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(Research Article)

Prevalence and risk factors of metabolic syndrome among female university students: A cross-sectional study

Chidimma Ozoemena Nweke *, Chinwendu Nancy Ibe, Ogechukwu Celestina Iloka, Rebecca Nkiru Sampson and Chinecherem Christiana Maduka

Department of Biochemistry, Faculty of Natural and Applied Sciences, Legacy University Okija, Anambra State, Nigeria.

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Abstract

Metabolic syndrome (MetS) encompasses various metabolic abnormalities linked to type 2 diabetes and cardiovascular diseases. The study is aimed to assess the prevalence of Metabolic Syndrome (MetS) among female university students, by gathering anthropometric data including Body Mass Index (BMI), Waist Circumference (WC), and Blood Pressure (BP) and evaluating biochemical data including total Cholesterol (TC), Fasting Plasma Glucose (FPG), High-Density Lipoprotein (HDL), and Triglycerides. This study done at Legacy University Okija assessed MetS prevalence among female students, gathering anthropometric (BMI, waist circumference (WC), blood pressure (BP)) and biochemical data (total cholesterol (TC), fasting plasma glucose (FBS), HDL, triglycerides) after an 8-hour fast. The tests were done using standard laboratory procedures. One-way analysis of variance (ANOVA) was used to assess differences in BMI groups and MetS components. The results showed that 2(2.9%) students were underweight, 49(70%) had ideal body weight, 12(17.1%) were overweight and 7(10%) were obese. The prevalence of the risk factors were: 7.1% for obesity according to WC, 7.1 % (high) and 1.4%(very high) for systolic BP, 18% for diastolic BP, 48.6% for triglyceride, and 7.1%(pre-diabetic) and 1.4%(diabetic) for FPG. Low HDL-C was absent. The highest prevailing risk factor was triglyceride. The variables with statistical significance were WC($p<0.05$), FPG($p<0.05$), and diastolic BP($p<0.05$). Overall MetS prevalence was 1.4%. MetS is present, especially among the obese, but risk factors are also evident in other groups.

Keywords: Metabolic syndrome; Female university students; Prevalence; Risk factors; anthropometric data; Biochemical analysis

1. Introduction

Metabolic pattern (MetS) is a clustering of factors that reflects overnutrition, sedentary cultures, and attendant redundant obesity. It (MetS) is a bunch of metabolic blights comprising hypertension, insulin resistance, visceral Obesity, adipose liver, and atherogenic cardiovascular diseases[1]. MetS is also associated with other comorbidities including apro-thrombotic state, pro-inflammatory state, nonalcoholic adipose liver complaint, and reproductive diseases. Because MetS is a cluster of different conditions, and not a single ailment, the development of multiple concurrent delineations has redounded. The five honored factors of MetS are waist circumference grounded on race to identify abdominal Obesity, high blood pressure, abnormal fasting blood sugar situations, advanced situations of triglycerides, and a reduction in the quantum of HDL cholesterol[2]. The WHO description was the first to tie together the crucial factors of insulin resistance, Obesity, dyslipidemia, and hypertension. The description authorizations that insulin resistance be present; without it, even if all the other criteria were met, the case would not have a metabolic pattern. The WHO (World Health Organization) description also allows cases with type 2 diabetes (T2D) to be diagnosed with metabolic patterns if they meet the other criteria[3]. According to the NCEP ATP III (National Cancer Education Program Adult Treatment Panel III) description, metabolic pattern is present if three or more of the following five

