Original Research Article

Metabolic Syndrome and its association Cardiometabolic risk factors; Prevalence among apparently healthy adults in a rural community in southwestern Nigeria

Abstract

Aim: The study assessed the prevalence of cardiometabolic risk factors associated with metabolic syndrome among apparently healthy adults in rural settlements.

Study design: Descriptive cross-sectional study with

Place and Duration: Ejigbo, a rural settlement in Osun State, Southwestern Nigeria, between September and December 2019.

Methodology: 271 apparently healthy individuals were recruited using a multistage sampling technique with the WHO STEPS Instrument questionnaire, level of significance set at P= 0.05

Results: The prevalences of overweight and obesity were 96 (35.4%) and 66 (24.4%) respectively. The prevalence of hypertension among respondents was 83 (30.6%). High plasma levels of Total Cholesterol 64 (23.6%), triglyceride 20 (7.4%), LDL-Cholesterol 28 (10.3%) and very high LDL-Cholesterol 31 (11.5%) were found among the respondents. While 72 (26.6%) of the respondents have a low level of HDL-Cholesterol. The prevalence of impaired glucose tolerance among the respondents was 34 (12.6%) when 45 (16.6%) had diabetic plasma glucose levels and 82 (30.3%) for metabolic syndrome.

Conclusion: Cardiometabolic risk factors were very high among rural dwellers, especially people without metabolic syndrome. Public awareness, therefore about those risk factors, should be intensified. Routine medical check-ups and screening should be encouraged.

Keywords: Cardiometabiolic, Metabolic syndrome, Pre-hypertension, Impaired glucose

Introduction

Metabolic syndrome is the aggregation of several known cardiovascular risk factors. These include insulin resistance, obesity, atherogenic dyslipidemia, and hypertension. It's often asymptomatic. These conditions have interrelated mechanisms, pathways, and underlying mediators.[1] It is generally agreed that having three or more of this aetiologically linked cardiometabolic risk factors increases the risk of developing multiple chronic diseases such as cardiovascular disease, type 2 diabetes (T2DM), arthritis, chronic kidney disease, schizophrenia, and cancer.[2] It is a worldwide epidemic disorder with a high socio-economic impact due to increased morbidity and mortality.[3] The main causes are increasing urbanization, nutrition changes, and reduced physical activity. Metabolic syndromes consist of several metabolic and physiological abnormalities, including abdominal obesity, impaired glucose tolerance, hypertriglyceridemia, decreased high-density lipoprotein cholesterol (HDL-C), and arterial hypertension. This syndrome increases the risk of developing type 2 diabetes mellitus by twofold and cardiovascular diseases (CVDs) by fivefold compared with apparently healthy persons.[1,3,4,5]

It is estimated by National Health and Nutrition Examination, that approximately 30% of overweight and 60% of obese men and women meet the criteria for a diagnosis of Metabolic syndrome.[4] It is estimated by the Framingham study that approximately 80% of essential hypertension in men and 65% in women is directly attributed to obesity.[6] The clustering of CVD risk factors that illustrates Metabolic syndrome is now considered to be the driving force for a new CVD epidemic and people with T2DM who have MetS carry a much higher risk of CVD than those who have T2DM alone.[7] Hypertension has been observed as one of the major risk factors associated with cardiovascular diseases, and a component of metabolic syndrome.[8] In individuals with uncontrolled blood pressure, the prevalence of metabolic syndrome and type 2

diabetes is significantly increased compared with those with controlled blood pressure.[9] Each component of the Metabolic syndrome is an independent risk factor for developing cardiovascular disease and producing a spectrum of vascular and cardiac diseases.[4] The mean overall prevalence of metabolic syndrome in Nigeria is 31.7%, 27.9% and 28.1% according to the World Health Organization (WHO), Adult Treatment Panel III (ATP III) and International Diabetes Federation (IDF) criteria, respectively [10]

During the past several decades, the prevalence of Metabolic Syndrome has markedly increased worldwide. It is estimated that 25% of the world's population has Metabolic Syndrome although this estimate varies widely due to the age, ethnicity, and gender of the population studied. Metabolic syndrome is associated with high socioeconomic costs. Behavioural and environmental changes, such as the adoption of a westernized diet and a sedentary lifestyle following the socioeconomic rise in developing countries, are thought to be the main reasons for this pandemic of metabolic syndrome.[2] Global prevalence of Metabolic syndrome ranges from <10% to 84% depending on the geographical, cultural and demographical (age, sex, ethnicity, social status, physical status of obesity) distribution in different regions of the world. Hence, there must be a proper understanding of the distribution of the syndrome in a particular geographical area.[11]

