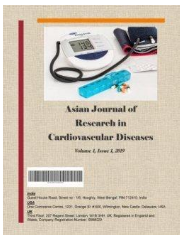

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Cardiovascular Risk Factor Profile among Public Servants in a Developing Country: A Look at the Prevalence of Metabolic Syndrome in a Nigerian University Community

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Cardiovascular diseases are surreptitiously increasing in developing countries unlike the declining trend in the developed world. Screening for risk factors is vital for early detection and control of these diseases. The University community; being compositely mixed, forms a handy surrogate for such latitudinal study in the general population of any community.

Objective: To determine the cardiovascular risk factor profile among workers in a federal government University in South East, Nigeria.

Materials and Methods: Blood pressure, obesity indices, fasting blood lipid and glucose were done, relevant questionnaire administered and the data analyzed using SPSS 16.0 statistical software.

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Results: Among the participants, 29.7% had metabolic syndrome (33.1% females; 23.9% males) and for the individual risk factors: Abdominal Obesity; 42.7%, Hyperglycemia; 20.3%, Hypertension; 43.2%, High triglycerides; 11.5%, "Low" High Density Lipoprotein (HDL); 66.0%, Tobacco smoking; 2.1%. Mean age and mean blood pressure were significantly higher in males while total cholesterol was significantly higher in the females.
Among the sexes and the workers, the higher prevalence of the parameters occurred thus: Females (abdominal obesity, hyperglycemia, and low HDL); Males (age, hypertension (HBP) and hypertriglyceridemia (high TG); senior staff (abdominal obesity, hypertension and low high density lipoprotein (HDL)); Junior staff (hyperglycemia and high Tg). High BP, high triglycerides and low HDL occurred mostly in the age group 40- 49 years.
Metabolic syndrome increased with BMI and age.In all groupings of age and BP, both increased in females but not in males.
Conclusion: Metabolic risk indices are prevalent among University workers in South East Nigeria.

Keywords: Cardiovascular risk factors; public servants; university; developing country.

1. INTRODUCTION

Current World Health Organization (WHO) report shows that about 63% of deaths in the world are caused by non-communicable diseases (NCD) with cardiovascular diseases (CVD) maintaining the lead[1]. Of these NCD deaths, about 80% occurred in low and middle-income countries. Although more deaths still occur from infectious diseases than NCDs in the African region as at present,it is projected that a tremendous reversal may occur with most deaths due to NCDs by 2030 [1].

This, indeed is worrisome, but more worrisome is the fact that the more productive adults are becoming more culpable. For instance, about 30% of people dying from NCDs in low- and middle-income countries are said to be aged under 60 years and are in their most productive period of life [1,2]. According to recent WHO news release, these premature deaths are all the more tragic because they are largely preventable [2]. WHO describes these deaths as a great loss, not only at individual and family levels but also to the greater societal levels [2]. The obvious and undebatable consequence of reduction of effective workforce is the enthronement of poverty and this breeds a vicious cycle: poverty contributes to NCDs and NCDs contribute to poverty. The afore-mentioned WHO release concluded that unless the epidemic of NCDs is aggressively addressed, the global goal of reducing poverty will be difficult to achieve. This picture becomes increasingly perturbing as there is generally a declining tendency of NCDs in the developed world, ostensibly due to increased awareness and more effective and aggressive management of cases [3].

Accordingly, educational and socio-economic strata are major factors that significantly influence awareness, prevalence and outcome of CVD risk factors [3-7]. Since awareness is grossly a major issue, screening campaigns as a strategy for improving early detection becomes paramount as an effective preventive means of reducing Cardiovascular Diseases in the general population [8].

The University community, being compositely mixed in sexuality, age, socio-economic and educational status forms a veritable ground for study of this magnitude and importance [9,10].The information gathered is important in issuing evidence based advice to the community and society at large and also in health system planning and implementation by the government.

1.1 Objective

This study aimed to determine the cardiovascular risk factor profile among workers in a federal government University in South East, Nigeria.

3. MATERIALS AND METHODS

This was a cross sectional study carried out among staff of themain campus of Nnamdi Azikiwe University (a Federal Government owned University in South East Nigeria) as part of cardiovascular screening exercise sponsored by the Chike Okoli Foundation. Announcements for this study was made via University FM Radio, circulated to various faculties/departments, and the university bulletin. It included pertinent information such as the date, time and other necessary instructions, such as fasting from food for at least 8 hours. Participation was voluntary and the study was carried out on only those who indicated interest by coming to the venue and meeting up with the established criteria. It was a 3-day exercise carried out in 15th to 17th of May 2018.

