

Original Research Article

Title: Prevalence of Metabolic Syndrome in a Rural and Urban Community in South-west Nigeria: a cross-sectional study

Abstract**Background**

The prevalence of Metabolic syndrome (MetS) is increasing in sub-Saharan Africa because of rapid demographic and epidemiologic transitions. There are several criteria for diagnosing MetS. This study compared the prevalence of MetS in a rural and urban community in South-west Nigeria using three different definitions.

Methods

A descriptive cross sectional study was conducted. Multi-stage sampling method was used to select a rural and urban community from two contiguous states in South-west Nigeria. Five hundred and thirty-five apparently healthy subjects aged 18 years and above were consecutively recruited from selected communities. Rural-urban comparison of prevalence of Metabolic syndrome using the International Diabetes Federation (IDF), National Cholesterol Education Program—Third Adult Treatment Panel (NCEP ATP III) and the Joint Interim Statement (JIS) definitions was done.

Results

The general prevalence of MetS according to the JIS, IDF and NCEP definitions was 23%, 21.7% and 21.1% respectively. The prevalence of MetS was higher in the urban than rural community irrespective of the definition used (28.2% vs 13.7% NCEP, 30.8% vs 12.2% IDF, 33.3% vs 12.2% JIS) ($P < .001$). The prevalence of the MetS was significantly higher in females using the JIS (15.8% vs 25.7%) ($P = .02$) and IDF (13.0% vs 24.9%) ($P = .003$) definitions. There

27 was no gender difference in the prevalence of the MetS using the NCEP ATP III definition ($P =$
28 .17).

29 **Conclusion**

30 Prevalence of MetS was high in rural and urban communities in South-west Nigeria regardless of
31 the criteria used. The need for public health measures to reduce the prevalence of MetS in
32 Nigeria cannot be over emphasized.

33 **Key Words; Metabolic syndrome, Prevalence, Rural, Urban, Nigeria.**

34 **Introduction**

35 Metabolic syndrome (MetS) also considered an abnormality of energy utilization and storage is a
36 complex disorder composed of interconnected risk factors [1]. The characterizing features
37 include hypertension, hyperglycaemia, hypertriglyceridaemia, decreased high density lipoprotein
38 cholesterol (HDL-C) and excess adiposity most especially abdominal obesity [2]. Clustering of
39 these interlinked metabolic abnormalities in a single individual has been associated with
40 considerably increased risk for the development of several non-communicable chronic diseases
41 such as cardiovascular diseases (CVD), Type 2 diabetes mellitus (T2DM) and cancers [1,3].
42 Additionally, the risk of all-cause mortality is increased in the presence of MetS [4].

43 Several formal definitions consisting of specified diagnostic parameters for identifying
44 individuals with the syndrome have been made available by the World Health Organization
45 (WHO) [5], the International Diabetes Federation (IDF) [6], National Cholesterol Education
46 Program—Third Adult Treatment Panel (NCEP ATPIII) [7] and the Joint Interim Statement
47 (JIS) was proposed by IDF and AHA/NHLBI to harmonize the definition of MetS [1]. Although
48 all the most commonly utilized definitions encompass similar characteristics, they differ

somewhat in assessment parameters such as measures of obesity, cut off values for anthropometric indices and degree of priority attached to certain components.

It is estimated that between 20 – 25% of the world’s adult population have MetS and are twice as likely to die from and three times as likely to have a heart attack or stroke compared with people without the syndrome [8]. Evidence however suggests that people with MetS have two-fold increased risk of developing CVD and fivefold increased risk of developing T2DM [8].

The prevalence of MetS varies according to the clinical criteria used for its definition. A 12-year systematic review from Nigeria reported that based on the NCEP ATPIII, IDF and WHO definitions, the overall prevalence of MetS in Nigeria is 27.9%, 28.1% and 31.7% respectively. However, hospital based study recorded mean prevalence of 41.8%, 38.4% and 40.8% as identified by NCEP-ATPIII, IDF and WHO definitions respectively [9].

