Original Article

Components and Risk Factors of Metabolic Syndrome among Rural Nigerian Workers

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Abstract

Background: Metabolic syndrome (MetS) is a serious public health risk predisposing the workforce to cardiovascular diseases and diabetes. **Aim:** The aim of this study was to determine the components and risk factors of MetS among Nigerian teachers and bank workers (BWs). **Settings and Design:** The cross-sectional study was conducted in Idemili South Local Government Area, Southeast Nigeria. **Materials and Methods:** The study involved 427 teachers and 66 BWs in 14 secondary schools and 5 microfinance banks, respectively. Data collection methods included questionnaire, lipid profile, fasting plasma glucose (FPG), weight, height, waist circumference, and blood pressure (BP) measurements. Inferential statistical analysis involved Pearson correlation and Chi square with Cochran–Mantel–Haenszel test. Significance was accepted at $P < 0.05$. **Results:** Most (73.3%) of the teachers were 40–60-year-olds; 75.8% of BWs were 19–39-year-olds ($P < 0.01$). Underweight (7.7%), overweight (26.8%), obesity (17.2%), impaired FPG (IFPG) (14.0%), hypertriglyceridemia (38.0%), and hypertension (40.0%) were prevalent with similarity ($P > 0.05$) between occupations, age, and gender. Females were more likely to have abdominal obesity ($P < 0.01$) than males. MetS prevalence was 20%. MetS was more likely among females (odds ratio [OR] =0.63, 95% confidence interval [CI] =0.471–0.841); workers with abdominal obesity (OR = 1.67, 95% CI = 1.210–2.295), IFPG (OR = 0.05, 95% CI = 0.008–0.347), raised diastolic BP (OR = 12.00, 95% CI = 2.177–66.134), and hypertriglyceridemia (OR = 1.55, 95% CI = 1.931–5.600); and those who often drank fluids other than water (OR = 0.11, 95% CI = 0.013–0.961). **Conclusion:** MetS was a problem of public health significance among the workers with higher prevalence among teachers, 40–60-year-olds, and females. Abdominal obesity was the strongest risk factor of metabolic syndrome among the workers.

Keywords: Abdominal obesity, hyperglycemia, hypertension, risk factors, triglyceride, workers

Introduction

Metabolic syndrome (MetS) is a cluster of conditions that occur together with increase in the risk of cardiovascular diseases (CVDs), stroke, and diabetes mellitus. It is a public health concern that often results from the increasing prevalence of obesity[1] and has been described as a cluster of the most dangerous heart attack risk factors: hyperglycemia, abdominal obesity, dyslipidemia, and high blood pressure (BP).[2] Low physical activity levels and diets rich in calories and saturated fat are common causes of MetS,[3] and workers are not left out. Work-related physical, social, and nutritional factors may be associated with MetS.

In Nigeria, noncommunicable diseases such as diabetes and CVDs have become public health issues. It could also be attributed to sociodemographic changes caused by urbanization of some areas. Fueled by rapid urbanization, nutrition transition, and increasingly sedentary lifestyles, type 2 diabetes epidemic has grown in parallel with worldwide rise in obesity.[4] It could also be a consequence of late identification of MetS as it is not often the habit of most Nigerians to go for medical/health check in the absence of disease.

Working hours for most Nigerian workers commence at the 8th h with likelihood of skipping breakfast and/or consuming foods prepared outside the homes. Some do not reach home until much later in the late evenings, and this appears to be the only opportunity to eat food cooked at home. In the area of study, teaching and bank employment are among the major occupations.

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School hours run from 7.45 A. M. to 1.30 P. M. In most secondary schools, lesson classes begin at about 2.00 P. M and end at about 5.00 P. M. giving a total of about 9 h. For bank workers (BWs), work hours last from 8.00 A. M. to 4.00 P. M. when the bank closes to customers and internal summary lasts till 6.00 or 7.00 P. M. These workers, therefore, had little or no time for physical activity, and adequate food and nutrient intake may be a challenge as street foods are usually high in carbohydrates and fats.[5] Unhealthy diet and low physical activity levels have been described as common causes of MetS.[3] Workers may further be exposed to physical inactivity and obesity as opportunities to walk to and from their workplaces, and engage in other physical activities may be absent.

The International Diabetes Federation[6] (IDF) explained that with MetS driving the twin global epidemics of type 2 diabetes and CVDs, there is an overwhelming moral, medical, and economic imperative for early identification of individuals with MetS, so that lifestyle interventions and treatment may prevent the development of diabetes and/or CVDs. Besides this, little is known about the prevalence of MetS in the world's workforce.[7] This study, therefore, assessed the prevalence of MetS, its components, and risk factors among two occupations as a window to what happens among workers in other occupations.