Because of the various factors that determine the prevalence and distribution of Metabolic Syndrome and its components[1,12,10, 13] thus, the study was carried out in a rural settlement, where there are ongoing demographical changes, to assess the prevalence of cardiometabolic risk factors associated with metabolic syndrome among apparently healthy adults.

Materials and Methods

It was a cross-sectional study conducted at Ejigbo, a rural settlement in Osun State, Southwestern Nigeria. Apparently healthy 271 individuals were recruited into the study using a multistage sampling technique. Adults who have lived in Ejigbo for at least one year were included in the study. Individuals with a history of cardiovascular diseases, cancer, type 2 diabetes mellitus, renal diseases, pregnancy, and taking medications for hypertension or dyslipidemia were excluded from the study.

In the first stage, out of the 30 Local Government Areas (LGAs) in Osun State, Ejigbo was selected from the list by simple random method (balloting technique). The Second stage involved the selection of 6 wards out of the existing 11 electoral wards from a list obtained from the LGA secretariat using a simple random sampling method (balloting technique). In the third stage, all households with eligible respondents in each of the selected electoral wards were then identified. They were instructed on overnight fasting, and questionnaires were administered. Where a household has more than one eligible respondent, one of them was chosen via a simple random sampling method.

WHO STEPS Instrument (core and Expanded) questionnaires were administered to obtain information from each participant. Anthropometric measurements were taken. About 10mls of fasting blood samples were taken following an aseptic procedure for phlebotomy into two separate bottles – lithium heparin and fluoride oxalate. The samples were centrifuged at x3000g and separated and the plasma obtained was stored at -4^0C in the laboratory. The stored samples were analyzed in batches using ready-to-use commercial kits manufactured by Randox Laboratories Ltd, Crumlin, County Antrim United Kingdom. All the analyses were done following the manufacturer's instructions and along with controls.

Lipid parameters – High-density lipoprotein cholesterol (HDL- C), Triglycerides and Total cholesterol (TC) were analyzed using the enzymatic method employed by the kits.[14] Low-density lipoprotein cholesterol (LDL-C) was calculated by the use of the Friedewald equation.[15] Fasting plasma glucose was determined using enzymatic oxidation in the presence of glucose oxidase, urea by the Urease-Berthelot method, uric acid by enzymatic colourimetric method and creatinine by the modified Jaffe Method.[16,17] Lipid profile was categorized according to Adult Treatment Panel III (ATP III) classification.[18] while blood pressure was classified into normal, pre-hypertension and hypertension according to Joint National Committee (JNC 7).[19]

In this study, International Diabetic Foundation IDF criteria for metabolic syndrome were employed to define the presence of the syndrome in the study population because of its flexibility in requiring obesity and not necessarily insulin resistance but still retained other criteria like the NCEP ATP III definition. The key features are hyperglycemia/insulin resistance, visceral obesity, atherogenic dyslipidemia and hypertension, and at least any three of the five criteria define metabolic syndrome.[1] The Statistical Package for Social Sciences (SPSS) version 23 (SPSS Inc., Chicago, IL, IBM Version) was used for entry and analysis of the data obtained. Univariate analysis of all the variables measured was first carried out. Data were presented using frequency distribution tables and charts. Association between metabolic syndrome and other categorical variables was assessed using a chi-square. For every cell with an expected value less than 5, Fisher's Exact Test was used to determine the statistical significance. In the multivariate analysis, a stepwise model of binary logistic regression analysis was done to determine the predictors of future metabolic syndrome. Variables imputed into the logistic model were selected based on their level of significance during bi-variate analysis. Adjusted odds ratio and 95%

confidence interval were obtained to identify determinants of metabolic syndrome. The level of significance was set at P = 0.05 for this study.

Ethical approval was obtained from Bowen University Teaching Hospital's (BUTH) ethical review committee. The respondents were informed about the nature of the study and that participation was completely voluntary. Written informed consent was obtained from all selected respondents before recruitment into the study. All information gathered was kept confidential and participants were identified using only serial numbers.

