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Research Article

PREVALENCE OF OVERWEIGHT AND OBESITY AND ASSESSMENT OF LIPID PROFILE AND FASTING BLOOD GLUCOSE LEVELS AMONG FEMALE PREMEDICAL STUDENTS AT NNAMDI AZIKIWE UNIVERSITY, NNEWI CAMPUS, NIGERIA

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ABSTRACT

Objective: Obesity is a major public health issue and a significant risk factor for metabolic disorders. This prospective study was aimed at evaluating the prevalence of obesity, lipid profiles, and fasting blood glucose (FBG) among female premedical students of NAU, Nnewi Campus, Nigeria.

Methods: A total of 320 female premedical students aged 18–35 years were recruited. The participants were classified using Body mass index(BMI) as underweight (35), overweight (104), obese (26), and control (155). FBG and lipids were estimated using enzymatic methods. Obesity was assessed using BMI and waist circumference. Blood pressure (BP) was measured using accoson sphygmomanometer.

Results: The study observed 10.9% underweight, 32.5% overweight, and 8.1% obesity. Underweight was higher among participants aged 18–23 years (48.6%), while overweight and obesity were more among participants aged 24–29 years (57.7% and 53.8%). Central obesity was observed in 28.8% of participants. BPs were higher in obese and overweight participants than in other groups. FBG was higher in obese and overweight participants than in other groups. The mean total cholesterol (TC) and low-density lipoprotein cholesterol (LDLC) were significantly higher in obese and overweight participants, while high-density lipoprotein cholesterol (HDLC) was significantly lower when compared to their corresponding values in underweight and control participants ($p<0.05$).

Conclusions: The study showed high prevalence of underweight, overweight, and obesity among the study population. The significantly higher levels of TC, LDLC, FBG, and elevated BP with significantly lower HDLC in overweight and obese participants compared to control suggests a possible risk of dyslipidemia, diabetes mellitus, and hypertension. The significant correlation between the lipid parameters, FBG, and anthropometric indices suggests high-risk cardiovascular disorders.

Keywords: Obesity, Overweight, Lipid indices, Fasting blood glucose, Female, Premedical students.

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INTRODUCTION

Obesity is a major non-communicable disease which has become a public health issue and future menace in developing countries, Nigeria inclusive. Young adult students of tertiary institutions are not left out. People are generally considered obese when their body mass index (BMI) is over 30 kg/m^2, with the range 25–30 kg/m^2 defined as overweight. This is determined by dividing a person's weight by the square of the person's height (kg/m^2) [1]. It has been estimated that more than 1 billion adults are overweight globally with more women being commonly obese than men [1]. About 300 million of them are clinically obese. This contributes enormously to the global burden of chronic disease and disability. Obesity is a very complex condition and mostly occurs together with undernutrition with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups in developing countries [2]. Excessive consumption of more energy dense and poor nutritional foods with high levels of sugar and saturated fats and reduced physical activity including genetic disorders has led to obesity [1,3]. Other minor causes of obesity are genes, medications, endocrine abnormality, and mental problem [4]. Previous study has classified obesity as a disease [5]. Obesity epidemic is not restricted to industrialized countries only but greatly multiplies faster in developing countries than in the developed world [2].

However, obesity and overweight are associated with major risk for chronic diseases, including type 2 diabetes mellitus and lipid peroxidation, hypertension, and atherosclerosis. The health implications of these include increased risk of morbidity and mortality such as premature death [2,6,7]. In developed countries, the incidence of obesity was reported to correspond to the widespread of diabetes [8]. The frequency of abnormality of lipids, lipoproteins, and apolipoproteins varies in different populations. Lipoprotein abnormalities often precede the onset of diabetes mellitus by many years and persist despite achievement of euglycemia, possibly as a result of increased rates of obesity [8,9]. Lipoprotein abnormalities are common in diabetes and contribute significantly to its complications. The most typical lipoprotein pattern in diabetes, also known as diabetic dyslipidemia or atherogenic dyslipidemia, consists of moderate elevation in triglyceride (TG) levels, low high-density lipoprotein cholesterol (HDLC) values, and small dense low-density lipoprotein (LDL) particles [9]. The present study, therefore, seeks to evaluate the prevalence of obesity and assess the lipid profile and fasting blood glucose (FBG) among the undergraduate female premedical students of Nnamdi Azikiwe University, Nnewi Campus, Nigeria.