Materials and Methods

Study design and participants

This cross-sectional survey was conducted among teachers and BWs in Idemili South Local Government Area (LGA) of Anambra State, Southeast Nigeria. The participants consisted of 427 secondary school teachers and 66 BWs. All sick persons, pregnant women, casual workers, cleaners, and security men in schools and banks were excluded from the study, and the remaining workers (493) were used for the study; there was no sampling. A subsample of 10% (50) was selected for biochemical assay using a two-stage sampling technique: (i) proportionate sampling was used to determine the number of respondents to be selected from each school/bank and (ii) simple random sampling technique was used to select the number of persons from the school/bank.

Ethical approval and consent to participate

Ethical approval for the study was obtained from the Ethical and Research Review Board of Ministry of Health, Anambra State (MH/AWK/M: 321). Informed consent was obtained from the participants after detailed explanation of the study protocol.

Data collection methods

Questionnaire

The questionnaire was developed to elicit socioeconomic information from the respondents. The questionnaire was self-administered; both researcher and research assistants were available to make clarifications where necessary. The response rate was 100%.

Anthropometry

Anthropometric measurements of weight, height, and waist circumference were taken according to already described standard methods.[8] Data obtained were used to calculate their body mass index and determine the presence of abdominal obesity.

Blood pressure measurement

An electronic sphygmomanometer was used to measure the BP of respondents three times using appropriate cuff size. Mean of the second and third values was used in statistical analysis. The BP was recorded to the nearest one mmHg. Hypertension was defined as systolic BP (SBP) ≥130 and/or diastolic BP (DBP) ≥85 mmHg[6] giving three categories of hypertension: raised SBP, raised DBP, and raised SBP and DBP.

Fasting plasma glucose determination

Fasting plasma glucose (FPG) levels of the respondents were determined after 8–10 h of overnight fast using Accu-Chek glucometer. A FPG level ≥5.6 mmol/L (100 mg/dl) defined impaired FPG (IFPG).[6]

Lipid profile determination

Five milliliters of venous blood was drawn from each of the 50 respondents selected as subsample after 8–12 h fast. The blood was allowed to clot, and clear serum was obtained by centrifugation at 3000 rpm for 15 min. Lipid profile was determined using Randox cholesterol kit (Randox Laboratory Reagents, United Kingdom; batch number: BT 317558). Raised triglyceride (TG) ≥1.7 mmol/L (150 mg/dL) and reduced high-density lipoprotein (HDL) <1.03 mmol/L (40 mg/dL) in males and <1.29 mmol/L (50 mg/dl) in females were taken as cutoff points for these parameters according to IDF.[6]

Statistical analysis

Data were analyzed using IBM SPSS, version 21.0 (IBM Corp., Armonk, NY, USA). Differences in socioeconomic characteristics and other variables by occupation, age, and sex were tested for with Chi square. Pearson correlation coefficient and Chi-square (Cochran–Mantel–Haenszel) test were used to define relationships among variables. All tests of significance were two-tailed with significance accepted at $P < 0.05$.

Results

General characteristics of the workers

The general characteristics of the respondents are shown in Table 1. BWs were significantly ($P < 0.001$) younger than the teachers with 75.8% aged 19–39 years. Male BWs (40.9%) were significantly more ($P < 0.001$) than the male teachers (7.5%); female teachers (92.5%) were more ($P < 0.001$) than female BWs (59.1%). More teachers than BWs had degree certificate ($P < 0.001$), earned higher monthly ($P < 0.001$), and had good nutrition and CVD knowledge scores ($P < 0.001$). Fewer teachers than BWs were never married ($P < 0.01$).

Components and prevalence of metabolic syndrome

Table 2 presents the components and prevalence of MetS among the workers by occupation. Teachers had a higher prevalence of general obesity (17.2%), IFPG (16.3%), and