* Corresponding author: Chidimma Ozoemena Nweke

criteria are met waist circumference over 40 elevationn (men) or 35 elevation (women), blood pressure (BP) over130/85 mmHg, fasting triglyceride (TG) of over 150 mg/ dl, fasting high- viscosity lipoproteinn (HDL). The description doesn't bear that any specific criterion be met; only that at least three of five criteria are met. In 2005, the International Diabetes Federation (IDF) published new criteria for metabolic syndrome[4]. Although it includes the same general criteria as the other delineations, it requires that Obesity, but not inescapably insulin resistance, be present. The major criteria for MetS include hyperglycemia, hypertriglyceridemia, hypertension, low HDL (high-viscosity lipoprotein), and Obesity. These conditions are interrelated and share underpinning intercessors, mechanisms, and pathways. Their causes may be inheritable but life choices play a significant part. Research has shown that there's a difference in the frequency of metabolic patterns between men and women and that it's frequently more current in women. Seerat and Jain reported that the frequency of MetS in women and men was 29 and 23 respectively[5]. In women, elevated BMI (Body Mass Index), low HDL cholesterol, increased waist circumference, and hyperglycemia were significantly larger contributors to the metabolic pattern while in men these were hypertension and elevated triglycerides[5]. In a study conducted on 963 cases with type 2 DM (diabetes mellitus) progressed between 35- 85 times, the frequency of the circumstance of the MetS was analogous for men (83) and women (86) and increased with age in both sexes[6]. In the study, the commonest being and least detected MetS defining parameters are central Obesity and elevated triglyceride situations respectively[6]. In a study conducted on children and adolescents, the pooled frequency of MetS in fat and fat children and adolescents was as follows IDF 24.1, ATP III 36.5, and de Ferranti 56.32. Whereas, it's 3.98,6.71, and 8.19 with the IDF, ATP III, and de Ferranti individual styles, independently in the general population[7]. Still, this study shows a discrepancy to an earlier statement. It reported that the frequency of MetS was fairly advanced in males (26.63) than ladies (24.05) in the IDF system. Likewise, males (33.37) were more largely affected by MetS than ladies (31.4) according to the modified ATP III individual criteria. The prevalence of MetS differs all over the world and is constantly linked with the frequency of Obesity. The variation in MetS frequency is grounded on gender, age, and race/ethnicity[1]. The frequency of MetS varies and depends on the criteria used in different delineations, as well as the composition (coitus, age, race, and race) of the population[8]. No matter which criteria are used, the frequency of MetS is high and rising in all societies, presumably as a result of the Obesity epidemic[9- 11]. Studies conducted on the general population from civic centers in Kenya reported the frequency as 25.6 (several civic centers) and 34.6 (one civic center)[12]. An aggregate of 528 actors were included in the analysis. The frequency of MetS was 25.6 (95 CI22.0 –29.5). Among the surrogate labels of visceral obesity, lipid accumulation product was the stylish predictor of MetS with an AUC of 0.880 while triglyceride was the stylish predictor among the lipid parameters with an AUC of 0.816 for all participants[12]. The optimal WC cut-off for diagnosing MetS was 94 cm and 86 cm independently for males and ladies. The frequency of MetS was high for a healthy population pressing the fact that one can be physically healthy but have metabolic dislocations reflective of an increased CVD threat.

2. Methods

This cross-sectional study was conducted at the Biochemistry laboratory of Legacy University, Okija. 70 female students, who lived within the university, were randomly selected with at least one year of studying. The inclusion criteria were female and at least 18 years old. Exclusion criteria included physical dysfunction, infectious disease, liver and kidney diseases, pregnancy and breastfeeding mothers, or missing blood samples. The study included the measurement of waist circumference, blood pressure, body mass index, and biochemical analysis of serum total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and fasting glucose. Blood samples were collected and allowed to clot for 45 minutes at room temperature. After centrifugation, the serum was transferred to a separate bottle. Triglycerides, total cholesterol, and HDL were determined using commercial kits, while LDL was calculated using the Friedewald formula[13]. For Fasting Glucose, Blood samples were collected into specimen bottles and centrifuged within 30-45 minutes. Glucose concentration was determined using the glucose oxidase method, where hydrogen peroxide produced was measured to calculate glucose concentration[14]. Subjects' waist circumference was measured by encircling the waist at the level of the navel after inhaling deeply and exhaling[15-18]. For Blood Pressure Measurement, subjects sat with feet flat on the floor and arms at heart level[19]. An automated blood pressure device was used to measure systolic and diastolic pressure. BMI was calculated using weight and height measurements[18]. Height was measured against a wall, and weight was measured using a digital scale. The research was approved by The Research and Ethical Review Committee of Legacy University Okija, Anambra State Nigeria. Data was analyzed, and values were expressed in terms of frequency, percentage, mean, and standard deviation using IBM SPSS Statistics for Windows. One-way analysis of variance (ANOVA) was used to assess differences in BMI groups and MetS components.