METHODS

Study design

This was a cross-sectional study designed to evaluate the prevalence of obesity and assess the FBG level and fasting lipid profile among female undergraduate pre-medical students of the College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, Nnewi, Nigeria. The demographic data and medical history were clinically obtained using pre-administered questionnaire. Blood glucose levels and lipid profile were obtained after overnight fasting (12–14 h).

Study population

A total of 320 undergraduate students aged between 18 and 35 years were recruited for this study using simple random sampling technique. They were categorized using their BMI as underweight (35), overweight (104), and obese (26) participants. The remaining 155 participants were normal (control) participants.

Data collection

A well-structured questionnaire was administered to all the participants to ascertain their medical history. The height and weight of the subjects were measured. Height was measured to the nearest 0.1 cm using a tape rule, and weight measured to the nearest 0.1 kg using calibrated platform scales. The body mass index (BMI) was calculated by the formula of weight (kg)/height (m^2).Obesity was assessed using body mass index (BMI) and waist circumference (WC). Based on BMI, the participants were categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9kg/m^2), and obese (>30.0 kg^2) [10]. WC was measured midway between iliac crest and coastal margin. WC cutoff value of >80 cm is regarded as risk factor for obesity in females. Three separate blood pressure (BP) readings were obtained per subject from the non-dominant arm using accoson sphygmomanometer with appropriate cuff size in sitting position at 2 min interval after an initial rest of 5–10 min with arm supported at heart level. The average of the past two readings was recorded for both systolic blood pressure and diastolic blood pressures (SBP and DBP) of each student. The cutoff value for hypertension was taken as SBP reading ≥130 mmHg and/or DBP of ≥85 mmHg.

Collection of sample

Random sampling technique was used during sample collection. Of 7 ml of venous blood collected, 5 ml was dispensed into plain specimen container and allowed to retract, centrifuged and separated for the determination of fasting lipid profile, while remaining 2 ml was dispensed into fluoride oxalate specimen container for FBG level estimation.

Exclusion and inclusion criteria

Students within the age range of 18–35 years were included in the study. Students who were pregnant, smokers, non-students, students above the age 35, known diabetics, and students with any known form of cardiovascular condition were excluded from the study.

Ethics approval and consent to participate

All authors hereby declare that all experiment and procedure have been examined and approved by the appropriate board of the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital Nnewi, South East Nigeria, and research have therefore been performed in accordance with the standards laid down in the 1964 Declaration of Helsinki.

Laboratory methods of sample analysis

Fasting lipid profile test (total cholesterol [TC], TG, HDLC, and LDL cholesterol [LDLC])

TC was determined as described by Trinder [11], while TGs was determined using the method by Tietz [12]. The estimation of HDL was performed using the method as described by Groove [13] and Burstein *et al.* [14]. This is principally a combination of phosphotungstate precipitation and enzymatic method, while the method of Assman *et al.* [15] was adopted for LDL. This is a combination of polyvinyl sulfate precipitation and enzymatic method.

FBG estimation

Glucose oxidase method was used to measure FBG spectrophotometrically as described by Julio and Montola [16].

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences version 20. The test of significant difference between the two groups was calculated using the student's t-test with $p<0.05$. Pearson's correlation coefficient was used to determine the relationship between the lipid profile, FBG, and anthropometric indices.

RESULTS

Demographic characteristics of study population

The results showed that of 320 female premedical students recruited for the study, 35 (10.9%) were underweight, 104 (32.5%) were overweight, 26 (8.1%) were obese, while 155 (48.4%) were normal participants. The prevalent rate of underweight was higher among participants aged 18–23 years (17, 48.6%). Overweight and obesity were more among the age range of 24–29 years of 60 (57.7%) and 14 (53.8%) participants, respectively. The WC of overweight and obese participants who were at risk of central obesity was 30 (28.8%) and 8 (30.8%), respectively. They had elevated WC of over 80 cm. 35 (33.7%) overweight and 9 (34.6%) obese participants had higher SBP, while 30 (28.8%) overweight and 10 (38.5%) obese participants had higher DBP. 10 (28.6%) underweight participants had lower FBG, while 32 (30.8%) overweight and 4 (15.4%) obese participants had higher FBG levels (Table 1).