The role of urbanization in the development of Cardiovascular (CV) risk factors such as hypertension, obesity and dyslipidemia has been established. [10]. Nigeria like other sub-Saharan African countries is experiencing rapid demographic and epidemiologic transitions responsible for the fast rate of urbanization [11]. This development has led to change in feeding habits and physical activity patterns and consequently increased the prevalence of lifestyle related chronic diseases projected to be higher than infectious diseases by 2030 [12,13]

Previous studies from Benin [14], Ghana [15], Nigeria [16,17] and Cameroon [18,19,] showed that the prevalence of MetS in rural communities to vary from 0 – 4.1%. Other studies from urban city in Nigeria showed that the prevalence of MetS ranged between 13% - 17.4% (16,17). This present study compared the prevalence of MetS in a rural and urban community in South-west Nigeria using three different definitions.

72 **Methods**

73 **Study design**

74 A descriptive cross sectional study design was used to determine the prevalence of MetS in an
75 urban and rural community in South-west Nigeria

76 **Study background**

77 Ikeja is a cosmopolitan city and the capital of Lagos state. It is one of the most populous
78 commercial city in Nigeria. It is an urban setting with an area of about 46.20 sqKm and a
79 population of 313,196 (Census, 2006). It is one of the 20 LGA in the state and now has 3 Local
80 council development area. The inhabitants of Ikeja include corporate executives, Civil servants,
81 Business men/women and artisans.

82 Ilara/ Akaka - Remo lie along the forest belt in Remo-North. It is a rural setting with an area of
83 about 199 km² and a population of 59,911 (Census, 2006). This area is characterized by
84 moderately hot and humid tropical climate with features of a tropical forest and is about 150 km
85 away from Lagos. The inhabitants usually engage in subsistent farming, hunting or petty trading
86 for a living. Dwellings are either traditional houses totally plastered with mud or cement or
87 houses constructed with corrugated iron sheets.

88 **Population and Sample**

89 Lagos and Ogun state were purposively selected for logistic reasons being two contiguous states
90 in South-west Nigeria. Multistage sampling technique method was used to select one community
91 in Lagos and Ogun States.

92 Using the sample size formula for comparing proportions of independent samples, prevalence of
93 MetS in urban (25.2%) [20] and rural (12.1%) [21] communities in Nigeria from previous
94 studies, power of 95%, level of significance of 0.05 and attrition rate 10%, the minimum sample

size of 255 each was calculated for the urban and rural community. However, 273 and 262 subjects were recruited from the selected urban and rural community.

Recruitment and study procedure

The Community Development Association (CDA), ward committee chairmen and the landlord association in Ikeja and the Baale in Ilara and Akaka- Remo were contacted and informed of the purpose of the study. After obtaining their permission for the study, residents were informed and invited for the study through hand bills (in Ikeja) and a local town crier (in Ilara and Akaka- Remo) to participate in the study at a designated place and time. Consecutive recruitment was used to enroll apparently healthy subjects 18 years and above who had resided in the community for at least 2 years prior to the study.

On recruitment into the study, an interviewer administered questionnaire was used to obtain subjects' sociodemographic details, thereafter waist circumference and blood pressure were taken using standard methods. Venous blood was collected after overnight fast from the subjects in sitting position by a trained phlebotomist. Samples were collected into appropriate Vacutainer tubes (fluoride oxalate and potassium ethylene diamine tetra acetic acid (K3EDTA)). Fasting blood glucose and lipid profile analysis were conducted at the Chemical Pathology laboratory of Babcock University Teaching Hospital, Ilishan – Remo, Ogun State,

Measurement of outcome variables

Anthropometric variables and measurements

Waist circumference (WC) was measured to the nearest 0.1 centimeter (cm), with a flexible tape, by locating the top of the right iliac crest and measuring in a horizontal plane around the abdomen immediately above the level of the iliac crest. Measurement was made at the end of a normal expiration in centimeter (cm).