Results

Table1 Socio-economic status of the respondents (n=271)

Variable	Frequency	Percentage (%)
Age (years)		
Range: 18 – 92		
<40	38	14.0
40 – 49	40	14.8
50 -59	49	18.1
60 – 69	73	26.9
≥70	71	26.2
Sex		
Male	110	40.6
Female	161	59.4
Education		
Less Secondary School	141	52.0
Secondary or More	130	48.0
Marital Status		
Currently married	177	65.3
Currently unmarried	94	34.7
Ethnic Group		
Yoruba	266	98.2
Igbo	3	1.1
Others	2	0.7

The youngest and oldest in the study population were 18 years and 92 years respectively. Majorities were 60 years and above; 73 (26.9%), and 71 (26.9%) respectively. Only 38 of the

study participants representing 14% were below 40 years. Over half of the respondents were females 161(54.4%) compared with males; 110 (40.6%). About 141(52%) of the study participants had less than a secondary school education. 177 (65.3%) were currently married while 94 (34.7%) were single. Nearly all 266 (98.2%) respondents were from the Yoruba ethnic group.

Table 2: Distribution of Nutritional and Cardiometabolic risk factors among the respondents (N=271)

Variables	Frequency	Percentage (%)
Body Mass Index (Kg/m^2)		
Underweight	7	2.6
Normal	102	37.6
Overweight	96	35.4
Obesity	66	24.4
Waist Height Ratio		
Low risk (<0.5)	70	25.8
High Risk (≥0.5)	201	74.2
Waist Hip Ratio		
Low Risk	93	34.3
High Risk	178	65.7
Waist Circumference (cm)		
Normal	113	41.7
At risk	53	19.6
Significant Risk (abdominal Obesity)	105	38.7
Blood Pressure (mmHg)		
Systolic		
Normal	70	25.8
Pre-HT	100	36.9
HT	101	37.3
Diastolic		
Normal	130	48.0
Pre-HT	69	25.5
HT	72	26.6
Combined		
Normal	120	44.3
Pre-HT	68	25.1
HT	83	30.6
Total Cholesterol (mmol/L)		
Desirable	159	58.7
Borderline	48	17.7
High	64	23.6
Triglyceride (mmol/L)		
Optimal	191	70.4
Normal	33	12.2
Borderline	27	10.0
High	20	7.4
LDL-Cholesterol (mmol/L)		
Optimal	117	43.2
Near-Optimal	48	17.7
Borderline	47	17.3
High	28	10.3

Very High	31	11.5
HDL-Cholesterol (mmol/L)		
Optimal	132	48.7
Borderline	67	24.7
Risk factor	72	26.6
Fasting Blood Glucose (mmol/L)		
Normal	192	70.8
Impaired glucose tolerance	34	12.6
Diabetes mellitus	45	16.6
Urea (mmol/L)		
Normal Level	253	93.4
Abnormal	18	6.6
Creatinine (mmol/L)		
Normal	231	86.2
Abnormal	37	13.8
Uric Acid (mmol/L)		
Normal	269	99.2
Abnormal	2	0.8

The prevalences of overweight and obesity were 96 (35.4%) and 66 (24.4%) respectively. The majority of the respondents 201 (74.2%) and 178 (65.7%) had high risk according to Waist Height Ratio and Waist Hip Ratio respectively. 105 (38.7%) had significant risk (abdominal Obesity) while 53 (19.6%) were at risk using their Waist Circumference. Pre-hypertensive category among the study participants were 100 (36.9%), 69 (25.5%) and 68 (25.1%) for systolic, diastolic and combined measurements respectively. The prevalence of hypertension among respondents was 101 (37.3%), 72 (26.6%) and 83 (30.6%) for systolic, diastolic and combined respectively. Prevalence of dyslipidemias was 64 (23.6%), 20 (7.4%), 28 (10.3%) and 31 (11.5%) for high plasma levels of total Cholesterol, triglyceride, LDL-Cholesterol and very high LDL-Cholesterol respectively. While 72 (26.6%) of HDL-Cholesterol were at risk. The prevalence of impaired glucose tolerance among the respondents was 34 (12.6%) while 45 (16.6%) had diabetic plasma glucose levels. A significant proportion of the respondents had normal plasma levels of urea 253 (93.4), creatinine 231 (86.2) and uric acid 269 (99.2).

