The Prevalence of Metabolic Syndrome and Its Components in an Adult Nigerian Population Attending a Tertiary Hospital

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ABSTRACT

BACKGROUND: *The metabolic syndrome (MetS) is a clinical concept that comprises a cluster of risk factors like arterial hypertension, obesity and high cholesterol in the same patient. The prevalence of metabolic syndrome seems to increase together with the prevalence of obesity.*

OBJECTIVE*: To determine the prevalence of metabolic syndrome and related factors in an adult population in Nigeria.*

METHODS*: This was a cross-sectional study that included 216 men and women. Sociodemographic, anthropometric, and biochemical characteristics were collected. Metabolic syndrome was diagnosed using the criteria of the National Cholesterol Education Program-ATPIII (NCEP-ATP III). A logistic regression model was used to calculate the crude odds ratio (OR) of the variables, and the statistical level of significance was set at 5.0%.*

RESULTS: *We identified 62 (28.04%) subjects with metabolic syndrome according to the criteria of the NCEP-ATPIII. More females had metabolic syndrome than males (38.8% vs. 15.3%, p<0.0001). MetS was associated positively with marital status and gender. Reduced HDL-C was found as the most common MetS component in our study (68.8%). Others in decreasing order were hypertension (66.7%), abdominal obesity (50.9%), high FBG levels (15.5%) and hypertriglyceridemia (6.2%).*

CONCLUSION: *More female adults attending this tertiary healthcare facility have metabolic syndrome, which can be associated with an increased risk of developing cardiovascular disease. Individuals who were married had a higher prevalence of metabolic syndrome; this finding can be explained by the high rate of obesity found in the married subjects.*

KEYWORDS: *Metabolic Syndrome; Obesity; Marital status*

INTRODUCTION

The metabolic syndrome (MetS) is a modern-day epidemic which predicts cardiovascular morbidity and mortality.[1] Also, subjects with MetS have increased risk of stroke, heart attack, and of developing type 2 diabetes mellitus in both sexes when compared to people without it.[2] The MetS comprise a constellation of interrelated metabolic disorders, including hypertension, central obesity, dyslipidemia and hyperglycemia that are associated with increased risk for cardiovascular disease leading to increased morbidity and mortality.[3-5] The prevalence of

MetS is increasing worldwide and is now considered a serious health problem globally.[6] The prevalence of MetS varies depending on the definition applied the ethnicity and the age of the study population. MetS does not only place a burden on the individual but also affect the economic and social aspects of society. Various environmental and social factors have been considered as risk factor for MetS. Hence, the identification of socioeconomic characteristics associated with MetS is essential for successful primary prevention.[7, 8] Studies that addressed social and economic determinants of cardiovascular diseases, consistently showed an increasing prevalence of the individual features of metabolic syndrome in the lower socio-economic strata.[9, 10] Thus, the prevalence of metabolic syndrome is expected to be influenced by social disparities, also providing clues to understand social inequalities in CVDs.[11, 12] Several social factors such as education level, occupation, household income, and marital status may influence MetS.[13] Occupation is recognized to reflect physical activity in the workplace, as well as, represent social economic position of the individual.[14] Several studies have also reported on the influence of educational inequalities on the prevalence of metabolic syndrome.[15, 16] Education is a good indicator of social position in epidemiological studies because it precedes other indicators, such as occupational-based social position or income, is comparable between men and women, does not usually change in adulthood.[17]

The social gradient as represented by gender, occupational and educational status in the MetS could help explain socioeconomic inequalities in cardiovascular diseases (CVD). This study aimed to assess the prevalence of MetS across the social strata of a representative sample of urban non-institutionalized adults in Port Harcourt, Southern Nigeria.

METHODS

Study population

Study subjects were randomly recruited from patients attending the general out-patients, and medical out-patient clinics of the University of Port-Harcourt Teaching Hospital, and from staff from various departments in the hospital spanning both junior and senior staff cadres. The study was conducted from January 2016 to August 2016. All participants underwent a routine clinical examination and blood biochemical examination. Two hundred and sixteen consecutive subjects were recruited for the study by random sampling. All subjects aged ⩾ 18 years who gave informed consent for the study were recruited. The exclusion criteria were critically ill patients, pregnant women, women in puerperium, and patients with demonstrable ascites. The sample selection was done consecutively using every adult patient who registered to see the clinicians on each consulting day during the study period and who met the inclusion criteria. Written informed consent was obtained from participants and the ethical committee of the hospital gave approval for the study.