The investigators included medical doctors (2 consultant cardiologists and 2 medical officers), 4 trained nurses, 2 laboratory scientists and 2 Technicians and all were trained for the study. The examination was carried out using adjacent offices (for privacy) in the administrative block of the university.

Being a staff of the university was the only inclusion criteria. All those with history of current use of steroids, clinical evidence of fluid retention and all pregnant females were excluded. Out of the 216 staff that presented for the study only 192 qualified for inclusion.

A pre-tested questionnaire addressing demographic information (age, sex, marital status, educational qualifications and salary grade levels), personal and family history of cardiovascular diseases and adopted life style was issued to each participant. Those who could not understand the questions were aided by the medical officers.

General physical examination was carried out on each participant who later had his/her height without foot wear or head tie/cap measured with a standiometer made locally using wood and non-stretchable tape. Their weights with light clothing and without foot wear were also measured using Hanson's weighing scale. All values were taken to the nearest one decimal place. BMI (Quetelet's index) was calculated by dividing the weight (w) in Kilogram by the square of subject's height (H^2) in meters. The results were graded as: BMI < 25 kg/ m^2 - Normal, BMI ≥ 25 – 29.9 kg/ m^2 – over weight, and BMI ≥ 30 kg/ m^2 – Obese [11-13]. Waist circumference was also measured for each participant with a non-stretchable tape. The umbilicus was the landmark and where the abdomen was pendulous, the point in the abdomen with highest circumference was taken. Waist circumference ≥ 102 cm for males and ≥ 88 cm for females was regarded as abdominal obesity [13].

Each participant's blood pressure (BP) was measured using the standard procedure [14,15]. Three readings were taken at about 5 to 10 minutes interval and the mean of the last two was regarded as the subject's blood pressure. Hypertension was defined as BP ≥140/90mmHg.

Lipids Determination: Ten milliliters of venous blood was withdrawn from each subject into a container containing dry sodium ethylene diamine tetra-acetic acid (EDTA) (1mg ml^{-1}) mixed gently and separated and stored at -20ºC until analysis. Plasma total cholesterol, high density lipoprotein-cholesterol (HDL-C) and triglycerides were determined by enzymatic methods [16] using diagnostic sera kits by RANDOX Laboratories UK. Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald Formula [17] as shown:

$$\mathrm{LDL-C} = \text{total cholesterol} - \left(\mathrm{HDLC} + \frac{\text{Triglycerides}}{5\,*}\right)\mathrm{mg/dl}$$

* = 2.2 if units were expressed in mmol/L

For each batch of assay, a commercial control serum of known value was always included and all the parameters were assayed within the same period in order to minimize inter and intra batch errors.

Dyslipidemia was defined as raised plasma total cholesterol (TC), raised low density lipoprotein cholesterol (LDL-C), raised plasma triglyceride (TG) or Low high density lipoprotein cholesterol (HDLC) i.e. TC greater than 5.71mmol/L, LDLC greater than 3.28mmol/L, TG greater than 1.71mmol/L or HDLC less than 1.04mmol/L. Raised TG, TC or LDLC were collectively referred to as hyperlipidemia while raised levels of either or both TC/LDLC and TG with low HDLC level as applicable were termed combined dyslipidemia [18].

All participants who indicated interest in having their lipid profile results sent to them were duly obliged after the lipid assay.

2.1 Diagnosis of the Metabolic Syndrome [11-18]

Risk Factor	Defining Level
Abdominal obesity	
(Waist circumference)	
Men	>102 cm (>40inches)
Women	> 88cm (> 35 inches)
Triglycerides	≥150mg/dl(≥1.69 mmol/l)
HDL Cholesterol	
Men	< 40mg/dl (<1.03mmol/l)
Women	< 50mg/dl (<1.29mmol/l)
Blood Pressure	≥ 130/85 mmHg
Fasting Glucose	≥110mg/dl (6.6mmol)

Metabolic syndrome (MS) is present when three or more of the above cardiovascular risk factors as shown above are present.

2.2 Data Analysis

The excel worksheet was used fordata entry and graphic representation while the SPSS (16.0) statistical software was used for statistical analysis. The mean values, standard deviations and percentages were determined for each parameter. Where statistical significance was tested, values < 0.05 were regarded as significant.