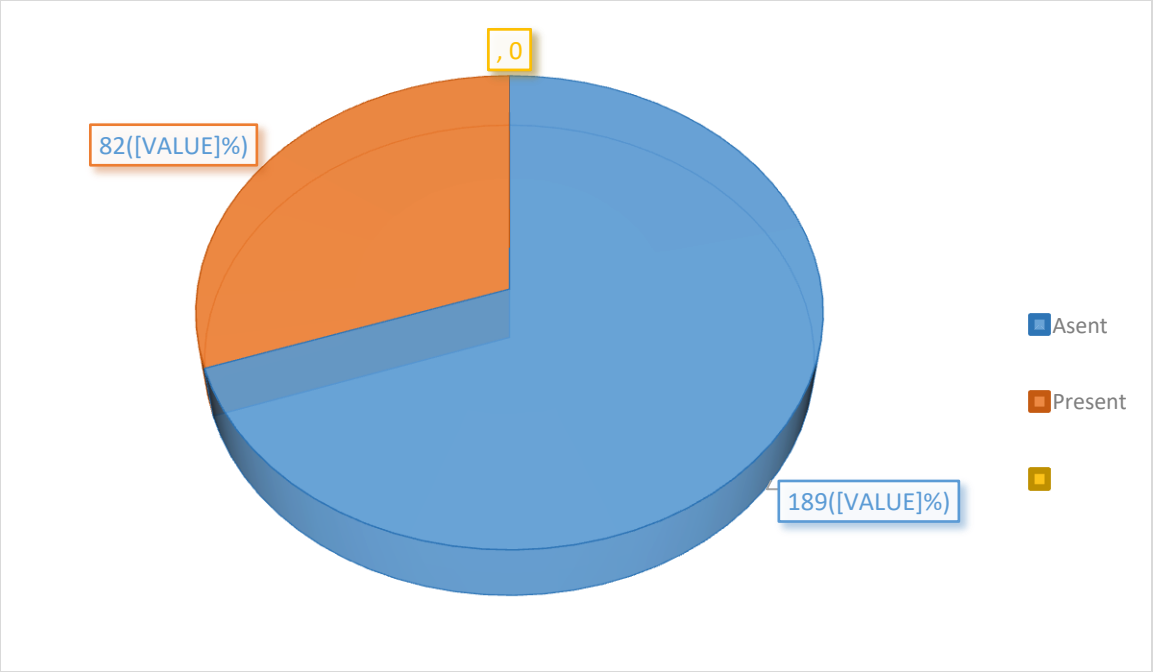

Figure 1 Prevalence of Metabolic Syndrome (n=271)

Figure 1 shows a prevalence of 82 (30.3%) for metabolic syndrome.

Table 3: Factors associated with Metabolic syndrome at the bivariate analysis level (N = 271)

Variable	Metabolic Syndrome n (%)		p-value
	Absent (n = 189)	**Present (n = 82)**	
Age (in years)	58.00 ± 16.00	59 ± 14.00	0.534[a]
Sex			**0.002***
Male	88 (80.0)	22 (20.0)	
Female	101 (62.7)	60 (37.3)	
Education			0.147 [b]
Less Secondary School	104 (73.8)	37 (26.2)	
Secondary or More	85 (65.4)	45 (34.6)	
Marital Status			0.877 [b]
Currently married	124 (70.1)	53 (29.9)	
Currently unmarried	65 (69.1)	29 (30.9)	
Ethnic Group			0.052 [b]
Yoruba	186 (69.9)	80 (30.1)	
Igbo	3 (100)	0 (0)	
Others	0 (0)	2 (100)	
BMI			**<0.001*** [b]
Underweight	7 (100)	0 (0)	
Normal	89 (87.3)	13 (12.7)	
Overweight	70 (72.9)	26 (27.1)	
Obesity	23 (34.8)	43 (65.2)	
Waist-to-height ratio			**<0.001*** [b]
Low risk (<0.5)	66 (94.3)	4 (5.7)	
High Risk (≥0.5)	123 (61.2)	78 (38.8)	
Waist-hip ratio			**0.005*** [b]
Low Risk	75 (80.6)	18 (19.4)	
High Risk	114 (64.0)	64 (36.0)	
Waist circumference			**<0.001*** [b]
Normal	106 (93.8)	7 (6.2)	
At risk	42 (79.2)	11 (20.0)	
Abdominal Obesity	41 (39.0)	64 (61.0)	
Blood Pressure			
Systolic			**<0.001*** [b]
Normal	63 (90.0)	7 (10.0)	
Pre- Hypertension	69 (69.0)	31 (31.0)	
Hypertension	57 (56.4)	44 (43.6)	
Diastolic			**0.001*** [b]
Normal	105 (80.8)	25 (19.2)	
Pre- Hypertension	42 (60.9)	27 (39.1)	
Hypertension	42(58.3)	30 (41.7)	
Combined			**<0.001*** [b]
Normal	108 (90.0)	12 (10.0)	