Table 1: General characteristics of the respondents

Variables	Teachers (*n*=427), *n* (%)	BWs (*n*=66), *n* (%)	Total (*n*=493), *n* (%)	χ^2 (*P*)	OR (95% CI)
Age (years)					
19-39	111 (26.0)	50 (75.8)	161 (32.7)	64.366 (0.000)**	8.896 (4.868-16.260)
40-60	316 (74.0)	16 (24.2)	332 (67.3)		
Sex					
Male	32 (7.5)	27 (40.9)	434 (88.0)	60.584 (0.000)**	0.117 (0.064-0.215)
Female	395 (92.5)	39 (59.1)	59 (12.0)		
Highest educational level attained					
Diploma/NCE	12 (2.8)	22 (33.3)	34 (6.9)	82.944 (0.000)**	17.292 (8.015-37.307)
Degree certificate	415 (97.2)	44 (66.7)	459 (93.1)		
Monthly income (Naira)					
≤60,000 ($166.20)	96 (22.5)	41 (62.1)	137 (27.8)	44.760 (0.000)**	5.655 (3.273-9.769)
>60,000 ($166.20)	331 (77.5)	25 (37.9)	356 (72.2)		
Marital status					
Ever married	413 (96.7)	59 (89.4)	472 (95.7)		0.286 (0.111-0.737)
Never married	14 (3.3)	7 (10.6)	21 (4.3)	7.526 (0.006)*	
Engagement in exercises					
Yes	234 (54.8)	39 (59.1)	273 (55.4)		0.839 (0.496-1.421)
No	193 (45.2)	27 (40.9)	220 (44.6)	0.426 (0.595)	
Hours spent on exercise per week (h)					
<1	141 (60.3)	22 (56.4)	163 (59.7)		0.854 (0.430-1.693)
≥1	93 (39.7)	17 (43.6)	110 (40.3)	0.206 (0.725)	
Cigarette smoking					
Yes	90 (21.1)	13 (19.7)	103 (20.9)		1.089 (0.569-2.085)
No	337 (78.9)	53 (80.3)	390 (79.1)	0.066 (0.872)	
Alcohol consumption					
Yes	169 (39.6)	23 (34.8)	192 (38.9)		1.225 (0.712-2.106)
No	258 (60.7)	43 (65.2)	301 (61.1)	0.538 (0.500)	
Use of added salt					
Yes	176 (41.2)	23 (34.8)	199 (40.4)		1.311 (0.763-2.253)
No	251 (58.8)	43 (65.2)	294 (59.6)	0.963 (0.348)	
Fluid often consumed					
Water	201 (47.1)	37 (56.1)	255 (51.7)		0.697 (0.414-1.175)
Other fluids (fruit juices, carbonated drinks, energy drinks, and alcoholic beverages)	226 (52.9)	29 (43.9)	238 (48.3)	1.849 (0.187)	
Nutrition and CVD knowledge scores					
Good (≥50%)	386 (90.4)	47 (71.2)	433 (87.8)		0.263 (0.141-0.490)
Poor (<50%)	41 (9.6)	19 (28.8)	60 (12.2)	19.686 (0.000)**	

**P<0.001, *P<0.01. BWs – Bank workers; CVD – Cardiovascular diseases; CI – Confidence interval; OR – Odds ratio; NCE – Nigeria certificate in education

raised TG (39.5%). Abdominal obesity (77.3%), raised SBP (42.9%), DBP (42.9%), both raised SBP and DBP (28.6%), and hypertension (57.1%) affected the BWs more. Significance was found in SBP alone ($P < 0.05$). The prevalence of reduced HDL-cholesterol (HDL-C) was 0.0% for both occupations. Few (20.9%) teachers had three components of MetS; BWs had one (57.1%) and two (28.6%) components; these differences were similar ($P > 0.05$). Overall, MetS prevalence was 20.0%, and only teachers were affected.

The components and prevalence of MetS among the workers by age and sex are presented in Table 3. There were no significant ($P > 0.05$) differences in all the variables between the two age groups. Gender differences in prevalence were significant ($P < 0.01$) for abdominal obesity, number of components of MetS ($P < 0.05$), and overall prevalence of MetS ($P < 0.01$) with females being affected more.

Figure 1 illustrates the prevalence of single and multiple components of MetS among the workers. Raised TG had the highest prevalence of 14.0%, followed closely by abdominal obesity (AO, 10.0%), raised DBP (10.0%), and a combination of TG, DBP, and AO (8.0%).

The correlation of the components of MetS is presented in Table 4. Positive significant relationships were found between FPG and DBP ($P < 0.05$), SBP and DBP ($P < 0.001$), and BMI and SBP ($P < 0.05$). The inverse relationship of HDL with FPG, TG, and DBP, respectively, was significant ($P < 0.05$); the relationship with SBP did not reach statistical significance ($P > 0.05$).