Demographic and clinical characteristics

Demographic and clinical characteristics such as age and gender were obtained by a structured questionnaire. Blood pressure was measured with a standard mercury sphygmomanometer. Height, weight, waist

circumference and hip circumference were measured manually. Body mass index (BMI) was calculated as weight (kilograms) divided by height (meters) squared. Waist-to-hip ratio was also calculated. Blood pressure was measured with a standard (Accosson) mercury sphygmomanometer (cuff size 12.5 X 40cm) on the patients' right arm in the seated position with feet on the floor after a five-minute rest. Systolic and diastolic blood pressures were taken at korotkoff phases 1 and 5 respectively to the nearest 2 mmHg. The average of two BP measurements taken 5 minutes apart was used. The presence and severity of HBP was then based on the JNC VIII guidelines.[18]

Using a measuring tape, the waist circumference was measured at the midpoint between the lower costal margin and the iliac crest with the patient standing and feet positioned close together and the value was read to the nearest 0.5 cm at the end of a normal expiration. The tape was snug around the body but not tight enough to constrict and it was held parallel to the floor at the level at which the measurement was taken. WC was considered increased when it exceeded 88 cm in women and 102 cm in men.[19]Hip circumferences was measured by the same method as for waist circumference but at the level of the greater trochanter and read to the nearest 0.5 cm. Each measurement was done twice, and the average value was taken. Waist-hip ratio was calculated by dividing the waist circumference by the hip circumference. Waist-hip ratio above 0.90 for males and above 0.85 for females was taken as the cut-off for central obesity.[19]

Weight was measured with a mechanical weighing scale with the subject wearing only light clothing, and height was measured using a stadiometer with the subject standing feet together without shoes or head gear, back and heel together against a vertical ruled bar to which a movable attached horizontal bar was brought to the vertex of the head and reading taken to the nearest 0.5 cm. Marital status was recorded in categories: single, divorced, widowed and married, but for analysis purposes, participants were considered as married or not. The education status was recorded and categorized into four levels: none, primary, secondary and tertiary levels. Participants' occupational status was classified as unemployed, unskilled, semi-skilled, clerical staff, managers/professionals, and homemakers. According to the definition of NCEP-ATP III, a person who has three or more of the following risk factors is defined as having metabolic syndrome (MetS): triglyceride level $\geqslant$ 1.7mmol/l or specific treatment for lipid abnormality; HDL cholesterol level <1.03mmol/l in men, <1.29mmol/l in women; systolic blood pressure $\geqslant$ 130 mmHg or diastolic blood pressure $\geqslant$ 85 mmHg or treated or previously diagnosed hypertension; fasting plasma glucose level $\geqslant$ 110 mg/dl or treated or previously diagnosed diabetes; and abdominal obesity. For the definition of abdominal obesity, a waist circumference of $\geqslant$ 102 cm (men) and $\geqslant$ 88cm (women) is required.[20]

Laboratory examination

Fasting venous blood was collected and analyzed in the chemical pathology laboratory of the University of Port Harcourt Teaching Hospital for serum lipid profile and blood glucose. Fasting cholesterol and

triglyceride levels were measured using the enzymatic method. Fasting HDL-C was measured by the precipitation method. LDL-C values were calculated using the Friedewald equation when triglyceride level was less than 4.0mmol/L: LDL-C= TCH-(HDL-C+TG/2.2).[21]

Statistical analysis

Data were expressed as mean± standard deviations and frequencies as a percentage. Continuous variables were compared with the Students t-test or one-way analysis of variance as considered appropriate. Proportions or categorical variables were compared with the Chi-square test. All analyses were performed by SPSS statistical software (version 19.0, SPSS Inc). *P* values of <0.05 were considered statistically significant.