Pre-Hypertension	35 (51.5)	33 (48.5)	
Hypertension	46 (55.4)	37 (44.6)	
Fasting blood sugar			**<0.001*** [b]
Normal	160 (83.3)	32 (16.7)	
Impaired glucose tolerance	14 (41.2)	20 (58.8)	
Diabetes mellitus	15 (33.3)	30 (66.7)	
Total cholesterol (mmol/L)	5.13 ± 1.63	5.29 ± 2.04	0.493 [a]
Triglyceride (mmol/L)	0.91 ± 0.54	1.30 ± 1.07	**<0.001*** [a]
HDL-C (mmol/L)	1.69 ± 0.61	1.27 ± 0.68	**<0.001*** [a]
LDL-C (mmol/L)	2.96 ± 1.46	3.35 ± 1.66	0.057 [a]
Creatinine (µmol/L	89.65 ± 38.17	81.73 ± 32.76	0.103 [a]
Urea (mmol/L)	3.45 ± 1.72	3.45 ± 1.42	0.967 [a]
Uric Acid (mmol/L)	0.344 ± 0.37	0.32 ± 0.12	0.595 [a]

* statistically significant [a] t-test for independent samples used [b] Pearson chi-square test used

There was no significant difference between the mean age among respondents for the absence of 58±16 and the presence of 59±14 of metabolic syndromes. More female respondents 60 (37.3%) had metabolic syndromes compared to males 22 (20%) and the difference was significant, (P= 0.002). There was a significant difference in the BMI for the absence and presence of metabolic syndrome for overweight (70; 72.9% vs 26; 27.1%) and obesity (23; 34.8% vs 43; 65.2%) P-value <0.001. Presence and absence of metabolic syndromes for Waist-to-height ratio low risk (66; 94.3% vs 4 (5.7%); high risk (123; 61.2% vs 78; 38.8%), P-value =0.001 and Waist-hip ratio low risk (75; 80.6% vs 18; 19.4%); high 114; 64% vs 64; 36%), P-value=0.005. A significant difference was observed among participants with the presence and absence of metabolic syndromes for different categories of Waist circumference; normal (7;10% vs 106; 93.8%), At risk (11;20% vs 42;79.2%) and abdominal obesity (64; 61.0%vs 41;39.0%), p-value <0.001. In blood pressure, a statistically significant percentage of the participants have a metabolic syndrome for pre-hypertensive and hypertensive categories; systolic (31;31.0% and 44;43.6%), diastolic (25; 19.2% and 30; 44.7%) and combined (33; 48.5% and 37; 44.6%), p<0.001. A significant percentage of participants with impaired glucose tolerance and diabetic

Mellitus have metabolic syndromes 20 (58.5%) and 30 (66.7%) respectively when compared with normal plasma glucose level 32 (16.7%), P-value<0.001. The plasma level of triglyceride for participants with metabolic syndrome was greater than that of participants with the absence of metabolic syndrome (1.30±1.07vs0.91±0.54) and the difference was significant, P-value<0.001. The plasma level of HDL-C for participants with metabolic syndrome was significantly less than those of the participants with the absence of metabolic syndrome (1.27±0.68vs1.69±0.61), P-value <0.001. Various degrees of differences were observed in the plasma level of total cholesterol, LDL-C, creatinine, urea and uric acid among participants with metabolic syndrome when compared with participants without metabolic syndrome but these differences were not significant.