118 **Measurement of blood pressure**

119 Systolic and diastolic blood pressure was measured on the right arm of the subjects in a sitting
120 position using an appropriate cuff size electronic sphygmomanometer after about 5 minutes of
121 rest. Three readings were taken, an average of the second and third readings was used.

122 **Definition of Metabolic syndrome**

123 Three definitions of MetS (NCEP ATPIII, IDF andJIS) were used to identify participants with
124 MetS in this study [1,6,7]. (See Table 1 below)

125

Definition	Harmonized definition (JIS) [1]	NCEP ATPIII [7]	IDF [6]
Criteria	Three or more of the following parameters:	Three or more of the following parameters:	Central obesity plus 2 of the following 4 other factors:
Fasting plasma glucose	≥ 100 mg/dL	≥ 100 mg/dL	≥ 100 mg/dL
Blood pressure	Systolic BP ≥ 130 mmHg or diastolic BP ≥ 85 mmHg	Blood pressure $\geq 130/85$ mmHg	Systolic BP ≥ 130 mmHg or diastolic BP ≥ 85 mmHg
Triglyceride (TG)	>150 mg/dL	>150 mg/dL	>150 mg/dL
High Density Lipoprotein-Cholesterol (HDL-C)	HDL-C < 40 mg/dL in men or <50 mg/dL in women.	HDL-C < 40 mg/dL in men or <50 mg/dL in women	HDL-C < 40 mg/dL in men or <50 mg/dL in women
Central obesity	WC ≥ 94 cm in men or ≥ 80 cm in women (as recommended for Europeans)	WC ≥ 102 cm in men or ≥ 80 cm in women (as recommended for Europeans)	Waist circumference ≥ 94 cm in men or ≥ 80 cm in women (as recommended for Europeans).

126 **Table 1: showing the definition of MetS based on NCEP ATPIII, IDF and JIS definition**

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128

Ethical considerations:

Ethical approval was obtained from the Health and Research Ethical Committee of the Lagos State University Teaching Hospital (LASUTH) and the Babcock University Health Research Ethical Committee (BUHREC) Ilishan, Remo, Ogun State

Statistical analysis

Data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) IBM version 22.0 software (IBM Corp., Armonk, NY, USA). Percentages, mean and standard deviation of numerical variables were determined. Student ‘t’ test was used to compare mean of numerical variables while chi squared test was used to compare categorical variables. Confidence interval for all statistical test was set 95% and all statistical test was considered significant if $p < .05$.

Results

Of the 535 recruited subjects, 51% were from an urban area while 49% were from a rural community. The age range was 18 – 89 years and mean age was 47.1 ± 14.7 . The majority of subjects were females (72.7%), Yorubas (74.2%), married (74.4%), non-smokers (90.5%) and don’t take alcohol (82.2%). About 60% of subjects had at least secondary education as shown in Table 2.

Table 3 shows the gender and rural- urban mean difference of the components of MetS. The fasting plasma glucose (94.16 ± 21.96 mg/dl vs 84.87 ± 27.80 mg/dl), systolic (130.84 ± 22.85 mmHg vs 120.90 ± 23.96 mmHg) and diastolic blood pressure (80.33 ± 13.64 mmHg vs 75.56 ± 12.39 mmHg) were significantly higher in urban compared to rural subjects ($P < .001$). However,

rural subjects had higher HDL-C than urban (50.48 ± 21.50 mg/dl vs 59.78 ± 18.70 mg/dl) ($P < .001$). The waist circumference was higher in the female subjects ($P < .001$). There was no gender difference in the mean systolic and diastolic measurements and mean serum triglyceride and HDL-C levels ($P > .05$)

