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Socio Demographic Determinants of Metabolic Syndrome and Its Components in South-West Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author ENA designed the study, was involved in data collection and writing the manuscript, author OAO was involved in study design and proof reading the manuscript, author OAA performed the statistical analysis, and was involved in writing the manuscript. Authors OJ and JS were involved in data collection and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The occurrence of hypertension, obesity, dysglycaemia and dyslipidaemia together has been shown to result in increased risk of development of cardiovascular disease and diabetes. This present study assessed prevalence of components and the socio-demographic determinants of metabolic syndrome.
Methods: A cross- sectional descriptive study was conducted. Lagos and Ogun States were

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purposively selected. Selection of an urban and a rural community in Lagos and Ogun state respectively was done using multi stage sampling methods. Consecutive sampling was used to select apparently healthy subjects 18 years and above. Metabolic syndrome was defined based on the Joint Interim Statement (JIS) criteria. Regression analysis was used to assess the determinants of metabolic syndrome and its components.

Results: Five hundred and thirty-five subjects were recruited with the mean age of 47.1±14.7 years. About 14% of subjects had no MetS components. More of the females than males had two (37.5% vs 24.7%, p =0.005) and three (17.2% vs 6.8%, p = 0.002) components of MetS. Generally, the most prevalent component of MetS were central obesity (49.5%), hypertension (42.1%) and reduced HDL cholesterol (41.5%). The proportion of subjects with two, three and four components of MetS increased with age. The prevalence of MetS based on the JIS criteria was 23%. Gender (OR 3.05, 95% CI 1.72 – 5.44, p < 0.001), urban setting (OR 4.2 95%CI 2.6 – 6.8, p <0.001) and alcohol intake (OR 2.407, 95% CI 1.37 – 4.2, p = 0.002) were the determinants of MetS in this study.

Conclusion: The prevalence of MetS and its components were high in this study especially among females. The need of life style modification to reduce the prevalence of MetS and its components cannot be overemphasized.

Keywords: Metabolic syndrome; socio-demographic; determinants; components; Nigeria.

1. INTRODUCTION

The metabolic syndrome (MetS) has emerged as a major public health and clinical cause for concern since Raeven described it as a cluster of risk factors over two decades ago [1]. Some criteria with varying principal elements have been used to define the syndrome. These include: hypertension, obesity, dysregulated glucose homeostasis, hypertriglyceridaemia and reduced high-density lipoprotein cholesterol (HDL-C) [2]. These components when they occur together results in increased risk of cardiovascular disease (CVD) and diabetes mellitus [3]. Some authors have suggested that the relevance of MetS to CVD risk is no greater than the contribution of the individual components [4-6].

Since the first proposition of a clinical definition for MetS by the World Health Organization (WHO), about six additional clinical definitions have been proposed and recently, in 2009, a Joint Interim Statement (JIS) was proposed to harmonize the definition of MetS [7,8]. The alarming increase in the number of individuals with MetS over the past decade has been acknowledged globally. Interestingly, this increase has been associated with the rapidly growing worldwide epidemic of obesity [9].

Similar study from the United States which evaluated trends in the MetS among adult population 20 years and above using the 2003 – 2012 National Health and Nutrition Examination Survey (NHANES) data showed that the projected prevalence of MetS for United States was 34.7% [10]. Other studies from Canada and Australia have reported the prevalence of 19.1% [11] and 33.5% [12] respectively. A study from Nigeria showed that the prevalence of MetS was 27.9% - 31.7% depending on the defining criteria. For community and hospital based studies, the mean prevalence of MetS ranged between 8.2% - 18.3% and 38.4% - 41.8% respectively [13].

While a study from Seychelles reported high blood pressure, obesity and impaired fasting glucose were the most common component of MetS [14], a Jamaican Study showed that decreased HDL-C was the most common while impaired fasting glucose and elevated triglycerides were rare. Studies from Nigeria showed obesity, high blood pressure and reduced HDL-cholesterol as the most prevalent components of MetS [15,16].

Socio-demographic characteristics demonstrated to be associated with MetS in previous studies include: age, lower education and income levels. [11], gender, race, work – related activities, ethnicity, location and disease condition of the population studied [17,18]. This study assessed prevalence of MetS and socio-demographic determinants of MetS and its components in South-west Nigeria.

