing CHD like atherosclerosis since they have increased low serum HDL-C, however, sex was not statistically significant with lipid profile. HDL-C has been identified in many research findings as an anti-atherosclerosis factor hence; it is called the "good cholesterol". A research finding has shown that there is a relationship between LDL and HDL and that for a given level of LDL, the risk of heart disease increase 10-fold as the HDL varied from high to low and on the converse, however, for a fixed level of HDL, the risk increased 3-fold as LDL varied from low to high (Rubins, 2002, Rahilly, 2011). Females seemed to have serum lipid pro-atherogenic risk than males in this study.

The Pearson's correlation analysis obtained in this study showed that Body Mass Index (BMI) was statistically significant with weight (r = 0.812; P = 0.000) and also showed that waist per hip ratio (WHR) was statistically significant with waist circumference (WaistCir) (r = 0.446; P = 0.007) as shown in fig. 3and fig. 4. In this study, both males and females were predisposed to overweight and obesity. Waist circumference measures central obesity as well as waist to hip ratio (WHR) which gives a more accurate measurement of central obesity. Results show that the subjects had high mean body weight, BMI, and waist to hip ratio (WHR) and these are predisposing factors to cardiovascular diseases (NCEP, 1993). The mean weight and BMI obtained for females in this study were higher (79.00 kg and 26.89 kg/m^2 respectively) than (59.9 kg and 23.3 kg/m^2 respectively) those reported for a group of Nigerian women in Ile-Ife (Ojo *et al*., 2011). This could be as a result of differences in socioeconomic status as the subjects in this study were mainly civil servants from the middle and upper cadres,

while the former were civil servants from lower and middle cadres. The mean weight and BMI obtained in this study for males were 80.13 kg and 26.98 kg/m^2 respectively and were higher than 72.7 kg and 24.8 kg/m^2 respectively reported for Abuja men (Glew *et al*., 2002).

The staple foods in Aba are usually heavy calorie foods such as garri, fu-fu, rice, yam and beans which are usually prepared or eaten with large quantities of saturated oils like palm oil. In this study, carbonated drinks was statistically significant with weight ($r = 0.371$; $P = 0.028$) and weight was significant with BMI ($r = 0.812$; $P = 0.000$) and BMI was significant with LDL ($r = 0.439$; $P = 0.008$). From figures 9 and 10 above, subjects who accepted to have been taken carbonated drinks (soft drinks) at least thrice a week showed significant risk of central obesity and abdominal obesity respectively. Therefore, soft drink intake could predispose an individual to CVD risks. However, not much has been done on carbonated drinks as predisposing factors to overweight and obesity, rather, alcohol has been extensively studied and many reports have implicated excessive alcohol intake as a risk factor for coronary heart diseases and a leading cause of death in industrialized country (Centers for Disease Control and prevention, 2004).

Table 1 represents the socioeconomic characteristics of the adults. 54.3 % were females and 40 % of the subjects were within the age group of 31 - 40 years while majority (65.7 %) of the subjects earned income greater than N200, 000.00 per month.

Table 2 represents the mean anthropometric values of the subjects. The mean weight, height and BMI of the males were 80.13 ± 13.41, 1.66 ± 0.18 and 26.98 ± 5.17 respectively while that of females were 79.00 ± 16.14, 1.61 ± 0.12 and 26.89 ± 4.78 respectively. However, males had greater mean waist circumference, 78.89 ± 31.28 than females, 69.14 ± 34.18 whereas females had greater mean hip circumference, 96.45 ± 34.83 than males, 83.23 ± 0.08. There was no significant difference ($P > 0.05$) in all the anthropometric parameters between both sexes except for WHR where the females had significantly higher value than the males ($P < 0.05$).

Table 3 shows the mean serum lipid profile of the male and female adults. The mean TC, HDL-C, and Triacylglycerol (TAG) were within the reference range. The females however, had mean LDL-C values of 114.37 ± 30.75 which is slightly above the reference range. Studies have shown that high LDL is strongly associated with a higher risk of cardiovascular diseases, while HDL-C is more protective. The values obtained for LDL-C was similar to that obtained among a group of adults in Delta state (113.8 mg/dl) (Ighosotu and Tonukari, 2010). The TC/HDL-C ratio revealed that the mean value for males and females were 4.64 ± 1.13 and 4.56 ± 2.02 respectively. In both cases, they were within the normal range. All lipid fractions were statistically similar in males and females ($P > 0.05$). TCHDL ratio is a useful guideline for advising individuals about their risk of cardiovascular diseases (Kocaoghe *et al*., 2005). The males and females had mean values of 4.8 and 4.5 respectively. This indicates that both sexes may only be at slight risk of cardiovascular diseases. The mean values correspond to results of Ighosotu and Tonukari (2010) which reported TCHDL-C ratio of 4.33 among a group of Delta state subjects.

6. Conclusion

Though excessive intake of carbonated drinks have not been extensively studied as one of the major risk factors of cardiovascular diseases (CVDs) such as obesity as it has been studied of excessive alcohol intake, this stud however, has revealed that taking carbonated drinks at least thrice a week for a minimum of 35cl of carbonated drink could predispose an individual to overweight and obesity. Many research findings however, implicated carbonated drinks as exercabating factors of diabetes rather than predisposing factors of obesity. However, the values of the lipid profile of the individuals in this study could be as a result of the type of foods they ate which are usually heavy calorie foods. Nevertheless, carbonated drinks should not be taken too often or in excess to avoid obesity as well as diabetes.

It seemed that the study population had favorable lipid profile with the exception of LDL-C. However, there is the likelihood that the favorable lipid profile may not be sustained for long due to lifestyle and nutritional/dietary habit. Furthermore, the relationship between diet and disease must be reviewed in the light of the complexities that underlie the data and for this reason; data obtained in this work do not conclusively prove a cause-and-effect relationship but provides a reasonable basis for further research.

7. Recommendation

This research was done through purposive selection of the subjects in other to qualitatively, critically, and carefully carryout the research hence, the small number of subjects involved. However, a larger number of subjects will be needed if results are to represent the entire population of all civil servants in Aba, Abia State, Nigeria.

The same caution taken to avoid excessive alcohol intake should as well be extended to carbonated drinks so as to avoid obesity as well as diabetes conditions which can be exacerbated by carbonated drinks.

Sensitization programs are necessary so as to acquint people on the dangers of living sedentary lifestyle and unhealthy dietary habits.

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