Table 4: Predictors of Metabolic Syndrome using binary logistic regression analysis

Variable	Adjusted Odds Ratio	P-Value	95% CI	
			Lower	Upper
Age	0.98	0.314	0.935	1.022
Sex				
Male (R)	1	1		
Female	1.29	0.763	0.245	6.819
Waist circumference				
Normal (R)	1	1		
At risk	0.72	0.775	0.075	6.936
Abdominal Obesity	75.65	**0.001***	6.158	929.202
Fasting blood sugar				
Normal (R)	1	1		
Impaired glucose tolerance	57.07	**<0.001***	7.160	454.906
Diabetes mellitus	63.07	**<0.001***	8.246	482.298
Systolic blood pressure				
Normal (R)	1	1		
Pre-hypertension	26.05	**0.001***	3.510	193.291
Hypertension	27.7	**0.002**	3.334	230.096
Diastolic blood pressure				
Normal (R)	1	1		
Prehypertension	1.79	0.403	0.457	7.020
Hypertension	2.19	0.350	0.424	11.305
Waist-to-height ratio				
Low risk (R)	1	1		
High Risk	5.92	0.185	0.424	11.305
Waist-hip ratio				
Low risk (R)	1	1		
High risk	0.707	0.655	0.155	3.222
Body mass index				
Normal (R)	1	1		
Overweight	0.566	0.448	0.130	2.459
Obesity	2.207	0.324	0.457	10.663
Total cholesterol	1.242	0.871	0.090	17.182
Triglyceride	9.543	**0.011***	1.678	54.290
LDLC	0.764	0.838	0.058	10.058
HDLC	0.046	**0.038***	0.003	0.845
Creatinine	0.989	0.173	0.972	1.005
Urea	0.924	0.608	0.684	1.248
Uric acid	1.431	0.616	0.353	5.806

* statistically significant

The binary logistic regression analysis shows that the respondents with high triglyceride levels had about 10 times the likelihood of developing metabolic syndrome compared with those who had normal plasma levels (OR:9.54; Cl:1.68-54.26).

Discussion.

The presence of metabolic syndrome increases the risk and mortality of cardiovascular diseases.[20] This study focused on the risk factors associated with metabolic syndrome in a rural community. The age range for this study was between 18 - 92 years and the majority of the study participants were above 60 years. The majority of the respondents were either overweight or obese and at high risk for developing cardiovascular diseases considering their Waist Height Ratio and Waist-hip ratio. It was similar to other studies that have raised concerns about the increase in cardiovascular risk factors in semi-urban and rural communities[21, 22] largely due to changes in lifestyle and urbanization.[23, 24] In the current study, the prevalence of pre-hypertension and hypertension was 100 (36.9%) and 101 (37.3%) respectively. An urban study by Ejiroghene and Henry in Delta State South-South Nigeria reported a higher prevalence of 42.64% for pre-hypertension but obtained a 29.3% prevalence for hypertension among their respondents.[25] A similar result was observed from a systemic analysis by Davies *et al* which puts the prevalence at 30.9% and 30.6% for pre-hypertension and hypertension respectively.[26] The high percentage of pre-hypertension in the community calls for concern. This on its own, is a cardiovascular risk factor and when left unattended to, will definitely increase the incidence of hypertension significantly in no time and consequently, increases morbidity and mortality.[25] Therefore, the present level of awareness for pre-hypertension must be improved especially among rural dwellers with emphasis on routine medical check-ups.

In the pattern of dyslipidemias among the studied population, more people have low HDL-C (26.6%), followed closely by a high level of TC (23.6%) when compared with a very high level of LDL-C (11.5%) and triglyceride (7.4%). Previous studies have reported inconsistent findings; Odenigbo and Oguejilor in Asaba found a high prevalence for low HDL-C (60%), LDL-C (51%), TC (23%) and TG (5%) levels. Agboola-Abu and Onabolu in Okada reported TC (60.4%) and TG (5%) levels. In Owerri, Osuji et al found low HDL-C (37.6%), TG (34.1%) and TC (31.4%) levels. While Sani, *et al*, in Katsina also found HDL-C (59.3%), TC (28.3%), LDC-C (25.7%) and TG (15.0%) levels.[27,28,29] All of these studies were conducted among apparently healthy individuals. The disparities between these previous studies and the current study may also be due to sociocultural differences in the study locations.[30,31]. The prevalence of impaired glucose tolerance was 12.6% while for individuals with diabetic glucose levels were 16.6%. Davies Adeloye et al obtained a pooled prevalence of 15.0% for impaired glucose tolerance and 5.8% for diabetics in a systematic review and meta-analysis study.[26]. ISI Ogbu et al in Owerri Imo State Nigeria observed a prevalence of 15.5% for impaired glucose tolerance and 8.6% for unreported diabetes.[31] Like, pre-hypertension above, the prevalence of impaired glucose tolerance is quite high. Impaired glucose tolerance had been shown by studies to be associated with increased cardiovascular morbidity and mortality.[32,33,34]