2. METHODS

2.1 Study Design

This cross-sectional study was designed to evaluate the prevalent components and

sociodemographic determinants of MetS among apparently healthy subjects from an urban and rural community in South-west Nigeria.

2.2 Study Background

The study was conducted in Ilara-Akaka and Ikeja in Ogun and Lagos States in Nigeria. The population of Lagos a commercialized state is one of the highest in the country. Ikeja a predominantly urban city is the capital of Lagos state, with an estimated land mass of 46.20 sqKm and population of 313,196 [19]. The majority of people in Ikeja are from other parts of the country, engaged either in paid occupation or business. Ilara-Akaka is a rural settlement in Ogun State with an estimated area and population of 199km^2 and 59,911 respectively [19]. People living in Ilara-Akaka are majorly petty traders, subsistent farmers or hunters. Most houses were locally built with mud and thatched roof.

2.3 Population and Sample

The present study is part of a study that assessed the prevalence of MetS in a rural and urban community in South-west Nigeria using three different definitions [20]. Briefly, Lagos and Ogun states were purposively selected. Selection of an urban and rural community from Lagos and Ogun state respectively was done using multistage sampling method while apparently healthy volunteer subjects who met the selection criteria were consecutively recruited. Details of the selection criteria and sample size calculation were earlier published [20].

2.4 Recruitment and Study Procedure

Apparently healthy subjects aged 18 years and above, who had lived in Ikeja and Ilara-Akaka not less than 2 years before the study commenced were consecutive recruited. Information about the study was communicated through the Ward committee and Community Development Association (CDA). On recruitment, socio-demographic data of subjects were collected on a proforma, subjects that reported alcohol consumption and cigarette smoking at the time of data collection were also noted. Afterwards, waist circumference and blood pressure measurements were taken following standard procedures. After overnight fast, blood sample was taken from subjects into Vacutainer tubes containing potassium ethylene diamine tetra acetic acid (K3EDTA) and flouride oxalate for analysis of lipid profile and blood glucose respectively.

2.5 Measurement of Outcome Variables

A flexible tape was used to measure waist circumference (WC), using the right iliac crest as landmark. Measurement was made in a horizontal plane above the level of the iliac crest at the end of a normal expiration to the nearest 0.1 centimeter (cm).

2.6 Measurement of Blood Pressure

To measure blood pressure, subjects were seated and allowed to rest for at least 5 minutes in the morning. Using standardized electronic sphygmomanometer and appropriate cuff size, measurements were taken on the right arm of subjects. An average of two blood pressure readings was calculated and documented.

2.7 Definition of MetS

The joint interim statement of the IDF Task Force was used in defining MetS. The JIS definition recommended that three or more of the following parameters could be used for the diagnosis of MetS

- Raised triglycerides: ≥150 mg/dl (1.7 mmol/l) or history of specific treatment for this lipid abnormality.
- Reduced HDL cholesterol: < 40 mg/dl (1.03 mmol/l) in males and < 50 mg/dl (1.29 mmol/l) in females or history of specific treatment for this lipid abnormality
- Raised blood pressure: systolic BP ≥130 mm Hg or diastolic BP ≥85 mm Hg or on treatment for previously diagnosed hypertension
- Raised Fasting plasma glucose (FPG): ≥ 100 mg/dl or previously diagnosed type 2 diabetes mellitus
- WC ≥94 cm in men or ≥80 cm in women (as recommended for Europeans)

2.8 Ethical Considerations

Ethical approvals for this study were obtained from the Babcock University Health Research Ethical Committee (BUHREC) Ilishan, Remo, Ogun State and the Health and Research Ethical Committee of the Lagos State University Teaching Hospital (LASUTH) Ikeja Lagos State.

Written informed consent was signed by all subjects enrolled into the study. They were assured of strict confidentiality and data collected from subjects were deidentified.

2.9 Statistical Analysis

Statistical Package for Social Sciences (SPSS) IBM version 22.0 software was used to analyze data. The mean, standard deviation and percentages of numerical variables were determined. Categorical variables were compared using chi squared. Regression analysis was done to determine the socio demographic determinants of metabolic syndrome, high blood pressure, reduced HDL-C and abdominal obesity. All socio demographic variables were entered at once into the model (enter method). All statistical tests were considered significant if p <0.05.