Table 2: Body mass index and components of metabolic syndrome among the respondents by occupation

Variables	BWs (*n*=7), *n* (%)	Teachers (*n*=43), *n* (%)	Total (*n*=50), *n* (%)	*P*	OR (95% CI)
BMI (kg/m^2) categories**					
Underweight (<18.5)	3 (4.5)	35 (8.2)	38 (7.7)		
Overweight (25-29.9)	14 (21.2)	118 (27.6)	132 (26.8)		
Obesity (≥30)	11 (16.7)	74 (17.3)	85 (17.2)	0.355	
Components of MetS					
**Abdominal obesity	51 (77.3)	302 (70.7)	353 (71.6)	0.307	0.71 (0.39-1.31)
Impaired FPG	0 (0.0)	7 (16.3)	7 (14.0)	0.573	1.12 (1.05-1.36)
Raised TG	2 (28.6)	17 (39.5)	19 (38.0)	0.695	0.61 (0.11-3.52)
Raised SBP only	3 (42.9)	4 (9.3)	7 (14.0)	0.048*	7.31 (1.19-44.98)
Raised DBP only	3 (42.9)	15 (34.9)	18 (36.0)	0.692	1.40 (0.28-7.10)
Both raised SBP and DBP	2 (28.6)	3 (7.0)	5 (10.0)	0.138	0.53 (0.71-40.06)
Hypertension (raised SBP or DBP or both)	4 (57.1)	16 (37.2)	20 (40.0)	0.416	2.25 (0.45-11.37)
Reduced HDL	0 (0.0)	0 (0.0)	0 (0.0)		
Number of components of MetS					
None	1 (14.3)	11 (25.6)	12 (24.0)		
One	4 (57.1)	16 (37.2)	20 (40.0)		
Two	2 (28.6)	6 (14.0)	8 (16.0)		
Three	0 (0.0)	9 (20.9)	9 (18.0)		
Four	0 (0.0)	1 (2.3)	1 (2.0)	0.501	
MetS	0 (0.0)	10 (23.3)	10 (20.0)	0.319	0.1.30 (1.11-1.54)

P values were generated through Chi-square analysis, *P<0.05, **n=493 (BWs=66 and teachers=427). CI – Confidence interval; OR – Odds ratio; BWs – Bank workers, Mets=Metabolic syndrome. Abdominal obesity = Waist circumference of ≥ 94 cm in males and ≥80 cm in females, Impaired FPG = Fasting plasma glucose ≥ 5.6 mmol/L, Raised triglyceride = TG ≥1.7 mmol/L, Raised SBP = Raised systolic blood pressure ≥130 mmHg, Raised DBP = Raised diastolic blood pressure ≥85 mmHg, Reduced HDL = Reduced high density lipoprotein <1.03 mmol/L in male and <1.29 mmol/L in female, Metabolic syndrome = Abdominal obesity and any two of raised FPG, triglyceride, blood pressure and reduced HDL, Hypertension = Raised systolic blood pressure ≥130 mmHg or raised diastolic blood pressure ≥85 mmHg or having both. Source: International Diabetes Federation (2006). The IDF consensus worldwide definition of metabolic syndrome

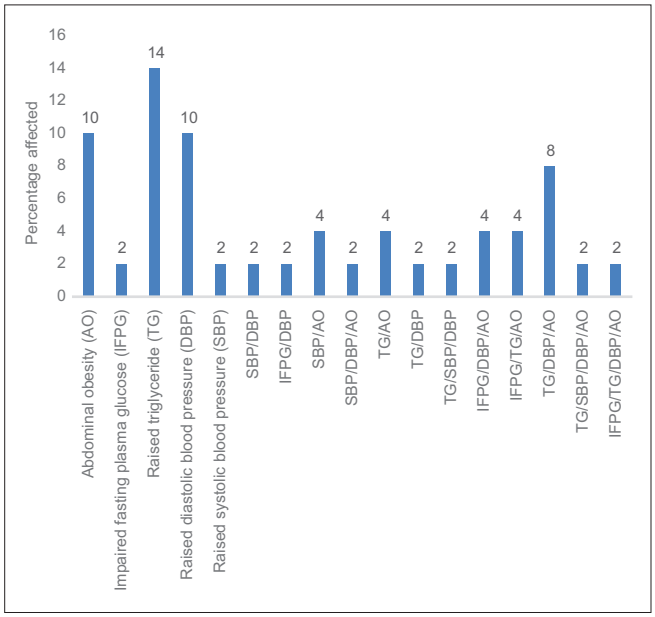

Figure 1: Prevalence of single and multiple components of metabolic syndrome among the workers