3. RESULTS

As shown in Table 1, Compared to the females, the males were significantly older (46.1 ±9.6years Vs. 41.5 ±8.7 years; P= 0.000) and had significantly higher mean systolic (133.8 ± 19.7mmHg Vs. 125.7 ±19.2 mmHg; P= 0.005) and diastolic (85.2 ±12.7mmHg Vs. 79.6 ± 14.0 mmHg; P= 0.005) blood pressure while the females had significantly higher total cholesterol (TC) (4.7 ± 1.4 mmol/L) than the males (4.3 ± 1.1 mmol/L); P= 0.028. Between the senior staff and the junior staff, the senior staff were significantly older (44. ± 8.3 years Vs. 39.9± 10.2 years; P= 0.000) and had significantly higher Body Mass Index (BMI); (27.9 ± 4.0 Kg/M^2 Vs. 26.0 ± 4.5 Kg/M^{2}P= 0.003) and Waist Circumference (WC); (92.2 ±10.0 Cm Vs. 86.5 ± 10.5Cm; P= 0.000).

Table 2 shows that a total of 192 workers participated in this study of which 37% were male, 63% were females. 130 (67.7%) of them were senior staff, 62 (32.3%) were junior staff and 107 (55.7%) were less than 45 years whereas 85 (44.3%) were 45 years and above. Only 4 (2.1%); (2 males (5.6%) and 2 females (3.3%)) smoked cigarettes. Abdominal obesity was found in 42.7% (19.7% males and 56.2% females; P= 0.000). Of the total with abdominal obesity, 49.3% of them were senior staff while 27.4% were junior staff (P= 0.003). Hyperglycemia prevalence (20.3%) was insignificantly higher in females (20.7%) than males (19.7%); P= 0.500 as well as in Junior staff (24.2%) compared to senior staff (18.5%); P=0.273. High blood pressure was more prevalent among the males and senior staff than among the females and junior staff using 140/90 mmHg as cut off: Males; 57.7% vs. females; 34.7% P= 0.001 and Senior staff; 46.2% vs. junior staff; 37.1%, P= 0.152). Using 130/85 mmHg as cut-off: Males; 64.8% vs. females; 42.1% P= 0.002 and Senior staff; 53.8% vs. junior staff; 43.5%, P= 0.094)]. High triglycerides with total prevalence of 11.5% insignificantly occurred more in males (12.2%) than females (10.7%); P= 0.437 and in junior staff (12.9%) than senior staff (10.8%); P= 0.400. Prevalence of “Low” High Density Lipoprotein (66.0%) was significantly higher in senior staff (73.1%) than junior staff (51.6%); P= 0.004 as well as in females (71.1) than males (57.1%); P= 0.032.

As shown in Table 3, only 2.1% of the participants smoked tobacco. Abdominal obesity prevalence differed significantly (0.042) among certain age groups: being highest in the 40-49 year age group (51.3%), least in those less than 30 year (15.0%) with those 30-39 years and those 50 years and above having equal prevalence (41.5%) respectively. When grouped into those less than 45 years and above 45 years, the prevalence was higher in the older people (50.6% Vs. 36.4%; P= 0.08). Hyperglycemia prevalence increased with age in both age groupings but the difference was significant only between less than 45 years (13.1%) and above 45 years (29.4%); P= 0.007. Defining HBP as BP≥ 130/85 mmHg, high Bp prevalence significantly increased linearly in both age groupings (P= 0.000 respectively) but when high BP was defined as BP≥ 140/90 mmHg, high BP prevalence was highest in those 40- 49 years (55.1%) compared to those 50 years and above (51.2%) just as both high triglycerides and low HDL were most prevalent in them. Prevalence of both high triglycerides and low HDL showed no statistical significance among and between the various age groupings.

Table 4 showed that the female participants had higher prevalence of metabolic syndrome (33.9%) than the males (23.9%); P> 0.120). The senior staff had significantly higher prevalence (35.4%) than the junior staff (17.7%); P= 0.009. The prevalence of metabolic syndrome increased with BMI (< 25 Kg/M^2; 7.8%, 25-29.9 Kg/M^2; 33.7%, 30-34.9 Kg/M^2; 43.8%, ≥35 Kg/ M^2; 76.6%). The difference in prevalence was statistically significant (P=0.000).