Figure 1 shows the prevalence of MetS in the study population. The prevalence of the MetS according to the JIS, IDF and NCEP definitions were 23%, 21.7% and 21.1% respectively. The prevalence of the MetS was significantly higher in females using the JIS ($P = .02$) and IDF ($P = .003$) definitions. There was no gender difference in the prevalence of the MetS using the NCEP ATP III definition ($P = .17$). There was no gender difference in the proportion of subjects with elevated blood pressure, and dyslipidaemia (high TG and low HDL-C) ($P > .05$). More males had dysglycaemia ($P > .001$) while more females were obese (using waist circumference) irrespective of the diagnostic criteria used ($P < .001$) as shown in Table 4. The prevalence of MetS was higher in the urban than rural community irrespective of the definition used ($P < .001$). In addition, a higher proportion of subjects in the urban community had elevated blood pressure, low HDL-C and dysglycaemia ($P < .001$). There were no rural-urban differences in serum triglyceride levels and obesity (using waist circumference) ($P > .05$) as shown in Table 5.

Discussion

The NCEP ATP III definition appears to be the most widely used in studies conducted in Nigeria probably because of its ease in clinical application. There is no clear consensus with regards which of the definitions gives the highest prevalence of the MetS. In this study, the JIS definition gave the highest prevalence of MetS which is similar to findings from a systematic review from Iran [22]. However similar to findings from Iran [22], this study showed no significant difference

between the prevalence of MetS using JIS, IDF and NCEP ATP III definitions. Two researchers in Nigeria documented that there was no significant difference between the prevalence of MetS using NCEP ATP III, IDF and WHO definitions [23,24]. A European study that compared NCEP-ATP III and IDF opined that the prevalence of MetS was higher using the IDF definition [25].

Metabolic syndrome has been studied among diabetics, hypertensive, and people living with HIV/AIDS, thyroid and asthma patients as well as apparently healthy people in rural and urban settings in Nigeria using different definitions [20, 26-29]. In this study, the prevalence of MetS among the apparently healthy, non - diabetic subjects was 23%, 21.7% and 21.1% using the JIS, IDF and NCEP ATP III definitions respectively. This is contrary to what was reported in a systematic review of MetS in Nigeria which showed a higher prevalence of MetS based on NCEP ATP III (27.9%), IDF (28.1%) and WHO (31.7%) definitions [9]. The different population groups considered in the systematic review maybe a possible explanation. Meta-analysis and systematic reviews of prevalence of MetS in apparently healthy subjects from Iran and Brazil also reported a higher prevalence of MetS than what was found in this study using the JIS (41.5%), NCEP ATP III (28.9% - 36.9%) and IDF definitions (34.6%). [22,30].

Studies from the United States and Peru reported prevalence similar to the findings of this study [31,32]. The prevalence of MetS varies according to the criteria or definitions used and other variables such as gender, age, race, socio-economic status, work – related activities, ethnicity, location and disease condition of the population studied [33,34].

Studies carried out in urban, suburban and rural settings, reported different prevalence of MetS based on location. Although the prevalence of MetS in Nigeria is highest in Sub-saharan Africa [9], studies comparing rural and urban prevalence of MetS have suggested that the prevalence is

higher in the urban than rural areas possibly because of increase urbanization, adoption of western lifestyle and low level of physical activity. [23,35]. In this study, the prevalence of MetS was significantly higher in urban than rural subjects using the JIS, IDF and NCEP- ATPIII definitions.

There is gender difference in the prevalence of MetS in this study with the women having a higher prevalence than men regardless of the definition used. These findings are similar to what was reported in studies among hypertensives, diabetes, apparently healthy people and rural/urban comparisons in Nigeria [23, 24, 36). This increased frequency is possibly driven by the high prevalence of visceral obesity among females. In addition, there is also a cultural perception about obesity in women being regarded as a sign of affluence and satisfaction in many cultures in Nigeria [23]. In this study a higher proportion of females than males had abdominal obesity. The findings in this study are similar to what was opined in population studies from United States of America and Korea [37,38]. However, the gender-specific differences in the prevalence of MetS are not consistent across studies. Studies from China showed that the prevalence of MetS and its components were higher among males [39]. Age [38], genetic traits [40] dietary habits [41] level of physical activity [42] and socio economic status [43] are possible explanation for the gender differences in the prevalence of MetS.