Risk factors of metabolic syndrome

The risk factors of MetS among the workers are shown in Table 5. Respondents with raised TG (odds ratio [OR] =1.55, 95% confidence interval [CI] =1.93–5.60, $P < 0.01$), raised DBP (OR = 12.00, 95% CI = 2.18–66.13, $P < 0.01$), abdominal obesity (OR = 1.67, 95% CI = 1.21–2.30, $P < 0.001$), and IFPG (OR = 0.05, 95% CI = 0.01–0.35, $P < 0.01$) were more likely to develop MetS. The risk of having MetS was higher among females (OR = 0.63, 95% CI = 0.47–0.84, $P < 0.01$). MetS was higher among those who did not have history of CVD running in their families (70.0%), but this did not reach statistical significance (OR = 0.52, 95% CI = 0.12–2.32, $P > 0.05$). Majority of the respondents (90.0%) who consumed fluids (fruit juices, carbonated drinks, energy drinks, and alcoholic beverages) other than water had MetS (OR = 0.11, 95% CI = 0.013–0.961, $P < 0.05$).

Discussion

General characteristics of the workers

Our observation that BWs consisted more of 19–39-year-olds was not a surprise because younger persons are more agile and can withstand longer working hours which may be difficult for older persons. Our finding that more teachers had higher educational qualification than BWs was in line with earlier expectation and was attributed to the educational qualification benchmark for secondary school teachers in Nigeria. The banks involved in this study were microfinance banks which may not have the resources to pay workers with higher educational qualifications. This may be the reason that higher income was observed more among teachers than among BWs. Teachers also had better nutrition and CVD knowledge scores. This also may

Table 3: Body mass index and components of metabolic syndrome among the respondents by age and sex

Variables	Age (years)		*P*	OR (95% CI)	Gender		*P*	OR (95% CI)
	19-39 (*n*=23), *n* (%)	40-60 (*n*=27), *n* (%)			Male (*n*=23)	Female (*n*=27)		
[a]BMI (kg/m^2)								
Underweight (<18.5)	13 (7.9)	25 (7.6)			4 (6.8)	34 (7.8)		
Overweight (25-29.9)	35 (21.3)	97 (29.5)			18 (30.5)	114 (26.3)		
Obesity (≥30)	34 (20.7)	51 (15.5)	0.202		11 (18.6)	74 (17.1)	0.862	
Components of MetS								
Abdominal obesity[a]	120 (73.2)	233 (70.8)	0.598	0.89 (0.59-1.35)	31 (52.5)	322 (74.2)	0.001**	0.39 (0.22-0.67)
Impaired FPG	3 (13.0)	4 (14.8)	1.000	0.86 (0.17-4.33)	1 (4.3)	6 (22.2)	0.107	6.29 (0.70-56.72)
Raised TG	7 (30.4)	12 (44.4)	0.387	1.83 (0.57-5.88)	8 (34.8)	11 (40.7)	0.773	0.78 (0.25-2.45)
Raised SBP only	4 (17.4)	3 (11.1)	0.407	0.59 (0.12-2.98)	4 (17.4)	3 (11.1)	0.698	1.68 (0.34-8.46)
Raised DBP only	9 (39.1)	9 (33.3)	0.771	0.78 (0.24-2.49)	7 (30.4)	11 (40.7)	0.559	0.64 (0.20-2.06)
Raised SBP and DBP	3 (13.0)	2 (7.4)	0.651	0.53 (0.08-3.51)	3 (13.0)	2 (7.4)	0.651	1.88 (0.29-12.33)
Hypertension	10 (43.5)	10 (37.0)	0.774	0.77 (0.25-2.38)	8 (34.8)	12 (44.4)	0.569	0.67 (0.21-2.10)
Reduced HDL	0 (0.0)	0 (0.0)			0 (0.0)	0 (0.0)		
Number of components of MetS								
None	3 (13.0)	9 (33.3)			7 (30.4)	5 (18.5)		
One	13 (56.5)	7 (25.9)			12 (52.2)	8 (29.6)		
Two	4 (17.4)	4 (14.8)			4 (17.4)	4 (14.8)		
Three	3 (13.0)	6 (22.2)			0 (0.0)	9 (33.3)		
Four	0 (0.0)	1 (3.7)	0.283		0 (0.0)	1 (3.7)	0.028*	
Metabolic syndrome	3 (13.0)	7 (25.9)	0.308	2.33 (0.52-10.33)	0 (0.0)	10 (37.0)	0.001**	0.63 (0.47-0.84)