Table 1. Mean values of the parameters

Parameter	Mean Value	Males	Females	P value	Senior staff	Junior staff	P value
Age (Years)	43.1 ± 9.3	46.1 ± 9.6	41.5 ±8.7	0.001*	44. ± 8.3	39.9± 10.2	0.000*
Body Mass Index (BMI) (Kg/M^2)	27.2 ± 4.3	26.6 ± 3.6	27.63 ± 4.6	0.08	27.9 ± 4.0	26.0 ± 4.5	0.003*
Waist Circumference (Cm)	90.4 ± 10.6	91.8 ±10.9	89.4 ± 10.2	0.128	92.2 ±10.0	86.5 ± 10.5	0.000*
Systolic Blood Pressure (BP) (mmHg)	129.0 ± 19.9	133.8 ± 19.7	125.7 ±19.2	0.005*	128.7 ± 18.4	128.8 ±22.3	0.978
Diastolic Blood Pressure (mmHg)	82.0 ± 13.9	85.2 ±12.7	79.6 ± 14.0	0.005*	81.6 ±14.7	81.7 ± 11.7	0.943
Fasting Blood Sugar (mg/dl)	101.3 ± 33.9	102.4 ± 29.6	100.4 ± 35.4	0.689	101.8 ± 36.3	99.8 ± 26.3	0.695
Total Cholesterol (TC) (mmol/L)	4.6 ± 1.3	4.3 ± 1.1	4.7 ± 1.4	0.028*	4.6 ± 1.3	4.4 ± 1.3	0.363
Triglyceride (Tg) (mmol/L)	1.1 ± 0.8	1.0 ± 0.7	1.1 ± 0.8	0.390	1.1 ± 0.7	1.2 ± 0.8	0.319
High Density Lipoprotein (HDL) (mmol/L)	1.1 ± 0.4	1.0 ± 0.3	1.1 ± 0.5	0.133	1.1 ± 0.5	1.2 ± 0.3	0.147
Low Density Lipoprotein (LDL) (mmol/ L)	2.8 ± 1.3	2.7 ± 1.1	2.9 ± 1.4	0.214	2.9 ± 1.3	2.6 ± 1.3	0.124

** significant*

Table 2. Prevalence of the various cardio-metabolic Risk Factors in the Institution by gender and rank

Grouping of participants N= 192	**General prevalence (%)**	**Prevalence by gender (%)**		**Prevalence by rank (%)**	
Parameters Number (%)	**All Participants N= 192 (100%)**	**Male N= 71 (37%)**	**Female N= 121 (63%)**	**Senior Staff N= 130 (67.7%)**	**Junior Staff N= 62 (32.3%)**
Smoking	2.1% N=4	5.6% N=2	3.3% N=2	2.3% N=3	1.6% N=1
P Value		1.000		0.63	
Abdominal Obesity (Cm)	42.7% N= 82	19.7% n=14	56.2% n= 68	49.3% n= 64	27.4% n= 18
P Value		0.000*		0.003*	
Hyperglycaemia (Mg/dl)	20.3% N= 39	19.7% n= 14	20.7% n= 25	18.5% n= 24	24.2% n= 15
P Value		0.500		0.273	
High Blood Pressure (BP≥ 140/90 mmHg)	43.2% N= 83	57.7% n= 41	34.7% n= 42	46.2% n= 60	37.1% n= 23
P Value		0.001*		0.152	
High Blood Pressure (BP≥ 130/85 mmHg)	50.5% N= 97	64.8% n= 46	42.1% n= 51	53.8% n= 70	43.5% n= 27
P Value		0.002*		0.094	
High Triglycerides (Tg) (mmol/L)	11.5% N 22	12.2% n= 9	10.7% n= 13	10.8% n= 14	12.9% n= 8
P Value		0.437		0.400	
Low High Density Lipoprotein (HDL)(mmol/L)	66.0% N= 127	57.1% n= 41 0.032*	71.1% n= 86	73.1% n= 95 0.004*	51.6% n= 32

Table 3. Prevalence of the various cardio-metabolic risk factors in the institution by age