In this study, the prevalence of metabolic syndrome was 30.3%. Findings from other studies with the same IDF definition; V.M.Oguoma *et al* in a systematic review obtained 31.3%, Yetunde et al in Ogun State 36.8%, 35.1% in North-Western Nigeria by Sabir *et al* while a lower prevalence of 21.7% was reported in South-west, Nigeria by Adejumo *et al.*[10,30,35,36,] The prevalence in this study, though conducted in a rural area, was similar to those obtained from studies done in urban

communities. The probable reason for this may be due to its proximity to big cities and the effects of urbanization.

There was no significant difference in the mean age between persons with metabolic syndromes and persons without metabolic syndromes. Though, metabolic syndrome was said to be more among the middle age and elderly respondents.[37] The prevalence of metabolic syndrome among females 60, (37.3%) was significantly higher than among males 22, (20%). This finding was similar to other studies which found that the prevalence of metabolic syndromes was higher in females than males. This significant difference was partially due to the occurrence of risk factors for metabolic syndromes which was higher in females than males.[37,38,39]

While comparing the risk factors for metabolic syndromes among persons that have already met the criteria and those that have not, it was surprising to find that most people that have not met the full criteria for metabolic syndromes have significantly high individual risk factors for metabolic syndromes. This category of respondents was also at high risk of the development of cardiovascular diseases. The presence of one risk factor, unattended to, is consequently an invitation for others, thus the risk factors have been described as a cluster.[1,6]

There were significant differences in anthropometric parameters between those with and those without metabolic syndromes; Waist-to-height ratio, and Waist circumference with p-value < 0.001 while Waist-hip-ratio has a p-value of 0.005. Findings from several studies have shown anthropometric parameters as simple and the best tools or indicators of metabolic syndromes. These can also be used as reliable screening tools.[40,41,42,43]

The study population were stratified into normal, pre-hypertension and hypertension using American Heart Foundation (AHF) criteria, significant number of people without metabolic

syndromes were pre-hypertensive and hypertensive when compared with people with metabolic syndromes. Hypertension is the most important and independent risk factor for metabolic syndrome. People with uncontrolled hypertension are at greater risk of developing cardiovascular diseases than people with controlled blood pressure.[8,9]

The incidence of impaired glucose tolerance and diabetes mellitus was significantly high in individuals with metabolic syndromes. Diabetics were said to be more prevalent among all age groups and closely associated with other risk factors such as hypertension, obesity and dyslipidemia.[44,45,46]. Impaired glucose is a pre-diabetic state, indicates insulin resistance which is at the central pathophysiology of metabolic syndromes.[1,47]

Dyslipidemias is an integral part of metabolic syndromes components, especially low HDL-Cholesterol levels and hypertriglyceridemia.[48,49] This was also observed in this study significantly low plasma levels of HDL-cholesterol and high levels of triglyceride among participants with metabolic syndromes.

Conclusion

The prevalence of metabolic syndrome was similar to that of urban settlements. The prevalences of cardiometabolic risk factors (overweight, obesity, high blood pressure, dyslipidemia and impaired glucose tolerance) were unexpectedly high. This was found especially among people without established metabolic syndrome. These are independent risk factors for cardiovascular disease, one of the leading causes of morbidity and mortality globally. The increase in cardiovascular risk factors among rural dwellers calls for concern. Public awareness, therefore, about those risk factors, should be intensified. Routine medical check-ups and screening should

be encouraged by government policy and non-governmental organizations vis-a-vis available and subsidized or free medical services among rural dwellers.

Data Availability
Data can be made available upon request

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