3. Results

The data used forth is study was collected from seventy(70) female under-graduates aimed to determine the prevalence of MetS, determine the BMI, WC, and BP, also measure the level of total cholesterol, Triglycerides, and fasting glucose among the female students in the study area. The results of the data collected are shown in the tables below.

The study shows that there is a very low prevalence, 1.4%, of MetS generally among the female students in the study area for the WHO, IDF, and NCEP ATP III standards employed in this study. None of the students indicated signs of MetS for the IDF standard, while 1.4% of the female students indicated signs of MetS according to the WHO and NCEP ATP III standards respectively.

Table 1 Prevalence of MetS among the respondents using WHO, IDF, and NCEP ATPIIIstandards

Standard	Frequency	Percentage
IDF(n=70)		
MetS	0	0
NoMetS	70	100
WHO(n=70)		
MetS	1	1.4
NoMetS	69	98.6
NCEPATPIII(n=70)		
MetS	1	1.4
NoMetS	69	98.6

Table 2 The mean levels of BMI, Waist circumference, SBP, and DBP of the female students in the study area.

Variables	Mean±SD	Median (IQR)	Min	Max
BMI(kg/m^2)	23.89±5.68	22.58(5.13)	15.82	51.76
Waist Circumference (cm)	28.85±4.26	27.9(4.25)	22.4	48.4
SystolicBP(mmHg)	115.16±10.66	115.0(12.0)	95	149
DiastolicBP(mmHg)	76.43±8.45	74.50(9)	59	99

The mean BMI of the students was 23.89 **±** 5.68 and a median and interquartilerange of 22.58 and 5.13 respectively. 49 (70%) of the female students had a healthy weight under the BMI, 7(10%) and 12(17.1%) were obese and overweight respectively, while 2 (2.9%) we're underweighted.

The mean Waist circumference of the female students was 28.85 ± 4.26 while the median and interquartile range were 27.9 and 4.25 respectively. The obese according to waist circumference was about 5 (7.1%) of the students while 65 (92.9%) had normal waist circumference. The minimum waist circumference was 22.4 and 48.4, was the maximum.

The mean systolic BP of the female students was 115.16 **±** 10.66 also having themedian and interquartile range of 115.0 and 12.0 respectively and a maximum systolic Bp of 149 and 95 as a minimum. Out of the 70 students, 53(75%) had anormal systolic BP, 11(15%) were at the borderline, 5 (7.1%) were high and 1(1.4%)wasvery high.

The mean diastolic BP of the students was 76.43 **±** 8.45, having the median andinterquartile range of 74.50 and 9 respectively, and a minimum and maximum diastolic BP of 59 and 99 respectively. 39 (55%) of the students had their diastolicBP falling at the borderline, 12 (17.1%) were normal and 1 (1.4%) was low, also, 13(18%) of the students had a high diastolic BP, while 5 (7.1%) was very high.