RESULTS

Socio-demographic characteristic: The mean (SD) age of the male subjects was 49.00(13.51) years and that of the females was 51.60(12.38) years (p=0.142). The mean (SD) age of subjects with MetS was 49.27(10.78) years and that of subjects without MetS was 50.88(13.75) years (p=0.415).

Anthropometric and blood pressure measurements: the anthropometric and blood pressure values of the research participants are shown in Table 1 and Table 2. The females had a higher waist circumference (WC) than the males (P=0.002). The subjects with MetS also had a higher WC than those without MetS (P<0.0001). There were no significant differences in the blood pressures between the sexes. The SBP and DBP of the subjects with MetS were, however, higher than those without MetS (P<0.0001, P<0.0001).

Metabolic profile: The males had significantly lower low-density lipoprotein cholesterol (LDL-C) than the females (p=0.012). The total cholesterol (TCH) is also higher in the females in a statistically significant manner (p=0.001) as is shown in Table 1. The subjects with MetS had a higher level of TCH than those without MetS, although this was not statistically significant (P=0.345). The subjects with MetS had higher TG and lower LDL-C levels than those without MetS (P<0.0001, P=0.047). The male subjects had a higher level of fasting blood glucose (FBG) than the females (P=0.012). The subjects with MetS equally had a higher FBG than those without MetS (P=0.047).

Table 1: Clinico-biochemical Characteristics of the entire Study Population according to Gender

Variables	Males (n=98)	Females (n=118)	Student t-test p-value
Age (years)	49.00±13.51	51.60±12.38	0.142
WC (cm)	90.22±16.37	96.74±13.79	0.002
SBP (mmHg)	137.92±24.53	137.47±25.91	0.898
DBP (mmHg)	85.24±16.70	85.72±15.83	0.830
TCH (mmol/L)	4.67±1.04	5.15±1.05	0.001
TG (mmol/L)	1.06±0.42	1.12±0.52	0.360
HDL-C (mmol/L)	0.96±0.39	1.05±0.48	0.162
LDL-C (mmol/L)	3.25±0.90	3.59±0.97	0.012
FBG (mmol/L)	5.32±1.23	4.89±0.81	0.012

Table 2: Clinico-biochemical Characteristics of the entire Study Population according to the presence or absence of Metabolic Syndrome

Variables	MS (n=62)	Without MS (n-154)	Student t-test p-value
Age (years)	49.27±10.78	50.88±13.75	0.415
Waist circumference (cm)	103.73±9.99	89.95±15.35	<0.0001
SBP (mmHg)	147.95±22.04	133.77±25.47	<0.0001
DBP (mmHg)	96.00±12.02	81.42±15.71	<0.0001
TCH (mmol/L)	5.04±1.22	4.88±1.00	0.345
TG (mmol/L)	1.33±0.57	1.00±0.39	<0.0001
HDL-C (mmol/L)	0.92±0.43	1.04±0.44	0.059
LDL-C (mmol/L)	3.56±1.14	3.38±0.86	0.201
FBG (mmol/L)	5.39±1.10	4.99±1.01	0.047

Determinants of metabolic syndrome: the determinants of metabolic syndrome are as shown in Table 3. Decreased high-density lipoprotein cholesterol (HDL) and hypertension were the most common components of metabolic syndrome respectively. Most of the women had central obesity (75.2%) and increased LDL-C. Increased plasma glucose, triglycerides, and decreased HDL were more common in the male subjects.

Table 3: Prevalence of the Components of Metabolic Syndrome in the entire Population

Components	Percentage
Hypertension	66.7
Hypertriglyceridemia	6.2
Abdominal obesity	50.9
Hyperglycemia	15.5
Reduced HDL-C	68.8

Prevalence of metabolic syndrome: The overall prevalence of metabolic syndrome in the entire study population was 28.04% (See Figure 1). There were more women with MetS than men and this statistically significant (P<0.0001). We also found that MetS was more prevalent among the married subjects (P=0.032). Although there was an inverse relationship between educational status and prevalence of MetS in the study population, it was not statistically significant (See Table 4). The type of occupation did not influence the prevalence of MetS in this study.