P values were generated through Chi-square analysis, **P*<0.05, ***P*<0.01, [a]*n*=493; 19–39 years=164 ; 40 – 60 years=329; Males=59, Females=434. Mets. Abdominal obesity, waist circumference of ≥94cm in males and ≥80 cm in females, Impaired FPG, impaired FPG ≥5.6mmol/L, Raised TG ≥1.7 mmol/L, Raised SBP, raised SBP ≥130 mmHg, Raised DBP, raised DBP ≥85 mmHg, Reduced HDL, reduced HDL <1.03 mmol/L in males and <1.29 mmol/L in females, Mets , abdominal obesity and any two of raised FPG, TG, BP and reduced HDL. Hypertension, Raised SBP ≥130 mmHg or raised DBP ≥85 mmHg or having both. Source: IDF (2006). The IDF consensus worldwide definition of the Mets. CI – Confidence interval; OR – Odds ratio; BWs – Bank workers; BP – Blood pressure; SBP – Systolic BP; DBP – Diastolic BP; HDL – High-density lipoprotein; IDF – International Diabetes Federation; Mets – Metabolic syndrome; FPG – Fasting plasma glucose; TG – Triglyceride

Table 4: Correlation of the components of metabolic syndrome

Variables	TG	SBP	DBP	WC	BMI	HDL-C
FPG	0.114	0.116	0.299*	0.122	0.047	−0.322*
TG		0.186	0.072	0.062	0.263	−0.285*
SBP			0.587***	0.116	0.303*	−0.262
DBP				0.017	0.017	−0.229*

**P*<0.05, ****P*<0.001. WC – Waist circumference; BMI – Body mass index; HDL-C – High-density lipoprotein-cholesterol; BP – Blood pressure; SBP – Systolic BP, DBP – Diastolic BP; TG – Triglyceride; FPG – Fasting plasma glucose

be a consequence of their higher educational level. Gupta *et al*.[9] in a study titled role of literacy in determining the nutritional awareness among mothers observed that the mean percentage of nutrition knowledge scores of mothers increased gradually along with increasing educational level.

Components and prevalence of metabolic syndrome

Obesity (general and abdominal)

The percentage of workers with overweight/obesity and abdominal obesity is worrisome. da Costa *et al*.[10] reported a lower obesity prevalence of 27.4% and prevalence of abdominal obesity as 45.2% among employees of Rio de Janeiro University. In a population-based study, Martins-Silva *et al*.[11] showed that out of 1433 participants, 29.5% had general obesity whereas 37.8% presented with abdominal obesity implying the existence of abdominal obesity in people with normal BMI. The 19–39-year-olds had a higher prevalence than older workers; this is a pointer of danger with grave implications of diabetes and cardiovascular involvement as they grow older. An estimated 382 million people with diabetes in 2013 was projected to rise to 592 million by 2035 with most affected persons living in low- and middle-income countries.[12] Abdominal obesity was more prevalent among females than males and may be a result of low physical activity, diet high in calories, parity, and abdominal enlargement following pregnancy since most women find it difficult to return to their prepregnancy weight and abdominal status. In a study on women's perceived reasons for their excessive postpartum weight retention, Christenson *et al*.[13] reported that eating more during pregnancy was associated with a belief that breastfeeding would automatically lead to weight loss. This belief never comes true because of lower physical activity level characteristic of the postnatal period. Adeniyi *et al*.[14] reported that 61.0% of their study participants were not aware that they could undertake physical exercises to enhance postpartum health and almost half (47.8%) were not engaged in any exercise. Besides, having three or more children has been shown to be strongly associated with overweight (OR = 1.78,