Age groups	**< 30** **N= 20**	**30 – 39** **N= 53**	**40 – 49** **N= 78**	**≥ 50** **N= 41**	**Total**	**< 45 Years** N= 107 **(55.7%)**	**≥ 45 Years** N= 85 **(44.3%)**
Smoking	0 (0%)	2 (3.8%)	2 (2.6%)	0 (0%)	2.1% N=4	1.9% N=2	2.4% N=2
P Value	0.561					1.000	
Abdominal Obesity (Cm)	3 (15.0%)	22 (41.5%)	40 (51.3%)	17 (41.5%)	42.7% N= 82	36.4% n= 39	50.6% n= 43
P Value	0.042*					0.08	
Hyperglycemia (Mg/dl)	2 (10.0%)	6 (11.3%)	19 (24.4%)	12 (29.3%)	20.3% N= 39	13.1% n= 14	29.4% n= 25
P Value	0.071					0.007*	
High Blood Pressure (BP≥ 140/90 mmHg)	3 (15.0%)	16 (30.2%)	43 (55.1%)	21 (51.2%)	43.2% N= 83	32.7% n= 35	56.5% n= 48
P Value	0.001*					0.001*	
High Blood Pressure (BP≥ 130/85 mmHg)	3 (15.0%)	20 (37.7%)	48 (61.5%)	27 (65.9%)	50.5% N= 97	39.3% n=42	64.7% n= 55
P Value	0.000*					0.000*	
High Triglycerides (Tg) (mmol/L)	2 (10.0%)	4 (7.5%)	11 (14.1%)	5 (12.2%)	11.5% N 22	8.4% n= 9	15.3% n= 13
P Value	0.670					0.106	
Low High Density Lipoprotein (HDL)(mmol/L)	13 (65.0%)	34 (64.2%)	53 (67.9%)	27 (65.9%)	66.0 N= 127	62.6% n= 67	70.6% n= 60
	0.907					0.131	

*Significant

Table 4. Prevalence of metabolic syndrome in the institution by gender, rank and BMI

Groups		Prevalence (%)	P Value
Gender (%)	Male N= 71	23.9% n= 17	0.120
	Female N= 121	33.9% n= 41	
Rank	Senior Staff N= 130	35.4% n= 46	0.009*
	Junior Staff N= 62	17.7% n= 11	
Body Mass Index (BMI)(Kg/ M²)	< 25 N= 64	7.8% n= 5	0.000*
	25- 29.9 N= 83	33.7% n= 28	
	30- 34.9 N= 32	43.8% n= 14	
	≥35 N= 13	76.9% n= 10	

**Significant*

Table 5 showed that the prevalence of metabolic syndrome increased with age in the general population (P= 0.000) and among the females irrespective of the age group divide. Among the males, those ≥ 50 years had the highest prevalence (29.2%) while those 40 – 49 years had the least prevalence (22.2%) behind the youngest age group (30 – 39 year; (26.7%). Before age 30years, no one had metabolic syndrome. For the age group <45 and ≥ 45 years, the prevalence was significantly higher in those ≥ 45years (0.000). Between the males and females in the different age groups, the difference in prevalence was significant in those 40 – 49 years (males; 22.2%, females; 51.0%: P= 0.017). When the participants were split into only two groups, the difference between the prevalence in males and females was significant in those ≥ 45 years (P= 0.008).

As shown in Table 6, generally and within all Blood pressure divide, the female participants had higher prevalence of metabolic syndrome in both hypertensive and non-hypertensives. Although the differences in prevalence in both sexes were not significant in the general population (Males (33.1%), males (23.9%); P= 0.195), the difference was significant in all the blood pressure divides except in those with systolic HBP and those with combined systolic and diastolic HBP.

Table 5. Prevalence of metabolic syndrome in the institution among various age groups of workers

Age group (years)	Males	Females	P Value	All subjects	P value
< 30	0 (0%) N=5	0 (0%) N=15		0 (0%) N=20	0.000*
30 - 39	4 (26.7%) N=15	4 (10.5%) N=38	0.202	8 (15.1%) N=53	
40 - 49	6 (22.2%) N=27	26 (51.0%) N= 51	0.017*	32 (41.0%) N=78	
≥ 50	7 (29.2%) N=24	10 (58.8%) N=17	0.107	24 (41.5%) N=41	
Total	17 (23.9%) N=71	40 (33.1%) N=121	0.195	57 (29.7%) N=192	
<45	4 (13.3%) 30	11 (14.3%) 77	1.000	16 (14.9%) N=107	0.000*
≥ 45	13 (33.8%) N=39	29 (63.0%) N=46	0.008*	43 (50.6%) N=85	

**Significant*

Table 6. Prevalence of metabolic syndrome in the institution among various blood pressure groups among the workers