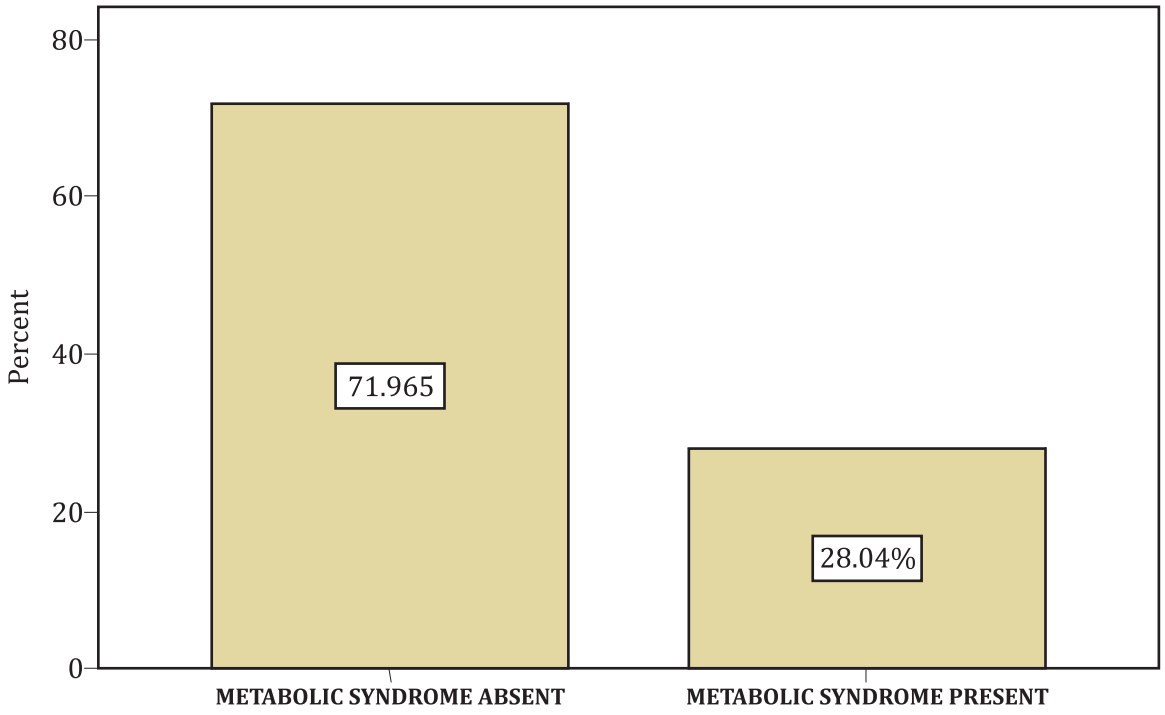

Figure 1: Prevalence of Metabolic Syndrome in the Entire Study Population

Table 4: Prevalence of Metabolic Syndrome according to Marital and Educational Status

Category	Metabolic Syndrome		X^2	p-value
	Yes (62)	No (154)		
Marital Status	(%)	(%)		
Married	32.1	67.9	4.594	0.032
Unmarried	17.2	82.8		
Education				
No formal education	43.7	56.3	2.542	0.468
Primary	31.0	69.0		
Secondary	27.8	72.2		
Tertiary	25.2	74.8		

Table 5: Prevalence of Components of the Metabolic Syndrome according to Gender

Category	Percentage (%)		X^2	p-value
TG	**Normal**	**Increased**		
Males	93.8	6.2	0.826	0.468
Females	91.2	8.8		
HDL-C	**Abnormal**	**Normal**		
Males	78.4	21.6	7.798	0.005
Females	60.4	39.6		
LDL-C	**Normal**	**Increased**		
Males	42.3	57.7	8.810	0.003
Females	22.9	77.1		
FBG	**Normal**	**Elevated**		
Males	78.3	21.7	3.784	0.052
Females	89.9	10.1		