Table 5: Risk factors of metabolic syndrome among the workers

Variables	Metabolic syndrome		*P*	OR (95% CI)
	Present (*n*=10), *n* (%)	Absent (*n*=40), *n* (%)		
HDL (normal)	10 (100.0)	40 (100.0)		
TG				
Raised	8 (80.0)	11 (27.5)		
Normal	2 (20.0)	29 (72.5)	0.004**	1.55 (1.93-5.60)
SBP				
Normal	9 (90.0)	34 (85.0)		
Raised	1 (10.0)	6 (15.0)	1.000	0.52 (0.06-4.83)
DBP				
Raised	8 (80.0)	10 (25.0)		
Normal	2 (20.0)	30 (75.0)	0.002**	12.00 (2.18-66.13)
Abdominal obesity				
Present	10 (100.0)	15 (37.5)		
Absent	0 (0.0)	25 (62.5)	0.000***	1.67 (1.21-2.30)
Impaired FPG				
No	5 (50.0)	38 (95.0)		
Yes	5 (50.0)	2 (5.0)	0.002**	0.05 (0.01-0.35)
Age (years)				
40-60	7 (70.0)	20 (50.0)		
19-39	3 (30.0)	20 (50.0)	0.219	2.33 (0.53-10.33)
Marital status				
Never married	0 (0.0)	5 (12.5)		
Ever married	10 (100.0)	35 (87.5)	0.311	0.78 (0.67-9.09)
Irregular meals				
No	1 (10.0)	8 (20.0)		
Yes	9 (90.0)	32 (80.0)	0.416	2.25 (0.25-20.44)
Nutrition and CVD knowledge				
Good (>50%)	8 (80.0)	31 (77.5)		
Poor (<50%)	2 (20.0)	9 (22.5)	0.618	0.86 (0.15-4.80)
Sex				
Male	0 (0.0)	23 (57.5)		
Female	10 (100.0)	17 (42.5)	0.001**	0.63 (0.47-0.84)
Hours of exercise per week				
Above 1 h	2 (33.3)	11 (39.3)		
1 h and below	4 (66.7)	17 (60.7)	1.000	0.73 (0.12-4.96)
CVD in family				
Yes	3 (30.0)	18 (45.0)		
No	7 (70.0)	22 (55.0)	0.312	0.52 (0.12-2.32)
Type of fluid often consumed				
Water	1 (10.0)	20 (50.0)		
Other fluids (fruit juices, carbonated drinks, energy drinks, and alcoholic beverages)	9 (90.0)	20 (50.0)	0.031*	0.11 (0.01-0.96)
Use added salt				
No	7 (70.0)	16 (40.0)		
Yes	3 (30.0)	24 (60.0)	0.155	0.29 (0.06-1.27)
Smoking				
No	9 (90.0)	37 (92.5)		
Yes	1 (10.0)	13 (7.5)	0.246	0.23 (0.03-2.02)
Alcohol				
Yes	6 (60.0)	15 (37.5)		
No	4 (40.0)	25 (62.5)	0.286	2.50 (0.61-10.32)

*P<0.05, **P<0.01, ***P<0.001. CVD, P values were generated through Chi-square analysis. CVD – Cardiovascular diseases; HDL-C – High-density lipoprotein-cholesterol; BP – Blood pressure; SBP – Systolic BP, DBP – Diastolic BP; TG – Triglyceride; CI – Confidence interval; OR – Odds ratio; FPG – Fasting plasma glucose

95% CI = 1.06–3.00)[15] and by implication, obesity. In a study that examined the total and abdominal obesity and hypertension in indigenous women in Midwest Brazil, Almeida *et al*.[16] observed that 74.0% had overweight/obesity combined. This calls for improved physical activities among females; involvement in household shores does not suffice.

Impaired fasting plasma glucose

The prevalence reported here is lower than 19.3% reported by Awosan *et al*.[17] With a higher prevalence among females, the danger of gestational diabetes is implied with grave consequences on the fetus. Szostak-Węgierek *et al*.[18] asserted that excessive body mass and related metabolic disorders are great threats to procreative health which may contribute to fetal macrosomia and an increased risk of diabetes, arterial hypertension, lipid disorders, and CVDs in the child's adulthood.

Hypertriglyceridemia

Raised serum TG status observed in this study, is a cause for worry and higher than 16.0% observed by Cassani *et al*.[19] among Brazilian industry workers and 32.8% reported by Awosan *et al*.[17] among civil servants in Northern Nigeria. The value is comparable to values reported by Strauß *et al*.[20] among German firefighters (36.1%) and office workers (39.1%). The higher prevalence among teachers may be attributed to lesser working hours because Nakanishi *et al*.[21] showed that the concentration of TG was lower among those who worked 9.0 h a day or more than among those who worked <9.0 h a day ($P = 0.031$). BWs had more hours of work than teachers. Yamaguchi *et al*.[22] also reported that higher job demands (in intensity and duration) were significantly associated with a lower risk of MetS. This may be a result of energy expenditure associated with work.

Hypertension

This was described as raised SBP and/or DBP. The prevalence of hypertension reported in this study is higher than 17.7%[23] and 39.3%.[24] among bank employees in Benin City, Nigeria, and Sullia taluk, Karnataka, India, respectively. The prevalence of raised SBP and DBP observed in this study implies a greater propensity to hypertension, and with the 19–39-year-olds being affected more, early onset is implied.