Metabolic Syndrome		Males	Females	P value
All participants	57 (29.7%) N=192	17 (23.9%) N=71	40 (33.1%) N=121	0.195
All those with systolic HBP	35 (53.8%) N=65	14 (42.4%) n= 33	21 (65.6%) n= 32	0.083
All with diastolic HBP	27 (40.9%) N= 66	10 (29.4%) n= 34	17 (53.1%) n= 32	0.044*
Those with both systolic and diastolic HBP together	22 (44.0%) N= 50	10 (35.7%) n=28	12 (54.5%) n=22	0.148
Those with Either Systolic HBP or Diastolic HBP or both using BP ≥ 140/90 mmHg	41 (49.4%) N= 83	15 (36.6%) n=41	26 (61.9%) n=42	0.028*
HBP using BP ≥ 130/85 mmHg	50 (51.0%) N= 98	16 (34.8%) n=46	34 (65.4%) n=52	0.002*
Non hypertensives BP ≤140/90 mmHg	16 (14.7%) N= 109	2 (6.7%) n= 30	14 (17.7%) n= 79	0.028*
Non hypertensives BP ≤130/85 mmHg	7 (7.4%) N= 94	1 (4.0%) n=25	6 (8.7%) n= 69	0.004*

**Significant*

4. DISCUSSION

The mean age of workers in the University was 43.1±9.3 years with the males being significantly older (46.1±9.6 years) than the females (41.1±8.7years); P= 0.001.

Abdominal obesity prevalence in this study was 42.7% which is higher compared to some others both locally and elsewhere [19-22] but lower than in some other African [23-25] and European countries[8]. The use of ≥94 cm as cut off for males and ≥80cm in defining abdominal obesity in some of those studies may have been responsible for the difference as present study used ≥102cm and ≥88cm respectively as cut off. In the same way, the use of waist to hip ratio (WHR) to determine abdominal obesity in some of those studies instead of waist circumference (WC) [11,12,23] may have also accounted for the difference in prevalence values. Again, different lifestyles and feeding habits between those countries/population samples and between geographical areas even in Nigeria might also have contributed to the different prevalence findings.

However, this study agreed with others in finding higher obesity prevalence in females than males with a statistically very significant difference in overall prevalence between them. (females (56.2%); males (19.7%): P= 0.000).

A study conducted among workers in a South Western Cameroun University [18] reported higher obesity prevalence. However, no objective comparison cannot be made, as, that studyassessed global instead of abdominal obesity.

Like in the Camerounian University study [18], triglyceride (Tg) correlated with age in this study though not significantly unlike in that other study in which the correlation was significant. Hypertriglyceridemia was found in 11.5% of the participants (males; 12.2%, females; 10.7%). Whereas the prevalence of hypertriglyceridemia in this study was higher in those ≥45 years (15.3%) than in those <45 years (8.4%), there was also no statistical significance between these. Again, when split further, the prevalence was highest in those 40- 49 years (14.1%) followed by those ≥50 years (12.2%) and those 30-39 years coming least (7.5%) behind those < 30years (10.0%). These differences were generally not statistically significant (P=0.670).

Compared to community based studies in Nigeria [22,23,26] and other countries inIran [27], this general prevalence finding is still, on a general note lower but however, higher than the finding in Asian Indians [19]. It is also much higher than the finding in a rural study in western Nigeria in which prevalence was only 1.9% [28]. This may not be surprising since this present study comprised workers of different income levels and as such feeding habits and life style would differ between them compared to the rural inhabitants of that study. Previous studies have shown higher prevalence in urban compared to rural dwellers [22]. As in all the other studies, hypertriglyceridemia prevalence was higher in males compared to females. Compared to the findings of a study conducted in a Brazilian University [29], this study found respectively higher prevalence of low HDL and lower hypertriglyceridemia.

Prevalence of low high-density Lipoprotein-Cholesterol (low HDL) was 66.0% (males 57.1%; females: 71.1%)and thus higher than the finding in government workers in Bahrain [30]. Contrary to the finding of that study in which prevalence was higher in males, the females in this study had significantly higher prevalence of low HDL (71.1%) than the males (57.1%); p=0.032. It was also higher than that in a rural Nigerian study [31] conducted in South-West Nigeria. Whereas differences in socio economic status may be adduced as the reason for the varying finding in this and the rural community study, there is no handy explanation as to why the females had higher prevalence of low HDL in this study while males had higher prevalence in that Bahrain study [30]. Neither this nor that study had information on the participants' alcohol history for comparison since alcohol is generally known to influence HDL metabolism. Compared to the findings of a study conducted in a Brazilian University [29], this study found higher prevalence of low HDL. Whereas that study involved participants 35-64 yrs, this one included all workers from 20 yrs.