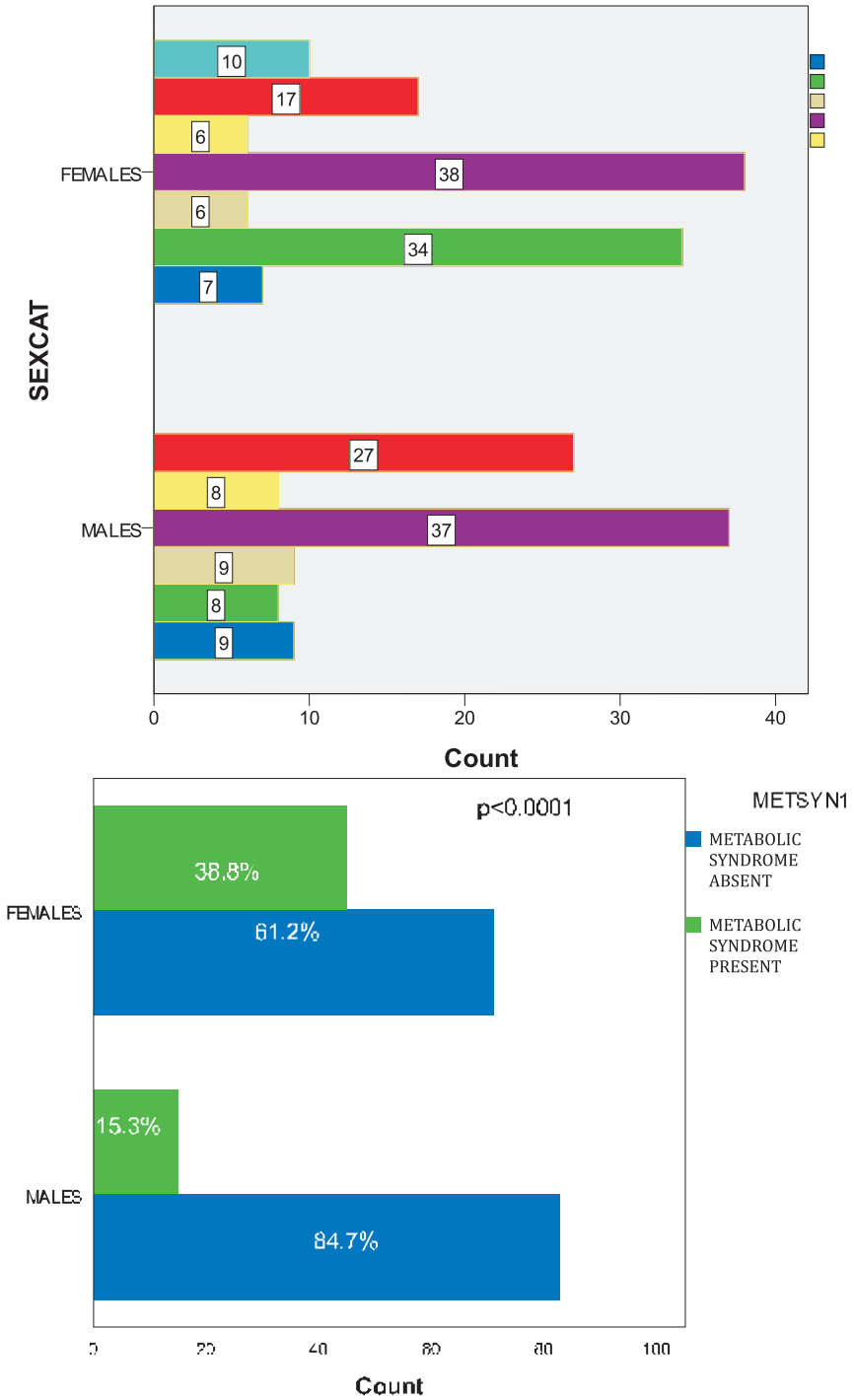

Figure 2: Prevalence of MetS across gender

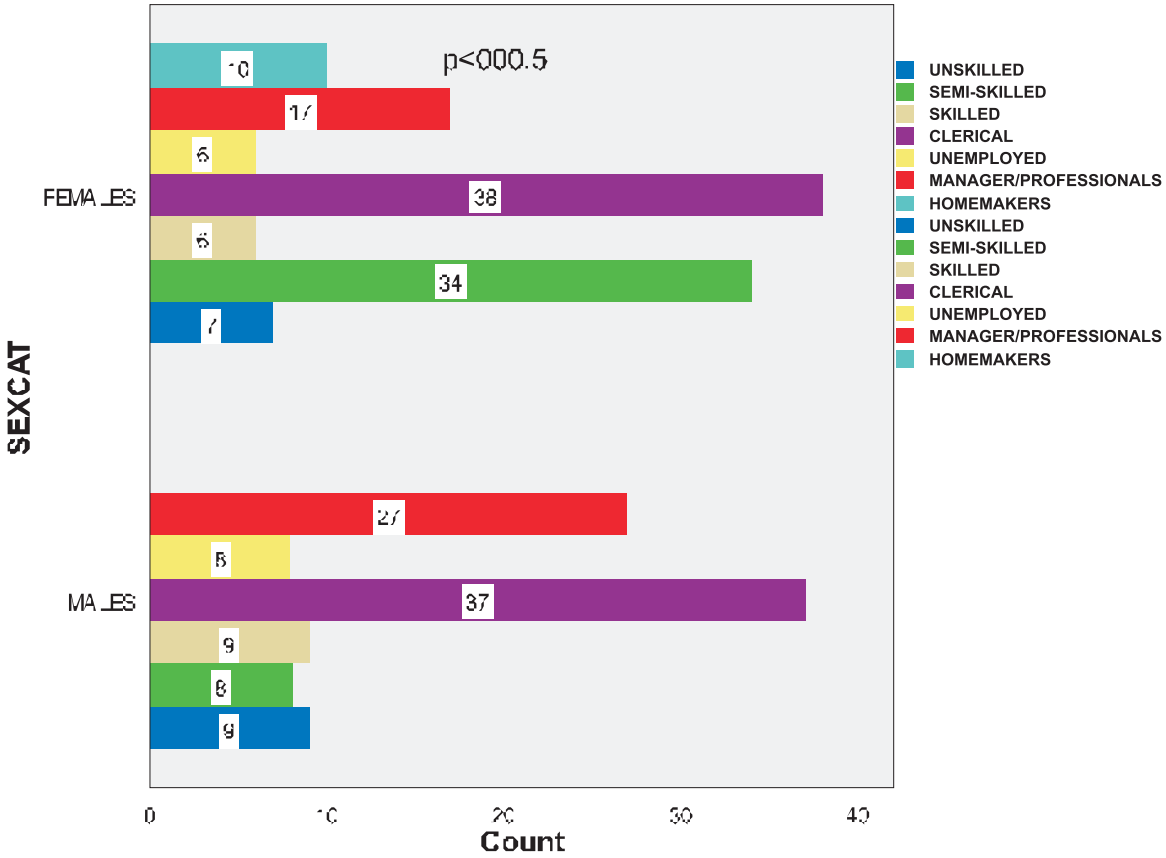

Figure 3: The Distribution of Occupation across Gender.

Predictive factors of metabolic syndrome were evaluated by bivariate and multivariate logistic regression analyses. The female sex, primary level of education, being married and semi-skilled occupational status was significantly associated with MetS (Table 6).

VARIABLE	UNIVARIATE REGRESSION		VARIABLES	MULTIVARIATE LOGISTIC REGRESSION	
		p-value		OR	p-value
Age (years)	0.234	<0.0001	Sex (female)	3.654	0.002
Sex					
Educational	0.188	0.012	Marital status		
status	0.074	0.369	(Married)	0.309	0.016
Occupation			Educational		
Hypertension	0.026	0.679	status	4.189	0.049
TG (mmol/L)	0.287	<0.0001	(Primary)		
HDL-C (mmol/L)		0.024	Occupation	0.032	0.020
WC (cm)	0.166	0.001	(Semi-skilled)		
FBG (mmol/L)		<0.0001			
Marital status	0.255	0.010			
	0.374	0.032			
	0.192				
	0.148				

DISCUSSION

The metabolic syndrome (MetS) is a cluster of cardiometabolic abnormalities that increases the risk of cardiovascular disease (CVD). In this study, we evaluated the prevalence of metabolic syndrome in a population of adults attending a tertiary healthcare facility in Southern Nigeria. We also sought to determine the prevalence of the individual components of the MetS. In this study we also evaluated associations of socioeconomic parameters and cardiovascular risk factors and MetS.