The mean total cholesterol of the students was 177.75 ± 44.18, also having the median and interquartile range of 167.8 and 54.85 respectively. Out of the 70 students, about 50 (71.4%) had normal total cholesterol, while about 12 (17.1%) were on the borderline, and 8 (11.4%) had high total cholesterol. The minimum and maximum total cholesterol of the students were 69.6 and 303.8 respectively. The mean triglycerides of the students were 203.72 ± 41.90, having the median and interquartile range of 197.25 and 71.63 respectively, and a minimum and maximum triglyceride of 134.6 and 306.0 respectively. 29 (41.4%) of the students had their TG falling at the borderline, 7 (10.0%) were normal and 34 (48.6%) were high. The mean HDL of the students was 98.01 ± 92.79, having the median and interquartile range of 89.20 and 14.47 respectively, and a minimum and maximum HDL of 55.90 and 857.0 respectively. Out of the 70 students, 68 (97.1%) had their HDL falling at the borderline, while 2 (2.9%) were normal.

The mean fasting glucose of the students was 80.59 ± 17.68, also having the median and interquartile range of 82.15 and 28.13 respectively. Out of the 70 students, about 64 (91.4%) had normal fasting glucose, while about 5 (7.1%) were Pre-diabetic and 1 (1.4%) was diabetic. The students' minimum and maximum fasting glucose were 44.0 and 132.90 respectively.

Table 3 Mean levels of HDL, Total cholesterol, Triglyceride, and Fasting blood glucose of the female students in the study area

Variables	**Mean±SD**	**Median(IQR)**	**Min**	**Max**
Total Cholesterol(mmol/L)	177.75	167.8(54.85)	69.9	303.8
Triglyceride(mmol/L)	±44.18 203.72	197.25(71.63)	134.6	306.0
HDL(mmol/L)	±41.90 98.01±92.79	89.20(14.47)	55.90	857.0
Fasting Glucose(mmol/L)	80.59±17.68	82.15(28.13)	44.0	132.90

Table 4 Clinical-biochemical characteristics of participants according to the various classes of BMI

Variable	**Underweight**	**IdealBMI**	**Overweight**	**Obese**	***F-value***	***P-value***
WC(cm)	23.0±0.85	27.2±1.81	30.9 ±2.08	38.3±5.30	51.7	0.001*
FPG (mmol/L)	59.9±11.95[a]	78.1±15.66[b]	91.9±17.12[c]	84.22±24.61[d]	3.27	0.026*
TC	205.5±60.25	175.50±43.70	185.8±52.83	171.8±31.35	0.47	0.705
(mmol/L)TG	209.4±49.50	207.0±42.74	194.1±39.0	195.6±45.0	0.396	0.757
(mmol/L) HDL	88.9±14.14	88.2±11.14	144.4±24.73	89.58±13.51	1.22	0.309
(mmol/L) SBP	107.0±7.07	116.5±10.85	111.75±10.24	114±10.11	1.07	0.367
(mmHg) DBP (mmHg)	71.0±1.41[e]	77.8±8.88[f]	70.7 ±6.27[g]	78.0±5.03[h]	2.81	0.046*

Post-Hoc result: For WC; all pairs were less than 0.05. WC=Waist Circumference; FPG= Fasting Plasma Glucose; TC=Total Cholesterol; TG=Triglycerides; HDL=High-Density Lipoprotein; SBP=Systolic Blood Pressure; DBP=Diastolic Blood Pressure; BMI=Body Mass Index.

4. Discussion

In this research, five risk factors of metabolic syndrome, as established by the IDF, WHO, and NCEP ATP III, were assessed. Four out of the five were present in the sample population. The four included hyperglycemia, hypertension, hypertriglyceridemia, and raised waist circumference (an indicator of central obesity). This is in contrast to a study that reported that the most prevalent MetS component was abdominal obesity[20] in 97.8% of the participants, followed by hypertension in over 40% of these individuals, low HDL-c levels in one-third of the population, and hyperglycemia in about six percent of the population[21]. The absent criterion in this study was low HDL-C. Though the above-cited study did not report a missing criterion, it did, however, note the low prevalence of hypertriglyceridemia, which was present in only one participant, this participant did not have MetS[21]. In the course of the study, standards established by three different organizations were employed to determine the prevalence of MetS. The organizations include IDF, WHO, and NCEP ATP III. Using the established standards, the overall prevalence of MetS was 1.4%. This finding in the present study is similar to the 2.1% and 5.4% prevalence at t0 and t+5, respectively, reported for women in a prospective study on the prevalence of metabolic syndrome among healthy French families[22].