Low high-density lipoprotein

The zero prevalence of low HDL observed in this study irrespective of age, gender, and occupation is in contrast with 68.6%[25] found among apparently healthy adults in Sagamu and Remo North LGAs of Ogun State, Nigeria, and 23.2% among working adults in Ethiopia.[26] There is apparently no reason for this zero prevalence since the consumption of fluids other than water is high, and most of these fluids contain added sugar. Usual %kcal from added sugars was shown to be inversely associated with HDL and positively associated with TG.[27] This finding emphasizes the relationship among HDL, TG, and FPG and calls for detailed simultaneous research into their metabolism and relationship since singling out added sugar as unique culprit for obesity, diabetes, and CVD is in contrast with high-quality research and very unlikely to yield health benefits.[28] Vegetable consumption may lead to high HDL since vegetables contain niacin, and niacin has been reported to enhance HDL serum levels,[29] thus reducing the TG: HDL ratio with lower CVD risk. Bartlett *et al*.[30] asserted that high HDL-C was associated with 20%–40% lower CVD risk except when TG and low-density lipoprotein-cholesterol were elevated. In support of this, Hu *et al*.[31] stated that the more components of MetS that are evident, the higher is the cardiovascular mortality rate. This implies that 2.0% of the workers with four components face higher cardiovascular mortality risks despite their high HDL status. The prevalence of MetS reported in this study is comparable with 20.3% reported by Strauß *et al*.[20] among German firefighters and office workers.

Correlation between the components of metabolic syndrome

The correlation of TG with HDL shows an inverse relationship implying that the higher TG level, the lower the HDL and supporting the assertion that high TG level is an important risk to cardiovascular health. We also observed a positive correlation between FPG and TG; though not significant, this is in line with the report of another study[32] and implies coexistence of the two which also puts the workers at higher risk of CVDs. According to Welty,[33] insulin resistance and central obesity underlie the pathophysiology of elevated TG and low HDL-C in MetS and type 2 diabetes. The workers' CVD risk is also worsened by the positive correlation observed between FPG and DBP ($P < 0.05$). The significant positive correlation between BMI and SBP shows the cardiovascular involvement in overweight and obese persons lending credence to the assertion of Saidu *et al*.[34] that their multivariate logistic regression analysis showed that IFPG, TG, and BMI were the strongest predictors of prehypertension. Obesity whether general or abdominal leads to IFPG, which leads to high serum levels of TG and low levels of HDL-C and higher cardiovascular threat, since high BMI is associated with fat deposits which also cause atherosclerosis.

Risk factors of metabolic syndrome

In support of the findings of this study, Eckel *et al*.[1] described MetS as a common metabolic disorder that results from the increasing prevalence of obesity. IDF[6] showed that prior to the diagnosis of diabetes in an individual, a buildup of TGs occurs which further impairs insulin sensitivity showing that they often coexist. In this study, both are significantly associated with MetS ($P < 0.01$). Obesity (both general and abdominal) contributes to hypertension, high serum cholesterol, hyperglycemia, and low HDL-C and is independently associated with higher cardiovascular risk.[5] It is, therefore, not a wonder that TG, DBP, and IFPG are significantly associated with MetS. IDF[6] further stated that it is excess body fat in the abdomen that is more indicative of MetS profile than BMI. It is worth pointing out that all the respondents with MetS had abdominal obesity showing the determinant role of abdominal

obesity on who has MetS or not. This agrees with our finding that females with a higher prevalence of abdominal obesity equally had low odds of having MetS. Alcohol has been shown by Huang *et al*.[35] to increase the risk of abdominal obesity.

Our finding that MetS was higher among those who did not have a history of CVD running in their families may support the role of inadequate diet and lifestyle in the etiology of CVDs. We also observed that majority of the respondents who consumed fluids other than water had MetS. Most of these fluids have high sugar content which in the absence of intensive physical exercises may lead to obesity. Overconsumption of calories in whatever form represents the single greatest health threat to individuals.[28]

Conclusion

MetS is a problem of public health significance among teachers, 40–60-year-olds, and females. Raised TG, raised DBP, abdominal obesity, IFPG, being female, and frequent consumption of fluids other than water were risk factors of MetS.

Limitation

The study was limited to two occupations and cannot generalize its findings to all occupations in Nigeria. Besides, the number of respondents used for biochemical assessments limits the generalization of our result findings. Nonetheless, it has shown that MetS and its components are health problems predisposing these workers to CVD.

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Conflicts of interest

There are no conflicts of interest.

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