The general prevalence of hypertension in this study was 43.2% (Males: 57.7%, Females: 34.7%) which is lower than the finding in some recent studies in an urban city located in the same geopolitical zone of Nigeria [32,33] as the University studied in this research but higher than prevalence value found in a recent rural community study in south-West Nigeria [34]. It is also lower than the prevalence reported in some other African country [35]. This prevalence finding being lower than findings in urban studies but higher than findings in some rural studies may not be surprising since the University community could be described as a mixed socioeconomic group (considering that both senior and junior staff were involved in the study). It also shows that whereas it may not suggest a further rise in prevalence, it is still an important cardiovascular risk factor not to relent in efforts to tackle. To buttress this is the fact that this prevalence finding is also higher than recent finding in people working in other universities and some other cooperate institutions both in Western and Northern Nigeria and in some other countries [26,28]. This higher hypertension prevalence found in this study; conducted nearly a decade after that in a Northern University in the same country, Nigeria [26] suggests that rather than dropping among the people that constitute the major work force of the country, hypertension prevalence is rising. Since the age range of employees in the University is same with that of those employed in different segments of the nation's economy, the possible negative economic implication of this rising cardiovascular risk factor in the long run should not be overlooked.

Generally, 2.1% (males; 2.8%, Females; 1.7%) of the participants smoked cigarettes; more senior staff (2.3%) than junior staff (1.6%). As found in other studies which showed that the likelihood of being a smoker decreased with age [4], smokers in this study clustered between 30-49years; no one above this age was found to be among the smokers. However, this smoking prevalence was lower than the finding in some community based studies in some African [36,37] and other non - African countries [38,39] as well as in students and workers (University and non-university workers) previously/ recently studied in other parts of Nigeria, some Asian and South American countries [26-29]. On the other hand, the ratio of male to female smokers is narrower in this study than in some of the other previous studies [26] probably because of less number of smokers in this study. This lower smoking prevalence is a welcome development as smoking is a key factor in determining and modifying the cardio-metabolic syndrome and its outcome aside playing a major adverse role in respiratory and other undesirable non communicable diseases. Therefore, efforts should be made to further encourage smoking cessation and even non initiation of smoking in the first place.

The Mean fasting glucose in this study was 101.3 mg/dl (5.62mmol/L) and as found in some other recent community based study in Nigeria [25], it was higher in males (102.4 $\pm$ 33.9mg/dl) than in females (100.4 $\pm$ 29.6mg/dl) and as also in that urban community based study, the difference was not statistically significant (P= 0.689).

Prevalence of hyperglycemia in this study (20.3%) was higher than the prevalence found in University workers in Brazil [13] as well as in teachers and bankers in different parts of Nigeria [14] with females being insignificantly more affected (20.7%) than males (19.7%); P= 0.500. It was also higher than that in a hospital-based survey in Nigeria [29] and in urban community in Northern Nigeria [25]. Smoking, hypertension and hypertriglyceridemia respectively occurred more in males than females while abnormal obesity, hyperglycemia and low HDL occurred more in females than males. In a study done in South Africa, all risk factors except obesity occurred more in males than females [30]. The varying ages of participants in these different studies and variations in geographical zones of these studies (with varying feeding and life styles of their inhabitants) may account for these variations in findings. Previous studies have shown that diabetes mellitus and hypertension vary with place of domicile [15,25,30,31].

29.7% of the participants had metabolic syndrome (33.1%% females vs. 23.9% males). This is higher than the finding by other researchers in other countries [12,23,32] and in Nigeria [15]; interestingly including some that are hospital based [29] and in a study done in the United states [30,31] among people of similar age group as those in this study. Contrary to that hospital study, the prevalence (33.9%) was higher in females than males (23.9%) in this study; although not statistically significant (P = 0.120). It is nevertheless lower than the 40 – 60% extrapolated to be the prevalence rate in middle class Africans [30]. In comparison with a community-based survey done in the same geopolitical zone as this one, this metabolic syndrome prevalence is lower than that in the slum but higher than in that in the rural participants in that study [19].

There was a significant positive linear relationship between BMI and metabolic syndrome prevalence (P = 0.000) in this study. Senior staff were also significantly more affected (35.4%) than junior staff (17.7%); P = 0.009. Since senior staff are on a general note more likely to be more educated than the junior staff, this higher prevalence in senior staff seems to be at variance with studies which found inverse relationship between MS and education [31]. The reason for these varying results needs to be elucidated. One may postulate that education in terms of academic certificates may not necessarily be equated to health education. Thus, since the other study was conducted in the United States, these varying findings may suggest that educational status over there may correlate to health awareness.