3. RESULTS

Five hundred and thirty-five subjects were recruited with the mean age of 47.1±14.7 years. The male; female ratio was 1;2.7. About 60%, 10% and 18% of subjects had at least secondary education, smoked cigarette and alcohol intake respectively. About half of the subjects were either from the rural and urban setting. A higher proportion of the males had at least secondary education (67.1% vs 58.9%, p <0.001), from urban setting (61% vs 47.3%, p = 0.005), smoked cigarette (32.2% vs 1%, p <0.001) and alcohol intake (34.9% vs 11.3% p <0.001) compared to females as shown in Table 1.

Table 2 illustrates the gender comparison of the number of MetS components. About 14% had no MetS components. A higher proportion of males (24.7%) compared with females (9.3%) had no component of MetS (p <0.001). More of the females had two (37.5% vs 24.7%, p =0.005) and three (17.2% vs 6.8%, p = 0.002) components of MetS. Generally, the most prevalent component of MetS were central obesity (49.5%), hypertension (42.1%) and reduced HDL cholesterol (41.5%). While obesity was the commonest component of MetS among females (74.3%), hypertension was the prevalent component of MetS among the males (42.5%). High triglyceride was the least prevalent component of MetS (10.1%) in the total population. The prevalence of triglyceride among males and females was 7.5% and 11.1% respectively as shown in Table 3. Table 4 shows the age distribution of the clustering of components of MetS. The proportion of subjects with two, three and four components of MetS increased with age.

Table 1. Socio demographic characteristics of subjects

Variables	Total	Male	Female	P
	n = 535 (%)	n = 146 (%)	n = 389 (%)	
Age group (years)				
< 30	60 (11.2)	15 (10.3)	45 (11.6)	0.656
30 – 39	105 (19.6)	33 (22.6)	72 (18.5)	
40 – 49	145 (27.1)	42 (28.8)	103 (26.5)	
50 – 59	102 (19.1)	23 (15.8)	79 (20.3)	
≥ 60	123 (23.0)	33 (22.6)	90 (23.1)	
Mean±SD	47.1±14.7	46.2±14.5	47.4±14.8	
Level of education				
No formal education	70 (13.1)	5 (3.4)	65 (16.7)	<0.001
Primary	138 (25.8)	43 (29.5)	95 (24.4)	
Secondary	199 (37.2)	51 (34.9)	148 (38.1)	
Tertiary	128 (23.9)	47 (32.2)	81 (20.8)	
Place of residence				
Urban	273 (51.0)	89 (61.0)	184 (47.3)	0.005
Rural	262 (49.0)	57 (39.0)	205 (52.7)	
Smoke cigarette				
Yes	51 (9.5)	47 (32.2)	4 (1.0)	<0.001
No	484 (90.5)	99 (67.8)	385 (99.0)	
Alcohol intake				
Yes	95 (17.8)	51 (34.9)	44 (11.3)	<0.001
No	440 (82.2)	95 (65.1)	345 (88.7)	

Table 2. Gender comparison of number of the MetS components in the study population

Components of MetS	Total	Male	Female	P
	n = 535 (%)	n = 146 (%)	n = 389 (%)	
None	72 (13.5)	36 (24.7)	36 (9.3)	<0.001
One	158 (29.5)	51 (34.9)	107 (27.5)	0.094
Two	182 (34.0)	36 (24.7)	146 (37.5)	0.005
Three	77 (14.4)	10 (6.8)	67 (17.2)	0.002
More than Three	46 (8.6)	13 (8.9)	33 (8.5)	0.530

Table 3. Gender difference in the prevalence of components of metabolic syndrome

Variable	Total	Men	Women	P
	n = 535	n = 146 (%)	n = 389 (%)	
Elevated blood pressure				
Blood pressure >130/85 mmHg	225 (42.1)	62 (42.5)	163 (41.9)	**0.906**
Dyslipidaemia				
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				
WC ≥94 cm in men or ≥80 cm in women	270 (49.5)	36 (24.7)	289 (74.3)	**<0.001**