Comparison (BMI [kg/m^2], WC [cm], SBP [mmHg], DBP [mmHg], and age) in underweight, overweight, obese, and non-obese (control) female students

The mean BMI in underweight (18.01±0.34) and overweight (26.81±0.87) female students was significantly lower compared to obese subjects (35.69±1.94) ($p<0.05$). BMI was significantly higher in overweight (26.81±0.87 and obese (35.69±1.94) females compared with their corresponding control (22.34±1.71) ($p<0.05$). Similar observation was made between underweight (18.01±0.34) and control (22.34±1.71) female students. The mean WC was significantly higher in overweight (82.34±7.68) and obese (87.08±8.91) compared with underweight (72.01±0.23) and control (72.01±0.23) counterparts ($p<0.05$ respectively). Similarly, WC was significantly higher in obese (87.08±8.91) compared with the overweight (82.34±7.68) female students ($p<0.05$). The value of SBP in overweight (132.22±11.20) and obese (136.48±14.12) female students was significantly higher compared with the value in control females (115.56±8.56) ($p<0.05$, respectively), while the value of DBP in overweight (83.76±8.45) and obese female students (87.89±11.45) was significantly higher when compared with the value in control (66.83±7.60) counterparts ($p<0.05$). However, there was no significant difference in the mean age difference of underweight (25.10±4.87), overweight (24.88±6.2), and obese (25.10±5.34) female premedical students when compared with control counterparts (24.94±3.35) ($p>0.05$, respectively) (Table 2).

Lipid profile (mmol/l) and FBG (mmol/l) levels in underweight, overweight, obese, and control female students

The mean TC level in overweight (5.28±0.86) and obese (5.86±0.92) was significantly higher compared with control (4.41±0.84) female students ($p<0.05$, respectively). No significant difference was observed in the value of TC between underweight (4.05±0.25) and control (4.41±0.84) female students ($p<0.05$).

However, the mean HDLC in overweight (1.07±0.29) and obese (0.89±0.17) female students was significantly lower compared with underweight (1.46±0.43) and control (1.44±0.56) counterparts ($p<0.05$ respectively). No significant difference was observed in HDL level

Table 1: Demographic characteristics of the study population

BMI parameters	Underweight (<18.5) F % n=35, 10.9	Overweight (25–29.9) F % n=104, 32.5	Obese (>30) F % n=26, 8.1	Normotensive (18.5–24.9) F % n=155, 48.4
Age				
18–23	17 (48.6)	25 (24.2)	8 (19.2)	79 (50.9)
24–29	12 (34.3)	60 (57.7)	14 (58.8)	40 (25.8)
30–34	6 (17.1)	19 (18.3)	7 (26.9)	36 (23.2)
WC				
Normal	35 (100)	74 (71.2)	18 (69.2)	135 (87.1)
At risk	0 (0)	30 (28.8)	8 (30.8)	20 (12.9)
SBP				
Normal	33 (94.3)	55 (52.9)	16 (61.5)	146 (94.2)
Low	1 (2.8)	14 (13.5)	1 (3.8)	1 (0.6)
High	1 (2.8)	35 (33.7)	9 (34.6)	8 (5.2)
DBP				
Normal	35 (100)	62 (59.6)	14 (53.8)	151 (97.4)
Low	0 (0)	12 (11.5)	2 (7.7)	1 (0.06)
High	0 (0)	30 (28.8)	10 (38.5)	3 (1.9)
FBG				
Normal	25 (71.4)	70 (67.3)	22 (84.6)	140 (90.3)
Low	10 (28.6)	2 (1.9)	0 (0)	13 (8.4)
High	0 (0)	32 (30.8)	4 (15.4)	2 (1.3)

BMI: Basal metabolic index, F: Frequency, %: Percentage, n: Number. FBG: Fasting blood glucose, WC: Waist circumference, SBP: Systolic blood pressure, DBP: Diastolic blood pressures

Table 2: Comparison of mean (±SD) BMI (kg/m^2), WC (cm), SBP, DBP, and age in underweight, overweight, obese, and normotensive (control) female premedical students

Groups	BMI	WC	SBP	DBP	Age
Underweight (A)(n=30)	18.01±0.S34	72.01±0.23	101.28±9.94	68.24±6.76	25.01±4.87
Overweight (B) (n=104)	26.81±0.87	82.34±7.68	132.12±11.20	83.76±8.45	24.88±6.20
Obese (C) (n=31)	35.69±1.94	87.08±8.91	136.48±14.12	87.89±11.45	25.10±5.34
Normotensive (D) (n=155)	22.34±1.71	76.59±2.74	115.56±8.56	66.83±7.60	24.94±3.35
F-value	4.194	−4.620	36.194	32.839	0.062
p-value	0.000	0.000	0.000	0.013	0.912
A vs. B	0.000	0.001	0.093	0.006	0.741
A vs. C	0.000	0.000	0.000	0.000	0.893
A vs. D	0.030	0.020	0.372	0.472	0.528
B vs. C	0.000	0.041	0.062	0.157	0.448
B vs. D	0.042	0.003	0.000	0.000	0.895
C vs. D	0.000	0.000	0.000	0.001	0.375

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, BMI: Basal metabolic index, SD: Standard deviation

between underweight (1.46±0.43) and control (1.44±0.56) females (p>0.05) and between overweight (1.07±0.29) and obese (0.89±0.17) counterparts (p>0.05).