The prevalence of MetS in this study population using the ATP III criteria was 28.04%. This was similar to mean overall prevalence ofMetS in Nigeria reported by Nwose *et al*[22]. They reported a prevalence of 27.9%. Our finding was however in contrast to those by Akintunde *et* al[23] and, Osuji and Omejua[24] who reported prevalence rates of 35% and 31.2%, respectively.

Although these studies were similar to ours in being hospital-based, the disparity in prevalence rates may be due to the difference in the intrinsic characteristics of the study population of a given geographic population. The prevalence rate of 28.04% reported in this study was however much higher than that reported by Siminialayi and Emem-Chioma[25] who reported a prevalence of 6.3% in a rural community in Southern Nigeria in 2008. This highlights the growing burden of MetS among urban dwellers due to socioeconomic inequalities which translate unfortunately to westernized lifestyles that most often results in increased cardiovascular risk.[26]

The prevalence of MetS was higher in the females than the males (Fig 2). This is similar to that reported by other investigators.[27,28]The difference in prevalence rates across gender may be due to the fact that the females were significantly more obese than the males, and because the females in this study were more involved in sedentary jobs than the males. We also found that more women were engaged in relatively lower income jobs than their male counterparts (Fig 3). It has been found that in general populations, low educational and income levels[11, 29] are related to metabolic syndrome in female subjects but not in male subjects. Women of high socioeconomic status tend to be more concerned about their fitness, consume healthy food, and practice regular exercise.[29] We also found that MetS was more prevalent among the married in the study population (Table 4). Our findings on lower prevalence of metabolic syndrome in unmarried subjects as compared to married ones are in contrast to published reports that married people are more likely to engage in positive health behaviors than widowed, divorced, or single people.[30, 31] This was however in concert with the findings by Bhanushali*et al.*[32] It is not clear how marital status contributes to metabolic syndrome, but a study in an Iranian population also showed that marriage was associated with an increased risk of obesity, a cardinal component of the metabolic syndrome.[33]A cultural perception among black Africans, for whom overweight or obese women are regarded as being more beautiful, symbols of happiness, well looked-after by their husbands, and being affluent, could be a reason for the association between marital status and metabolic syndrome.[34,35]

We found that the components of the MetS appeared at different rates. We found hypertension and reduced HDL-C to be the prevalent components of MetS. Sabir *et al*[36] in a study conducted in North-Western Nigeria also found that hypertension (46.1%) and reduced HDL-C (56.1%) were the most prevalent components of MetS. This was however in contrast to the findings by Onyenekwu*e t al*[37] in South-Western Nigerian who reported abdominal obesity (97.8%) as the most prevalent component of MetS in their study population. This finding could be explained by the fact that their study population comprised of overweight and obese adults. Hypertriglyceridemia (15.5%) was the least prevalent component of the MetS in our study. This was similar to the findings by Nwegbu and Jaiyesimi[38] in Abuja, North-Central Nigeria.

Regarding the impact of socioeconomic status (SES) on metabolic syndrome, our study showed that sex, marital status and occupational status were associated with metabolic syndrome.This finding agrees with results by other investigators which found thatSES is inversely associated with MetS and that having a higher SES decreases the risk of MetS.[39, 40] The reason for this is that males and females who have a higher SES generally adopt lifestyles that are healthier overall; while those who have a lower SES have adopt less healthy lifestyles.[41] Our findings could therefore be due to the fact that females in the West-African sub-region are usually financially constrained because they experience a greater degree of discrimination in all spheres of life (e.g. labor market, pay, household work etc.). Thus, women of low SES might have worse living conditions than low SES men. Likewise, occupations which require high educational attainment are well compensated and are held in high public esteem. Therefore, with respect to Nigerian job categories, physicians, lawyers, engineers, scientists, and professors are largely considered to have a higher SES.

CONCLUSION

The prevalence of MetS among adults attending a tertiary healthcare facility was relatively high. The prevalence of MetS was much higher among the females than the males. Hypertension and reduced HDL-C were the most common components of MetS. People in the lower socioeconomic bracket were more likely to have the MetS.

Limitation

The cross-sectional design of the study limits the ability in addressing causality and the present work only describes the association between socioeconomic factors and metabolic syndrome.

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