The mean HDL level of the students fell within a high range (98.01), with an almost equal deviation (±92.79), (table 3). This suggested that some of the students had extremely high HDL levels as well as almost low levels. This result differs from a study carried out on overweight and obese Nigerian adolescents and young adults. It reported the prevalence of HDL-C among the sample population. This prevalence was not statistically significant ($p>0.05$)[21]. Despite neither of the students having low HDL levels, high LDL-C (low-density lipoprotein cholesterol) levels were still observed during the tests. This however was not considered an abnormality. Extremely high HDL levels in the blood can cause the process of clearing out LDL-C from the arteries to slow down and thus, high levels of HDL and LDL-C are maintained in the bloodstream. This elevated or high presence of HDL could be influenced by several factors such as genetics, treatments, alcohol, general lifestyle choices, etc.

Table 2 showed that hypertriglyceridemia was the highest prevailing risk factor amongst the students. Its overall mean was 203.72 ± 41.90, which was way beyond the normal range. Such extreme levels were maintained across all BMI groups with the highest being in the underweight category.

This was considered unusual because triglyceride contributes significantly to body mass. There are several reasons for this (genetics, lifestyle, etc.) but to determine the actual culprit further research has to be carried out. This finding was supported by a study conducted in Iraq. The study reported the mean serum triglyceride levels of the underweight and normal-weight individuals to be 172.4 ± 25.2mg/dl and 177.5 ± 18.2mg/dl respectively. This led to the conclusion that underweight and normal-weight individuals were as much at risk of elevated levels of triglyceride as overweight and obese ones[23].

According to the analysis, the differences in the FPG (fasting plasma glucose) of the different categories were statistically significant ($p<0.05$). Five individuals were found to be pre-diabetic and one diabetic. From Table 4, it was observed that the overweight group had the highest mean for FPG. Those with ideal body weight and the obese were within the desired range, whereas those in the underweight category were experiencing hypoglycemia. In a different study conducted among overweight and obese Nigerian adolescents and young adults, FPG was not statistically significant ($p>0.05$)[21].

With regards to the waist circumference (WC), which had a statistical significance of $p<0.05$. Most of the individuals had an ideal waist circumference. The exceptions were in the obese category alone. Interestingly, the mean WC of the students moved in increasing order across the group (table 4). This was however in contrast to a study conducted in Saudi Arabia, which reported that a single individual in the underweight category (as characterized by BMI) had a high waist circumference[24].

Based on the analysis concerning the blood pressure of the individuals, the diastolic blood pressure (DBP) was statistically more significant ($p=0.046$) than the systolic blood pressure (SBP) ($p=0.367$). The deviations from the mean of the SBP were higher compared to that of DBP, (table 4). This meant that the mean of the systolic blood pressure gave a less clear representation when compared to that of the diastolic blood pressure. This conclusion was made because the standard deviation from the mean of the diastolic blood pressure gave a closer value. Despite the fact that the mean indicated that the individuals were not hypertensive, some of them were. In this case, the mean could not be used as a determinant of hypertension since it only showed the fraction of the population that was now as.

5. Conclusion

Four out of the five criteria assessed for metabolic syndrome in this study were present in the population, although they were not all present in equal degrees. The highest prevailing risk factor was hypertriglyceridemia. The overall prevalence of MetS was 1.4%

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. We confirm that this work has not been published elsewhere, either in part or in full.

Statement of ethical approval

The research was approved by The Research and Ethical Review Committee of Legacy University Okija, Anambra State Nigeria, with the approval number: LUO/FNAS/EC/0002.

Statement of informed consent

Informed consent was sought and obtained from each participants and information provided were kept confidential.

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