LDLC level in overweight (3.46±0.58) and obese (4.26±0.84) female students was significantly higher compared with their corresponding values in underweight (3.01±0.31) and control (3.18±0.49) females (p<0.05, respectively). No significant difference existed between underweight (3.01±0.31) and control (3.18±0.49) females (p>0.05). Contrastingly, the mean LDLC level was significantly lower in overweight (3.46±0.58) compared obese (4.26±0.84) female students (p<0.05).

The mean TG level in underweight (1.11±0.45), overweight (1.21±0.64), and obese (1.25±0.84) female students was not significantly different from control (1.19±0.39) counterparts (p>0.05, respectively).

The mean FBG level in overweight (5.01±0.29) and obese (5.12±0.38) was significantly higher compared with the values in underweight (4.72±0.36) and control (4.83±0.32) female students (p<0.05). On the other hand, no significant difference was existed between underweight (4.72±0.36) and control (4.83±0.32) female students (p>0.05) (Table 3).

Pearson correlation of lipid profile (mmol/l), FBG (mmol/l), and anthropometric parameters in overweight and obese participants

Significant positive correlation was observed between TC and age, FBG; TG and age, FBG, WC; LDL and FBS; HDL and age while significant negative correlation existed between TC and BMI, SBP, DBP; TG and BMI; HDL and BMI, WC in both overweight and obese participants.

DISCUSSION

The present study recorded 10.9% underweight, 32.5% overweight, and 8.1% obesity among all the study population. Underweight was more common among students whose age ranged 18–23 years. The high incidence of underweight among university students has been previously reported [17,18]. The overall implications of this include malnutrition, menstrual irregularities, diabetes, osteoporosis, and reduced immunity [19-21]. The prevalence of underweight recorded among these students may be attributed not only to poor feeding habits but also to misperceptions usually exhibited by these female students that they want to maintain a good shape. Most of the students under this age range might be newly admitted students who have not become acquainted with university environment and their feeding habits [17,22-25]. The overweight and obesity were more prevalent in female premedical undergraduate students between the age range of 24 and 29 years although overweight was higher than obese participants. This is in agreement with study by Oguoma *et al.* [21,26]. Similarly, SBP, DBP, WC, and FBG were all elevated in overweight and obese students when compared with control participants. These findings indicate that the overweight students were at the verge of getting to obesity, central obesity, hypertension, and pre-diabetes which might result to future cardiovascular diseases if the risk factors

Table 3: Mean (±SD) levels of lipid profile (mmol/l) and FBG (mmol/l) in underweight, overweight, obese, and control female premedical students

Groups	TC	HDL	LDL	TG	FBG
Underweight (A) (n=30)	4.05±0.25	1.46±0.43	3.01 ± 0.31	1.11±0.45	4.72±0.36
Overweight (B) (n=104)	5.28±0.86	1.07±0.29	3.46 ± 0.58	1.21±0.64	5.01±0.29
Obese (C) (n=31)	5.86±0.92	0.89±0.17	4.26 ± 0.84	1.25±0.84	5.12±0.38
Normotensive (D) (n=155)	4.41±0.84	1.44±0.56	3.18 ± 0.49	1.19±0.39	4.83±0.32
F-value	0.395	0.446	0.341	0.058	0.059
p-value	0.007	0.002	0.000	0.106	0.010
A vs. B	0.000	0.000	0.000	0.863	0.029
A vs. C	0.000	0.000	0.000	0.581	0.000
A vs. D	0.063	0.873	0.811	0.360	0.741
B vs. C	0.046	0.058	0.000	0.673	0.692
B vs. D	0.000	0.003	0.010	0.773	0.000
C vs. D	0.001	0.000	0.000	0.315	0.006

TC: Total cholesterol, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TG: Triglycerides, FBG: Fasting blood glucose, SD: Standard deviation

Table 4: Correlation of lipid profile (mmol/l), FBG (mmol/l), and anthropometric indices in overweight and obese female subjects