Conclusion

Although the prevalence of Metabolic syndrome was high in rural and urban Nigeria, the prevalence was significantly higher in female and urban community. There is need for clinicians to have high index of suspicion and public enlightenment campaign that will educate the populace on the need to reduce the prevalence of MetS in Nigeria.

221 **Table 2: Socio demographic characteristics subjects**

222	Variables`	Frequency n = 535	%
223	Age group (years)		
224	<30	90	11.2
225	30 – 39	105	19.6
226	40 – 49	145	27.1
227	50 – 59	102	19.1
228	≥60	123	23.0
229	Mean±SD	47.1±14.7	
230			
231	Gender		
232	Male	146	27.3
233	Female	389	72.7
234			
235	Ethnic group		
236	Yoruba	397	74.2
237	Hausa	11	2.1
238	Igbo	87	16.3
239	Others	40	7.5
240			
241	Marital Status		
242	Single	61	11.4
243	Married	398	74.4
244	Divorced/Separated	24	4.5
245	Widowed/widower	52	9.7
246			
247	Level of education		
248	No formal education	70	13.1
249	Primary	138	25.8
250	Secondary	199	37.2
251	Tertiary	128	23.9
252			
253	Place of residence		
254	Urban	273	51.0
255	Rural	262	49.0
256			
257	Smoke cigarette		
258	Yes	51	9.5
259	No	484	90.5
260			
261	Alcohol intake		
262	Yes	95	17.8
263	No	440	82.2
264			

Table 3: Gender and rural/ Urban comparison of the components of Metabolic syndrome

Variable	Urban n = 273	Rural n = 262	t	p
WC (cm)	90.02±13.18	89.62±13.77	0.343	0.732
SBP (mmHg)	130.84±22.85	120.90±23.96	4.911	<0.001
DBP (mmHg)	80.33±13.64	75.56± 12.39	4.227	<0.001
Triglyceride (mg/L)	94.63±56.78	86.66±54.03	1.661	0.097
HDL-C (mg/dL)	50.48±21.50	59.78±18.70	5.327	<0.001
Glucose (mg/dL)	94.16±21.96	84.87±27.80	4.299	<0.001
	Male n = 146	Female n = 389	t	p
WC (cm)	87.64± 11.07	90.65± 14.18	2.311	0.021
SBP (mmHg)	127.52± 21.55	125.40± 24.73	0.916	0.360
DBP (mmHg)	78.24±13.13	77.91±13.31	0.258	0.796
Triglyceride (mg/dL)	92.58±69.03	90.03±49.63	0.474	0.636
HDL-C (mg/dL)	52.69±19.58	55.91±21.04	1.607	0.109
Glucose (mg/dL)	96.74±27.80	86.94±27.53	4.031	<0.001