In the general population and within the females, prevalence of MS also increased with age (P =0.000) irrespective of the age group divide. This trend had been demonstrated in previous studies [30,31]. However, when participants were grouped into four viz: <30 years, 30-39yrs, 40-49yrs and more than or equal to 50yrs, no participant less than 30yrs (both within the males and females) had MS. This finding contradicts what was recently documented to be the current trend in Nigerias [30] where MS prevalence was reported to be 11% in those 20-29yrs. On the other hand, within the males, MS prevalence was highest in those ≥50 yrs (41.5%) but the younger age group (30-39yrs) had higher prevalence (26.7%) than those immediately older than them (40-49yrs; 22.2%). Like in the females, the males who were ≥ 49yrs had higher prevalence (33.8%) than in those < 45yrs (13.3%). Except within the age group 30-39yrs in whom MS prevalence was insignificantly higher in males (26.7%) than females (10.5%); P= 0.202, MS prevalence in females was higher than that in males within all the other age groups. This difference was, however, significant only within the 40-49yr age group (males 22.2%,females 51.0% p = 0.017). In the age group divide that grouped the participants as those < 45yrs and those ≥ 45yrs, the difference in MS prevalence between the males and females was significant only in the age group ≥ 45yrs (males; 33.8%, females; 63.0%: P= 0.008).

Contrary to the finding in this study, some other studies in Nigeria found higher prevalence in males than females [29,30]. One of the studies [29] was, however, hospital based and included only participants 40- 70yrs whereas the ages of participants in this study ranged from 24 to 67years. Aside the difference in age range between this study and that one, awareness may have played a role in the lower prevalence finding in the hospital based study since it included apparently healthy hospital workers (with likely better awareness on health related issues) as well as individuals who came on routine biochemical evaluation for medical checkup. One can arguably assume that someone who goes on self-advised medical checkup undoubtedly has higher health awareness than someone who does not. Thus, the chances are that the participants in that other study might be better informed about habits and other lifestyle/factors that may influence development of metabolic syndrome and may apply to them more positively. A study which assessed metabolic syndrome in two different communities in Northern part of Nigeria further buttressed the role of lifestyle in prevalence of MS. That study suggested high activity profile in females of that part of Northern Nigeria as a possible reason for the higher MS prevalence in males of that community (who are comparatively more sedentary) than the females [30]as against the other parts of the Northern Nigeria like in Sokoto where religious practice like puddah makes women sedentary.

The general MS prevalence finding in this study (29.7%) is comparable; though slightly higher, than findings in some recent studies both in the same country [15]and elsewhere [16,31]. Unlike in this and many other studies in which metabolic syndrome occurred more in females, the male participants in some other studies with similar age as this one [31,32] had higher prevalence than the females. Whereas this fairly comparable prevalence finding in that study reflected a reduction from their previously reported MS prevalence, it is worrisome that the prevalence finding in this institution of higher learning in Nigeria is still higher than some recent findings locally and elsewhere [29,30,32]. Hence, something needs to be done urgently to curb and reverse this trend early. The higher MS prevalence found in the female participants of this study agrees with previously documented findings stating the female gender to be positively associated with MS [30,31].

In agreement with what has been documented from review of recent studies [15,30], hypertensive participants in this study had higher prevalence of MS (irrespective of whether it was systolic, diastolic or combined HBP) compared to non-hypertensive participants. When compared with previous Nigerian studies, this prevalence value in these hypertensive participants (49.4%) is higher than what had been reported in hypertensive Nigerians previously [30].

5. CONCLUSION

Metabolic risk indices are prevalent among the workers in the South East Nigeria University studied. Although further studies which will include a higher number of the University workers is needed to really validate this seeming rising trend, the finding in this study should not be undermined (a stitch in time saves nine).

6. LIMITATION OF THE STUDY

The major limitation of this study was the number of participants compared to the general university population. The plausible explanation may be that this study was conducted in the administrative block of the institution and so, academic and non-academic staff whose offices were outside the administrative block may not take the pains to come down to that venue but may have willingly wanted to assess their cardiovascular risk if the venue was closer to them. More so office workload and individual inertia may also be contributory to the paucity of staff participation. Therefore, the findings recorded in this study may have differed if the venue was rotated to other points in the institution to bring it closer to those who may not be as keen as those who came down to participate.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

Ethical approval was obtained from the university ethical committee and each participant confirmed interest in writing.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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