Parameters	Overweight R	Obese R	p-value
TC vs. BMI	−0.353	−0.256	<0.005
TC vs. age	0.453	0.589	<0.005
TC vs. SBP	−0.311	− 0.456	<0.005
TC vs. DBP	−0.401	−0.442	<0.005
TC vs. FBG	0.383	0.399	<0.005
TG vs. BMI	−0.438	−0.438	<0.005
TG vs. FBS	0.428	0.297	<0.005
TG vs. age	0.399	0.382	<0.005
TG vs. WC	0.275	0.288	<0.005
LDL vs. FBG	0.311	0.344	<0.005
HDL vs. BMI	−0.714	−0.789	<0.005
HDL vs. age	0.663	0.796	<0.005
HDL vs. WC	−0.221	−0.256	<0.005

TC: Total cholesterol, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TG: Triglycerides, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, BMI: Basal metabolic index, FBG: Fasting blood glucose

are not controlled on time. Increased morbidity and mortality rate as a result of increase in cardiovascular diseases have been grossly reported in developing countries including Nigeria [27,28]. This may be attributed to the westernized lifestyle and physical inactivity among these participants [18,29]. The westernized lifestyle is as a result of frequent consumption of saturated fats, poor and unhealthy fast foods such as snacks, and indomie by university students. High incidence of overweight and obesity among female undergraduate students has been widely reported [25,30-32]. Our study has shown the presence of higher prevalence rate of central obesity in overweight as well as obese participants. This is consistent with the study reported by Ogunmola *et al.* [33] and Adegoke *et al.* [34]. The authors reported that in addition to unhealthy eating and physical inactivity, urbanization was also a factor. Excessive consumption of high calorie carbohydrate junk food [1,3] and saturated unprocessed palm fruit soup popularly known as "OfeAkwu" which is common and frequently consumed by students in this locality may also contribute greatly to the increase and accumulation of high amount of calorie and can result to the condition observed in this study. Reports have shown that central obesity is associated with cancer, heart diseases as well as lipid dysregulation and these can greatly contribute to risk of cardiovascular disorders [35,36]. The significant elevation in blood pressure among overweight and obese participants in this study suggests that these students might be predisposed to hypertension if appropriate intervention is not instituted. Previous reports have been documented [37,38]. There have been strong reports on significant association between obesity and hypertension in young adults [39-41]. It has also been established that lipid abnormality even in apparently normal subjects might result to hypertension [42].

The present study showed that TC, LDL, and FBG were significantly higher in overweight and obese participants when compared with normal participants. However, no significant difference was observed in TG level between the obese and control counterparts. High levels of fats and TC are potential risk factors for developing macrovascular complications such as coronary heart disease (CHD) and stroke [21,43-45]. Serum TC ranging from 5.0 to 6.5 mmol/L has been established as risk factor for CHD and considered undesirable [46]. Obesity is the leading cause of dyslipidemia (abnormal lipid concentrations) and diabetes mellitus. Dyslipidemia, on the other hand, has been associated with CHD which can be caused by elevated levels of TGs, TC, and LDLC [47].

Normal LDLC concentration has been established to be <130 mg/dl (3.36 mmol/L). Concentrations higher than 160 mg/dl (4.14 mmol/L) are considered high risk [47]. The findings in the present study showed that the obese participants were at high risk of developing cardiovascular disease which may be as result of oxidative modification of LDLC or other environmental factors such as lack of exercise and increased intake of junk foods with poor nutrients. Previous reports have shown that high levels of LDLC are an indication of progression to atherosclerosis which is a known risk of cardiovascular disorders, thus the major causes of morbidity and mortality [48].

Our study observed significantly lower level of HDL in obese subjects when compared with the value control participants. This is in agreement with the findings by Després [49] and Kimberly et al. [50]. Abnormal HDLC might be a leading cause of atherogenic dyslipidemia. Furthermore, the previous report has shown that a low level of high-density lipoprotein cholesterol is consistent with atherosclerosis [51]. Furthermore, low HDL levels in obese subjects can contribute greatly to the risk of cardiovascular diseases. HDL is known as the "good cholesterol" which helps to mop up cholesterol, removes extra cholesterol from the peripheral tissues, and transports it to the liver for degradation and storage [51]. HDLC possesses a potent anti-inflammatory and antioxidant effects which can prevent the atherogenic process [52,53].