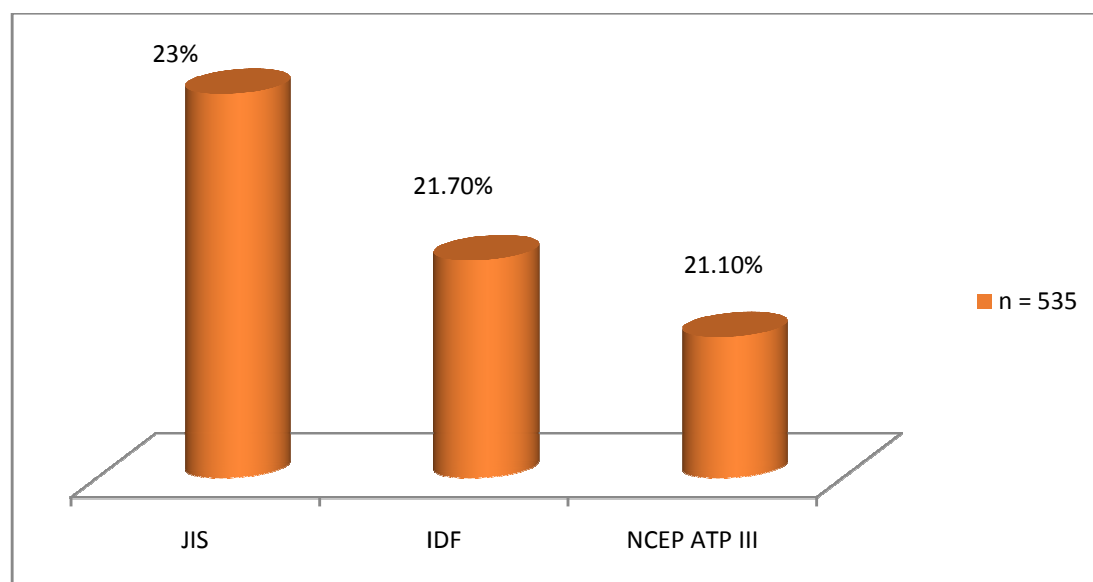


Figure1: Prevalence of MetS using the harmonized (JIS), IDF, NCEP ATPIII definitions in the study population.

Table 4. Prevalence of Metabolic syndrome based on 3 different definitions and its individual components in men and women

Variable	Total	Men	Women	p
	n = 535 (%)	n = 146 (%)	n = 389 (%)	
Definition of Metabolic syndrome				
NCEP ATP III	113 (21.1)	25 (17.1)	88 (22.6)	0.165
JIS	123 (23.0)	23 (15.8)	100 (25.7)	0.015
IDF	116 (21.7)	19 (13.0)	97 (24.9)	0.003
Elevated blood pressure				
Blood pressure >130/85 mmHg	225 (42.1)	62 (42.5)	163 (41.9)	0.906
Dyslipidaemi				
TG>150mg/dL	54 (10.1)	11 (7.5)	43 (11.1)	0.229
HDL-C < 40 mg/dL in men or <50 mg/dL in women	222 (41.5)	53 (36.3)	169 (43.4)	0.135
Dysglycaemia				
FPG ≥ 100 mg/dL	113 (21.1)	43 (29.5)	70 (18.0)	0.004
Obesity				
JIS and IDF: WC ≥94 cm in men or ≥80 cm in women	325 (60.7)	36 (24.7)	289 (74.3)	<0.001
NCEP ATPIII: WC ≥102 cm in men or ≥80 cm in women	248 (46.4)	17 (11.6)	231 (59.4)	<0.001

Table 5. Prevalence (%) of MetS based on different definitions and their individual components in urban and rural subjects

Variable	Total n = 535 (%)	Urban n = 273 (%)	Rural n = 262 (%)	p
Definition of Metabolic syndrome				
NCEP ATP III	113 (21.1)	77 (28.2)	36 (13.7)	<0.001
JIS	123 (23.0)	91 (33.3)	32 (12.2)	<0.001
IDF	116 (21.7)	84 (30.8)	32 (12.2)	<0.001
Elevated blood pressure				
BP >130/85 mmHg	225 (42.1)	140 (51.3)	85 (32.4)	<0.001
Dyslipidaemia				
TG>150mg/dL	54 (10.1)	24 (8.8)	30 (11.5)	0.307
HDL-C< 40 mg/dL in men or <50 mg/dL in women	222 (41.5)	139 (50.9)	83 (31.7)	<0.001
Dysglycaemia				
FPG ≥ 100 mg/dl	113 (21.1)	76 (27.8)	37 (14.1)	<0.001
Obesity				
JIS and IDF WC ≥94 cm in men or ≥80 cm in women	325 (60.7)	170 (62.3)	115 (59.2)	0.461
NCEP ATPIII: WC ≥102 cm in men or ≥80 cm in women	248 (46.4)	121 (44.3)	127 (48.5)	0.336

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