The significantly higher FBG level observed in overweight and obese participants in the present study is consistent with the study done by McGill *et al.* [54] even though the increase was not higher than the reference range. The authors reported that obese subjects with elevated FBG are prone to diabetes mellitus. Individuals with FBG ranging from 110 to 125 mg/dl have been postulated to have a double to 6-fold increase of developing diabetes mellitus [55]. These participants if the risk factors of obesity are not controlled may be predisposed to diabetes. Studies in Nigeria have documented the high incidence of impaired fasting glucose as well as impaired glucose tolerance [56-58]. Elevated glucose levels in the intermediate range are caused primarily by a deficiency in insulin secreted by pancreatic beta cells. Deficient insulin secretion can be caused by loss of beta cells or defect in the function of beta cell [59,60].

An elevated glucose level is one major characteristic that can define metabolic syndrome. Others are abdominal obesity, elevated blood pressure, elevated TGs, and reduced HDL cholesterol. Any 3 of these 5 conditions can establish the diagnosis of the syndrome [61,62]. However, the obese students, in this study, presented with similar findings showing possible development to pre-diabetes as well as metabolic syndrome if the obesity is not checked. Significant number of individuals with metabolic syndrome has abdominal obesity. Increased storage of fatty acids in the adipose tissue can lead to excessive release of adipokines. This can encourage metabolic susceptibility to diabetes and cardiovascular disease [63].

Significant positive correlation were observed between TC, HDL, TG and age, FBG while significant negative correlation existed between TC, HDL, TG and BMI, SBP DBP, WC respectively in overweight and obese participants. Similar reports have been previously documented [45,54,64-66]. Evidence has also shown that FBG positively correlated with BMI [67]. Adequate physical exercise increases the activation of the peptide hormone adiponectin that causes the cascade activation of activated protein kinase to prevent the syntheses of malonyl-coenzyme A (CoA) for fatty acid biosynthesis in hepatocytes by acetyl CoA carboxylase [67]. This enhances the uptake of glucose and fatty acid from the blood myocytes into the hepatocytes for metabolism [68,69]. The increased accumulation of weight by the female in the present study may also be attributed to creeping weight normally accumulated after sensitization of ghrelin hormone which enhances the hunger reflexes in females after strenuous activities. Females tend to relax after dietary intake, thereby resulting to increase in weight gain [70]. The significant association between lipid parameters and anthropometric indices in the present study might be attributed to risk factors for dyslipidemia, hypertension, and obesity [71]. Previous reports have shown that lipid abnormality even in normal subjects might result to hypertension and can enhance the risk of developing macrovascular complications [42,72]. Abnormal HDLC can result in endothelial damage and trigger an increase in BP; this might significantly contribute to CHD. Report has shown that low HDLC level of 1mg/dL (0.03 mmol/L) can result to risk of CHD in both men and women. Therefore, a low HDLC level of ≤40mg/dL (≤1.04 mmol/L) was established as undesirable for both genders [73,74] and should be regarded as a baseline for treatment to reduce cardiovascular risk.

CONCLUSION

The present study showed significantly higher levels of TC, LDLC, and FBG in overweight and obese female participants with significantly lower HDLC when compared to controls. The lipid parameters were significantly correlated with the anthropometric indices, suggesting that the study participants have high potentials for developing cardiovascular risk factors such as dyslipidemia, hypertension, and obesity. However, this study justifies the need to encourage modalities and appropriate interventions to promote healthy body mass, frequent physical activities, and high calorie dietary controls with quality protein foods and fruits to prevent or minimize risks of developing disorders associated with obesity among the study population. A more longitudinal study is also advocated in the study environment, male student inclusive, to ascertain a clearer picture of overweight and obesity status among these individuals to cub the increase and future menace of cardiovascular disease among this young population.

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AUTHORS' CONTRIBUTION

1. Conceptualization and study design - Nkiruka Rose Ukibe and Solomon Nwabueze Ukibe.
2. Data collection, sample analysis, and performing the experiment - Nkiruka Rose Ukibe, Emmanuel Ikechukwu Onwubuya, and Ofia Anya Kalu.
3. Preparation of manuscript - Nkiruka Rose Ukibe, Solomon Nwabueze Ukibe, and Ifeoma Nwamaka Monago.
4. Statistical Analysis - Ofia Anya Kalu and Obiageli Fidelia Emelumadu.
5. Proofreading the manuscript - Solomon Nwabueze Ukibe, Emmanuel Ikechukwu Onwubuya, and Obiageli Fidelia Emelumadu.
6. All authors read and approved the final manuscript.

CONFLICTS OF INTEREST

All authors have none to declare.

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