Table 4. Clustering of components of metabolic syndrome by age group

Age group (years)	Number of components of MetS					
	0	1	2	3	4	Total
	n = 72	n = 158	n = 182	n = 77	n = 46	n =535
< 30	26 (43.3)	19 (31.7)	14 (23.3)	1 (1.7)	0 (0.0)	60(100.0)
30 – 39	14(13.3)	49(46.7)	23(21.9)	14(13.3)	5 (4.8)	105(100.0
40 – 49	16 (11.0)	41 (28.3)	49 (33.8)	28 (19.3)	11(7.6)	145(100.0)
50 – 59	8 (7.8)	21 (20.6)	43 (42.2)	19 (18.6)	11(10.8)	102(100.0)
≥ 60	8 (6.5)	28 (22.8)	53 (43.1)	15 (12.2)	19(15.4)	123(100.0)
Total	72(13.5)	158(29.5)	182(34.0)	77 (14.4)	46(8.6)	535(100.0)

Table 5 illustrates the socio demographic factors associated with the MetS. Age (p <0.001), gender (p = 0.015), place of residence (p <0.001) and alcohol intake (p = 0.025) were associated with MetS. Gender, place of residence and alcohol were determinants of MetS. Female subjects had 3-fold chance of developing MetS than male subjects (OR 3.05, 95%CI 1.72 – 5.44). Subjects from urban setting had 4-fold chance of developing MetS than subjects from rural setting (OR 4.2 95%CI 2.6 – 6.8) while subjects who took alcohol had 2.4 chance of developing MetS than subjects who never took alcohol (Table 6). The socio-demographic determinants of high blood pressure, reduced HDL-C and abdominal obesity is shown in Table 7. Subjects from the urban setting (OR 2.092, 95% CI 1.424 – 3.074) and those employed (OR 2.269 95%CI 1.381 – 3.727) had two-fold chance of developing high blood pressure than those from the rural setting and unemployed respectively. Gender and place of residence were determinants of abdominal obesity and reduced HDL-C respectively. The odd of having

reduced HDL-C was two-fold more (OR 2.294, 95%CI 1.582 – 3.327) in subjects from urban setting while female subjects had four-fold chance (OR 4.259, 95% CI 2.573 – 7.050) of developing abdominal obesity than male subjects.

Table 5. Socio demographic factors associated with the MetS in the study population

Variable	Non MetS	MetS	χ2	P
	n = 412 (%)	n = 123 (%)		
Age group (years)				
< 30	59 (98.3)	1 (1.7)	21.96	<0.001
30 – 39	86 (81.9)	19 (18.1)		
40 – 49	106 (73.1)	39 (26.9)		
50 – 59	72 (70.6)	30 (29.4)		
≥ 60	89 (72.4)	34 (27.6)		
Mean±SD	45.7±15.2	51.6±12.0		
Gender				
Male	123 (84.2)	23 (15.8)	5.940	0.015
Female	289 (74.3)	100 (25.7)		
Place of residence				
Urban area	182 (66.7)	91 (33.3)	33.681	<0.001
Rural area	230 (87.8)	32 (12.2)		
Education status				
Less than secondary	200 (78.7)	54 (21.3)	0.82	0.3657
Secondary/ tertiary	212 (91.8)	69 (8.2)		
Social class				
Upper	70 (74.5)	24 (25.5)	0.422	0.810
Middle	147 (77.4)	43 (22.6)		
Lower	195 (77.7)	56 (22.3)		
Employment status				
Employed	315 (76.1)	99 (23.9)	0.880	0.348
Unemployed	97 (80.2)	24 (19.8)		
Smoke cigarette				
Yes	39 (76.5)	12 (23.5)	0.009	0.923
No	373 (77.1)	111 (22.9)		
Alcohol intake				
Yes	65 (68.4)	30 (31.6)	4.812	0.028*
No	347 (78.9)	93 (21.1)		

** = Statistically significant at p < 0.05*

Table 6. Socio demographic determinants of the MetS in the study population

Variable	p	OR**	95%CI
Age	<0.001	1.034	1.016 – 1.051
Male	1		
Female	<0.001	3.053	1.761 – 6.443
Rural	**1**		
Urban	<0.001	3.864	2.386 – 6.257
Secondary/ Tertiary	**1**		
Less than secondary	0.146	0.699	0.431 – 1.133
Unemployed	**1**		
Employed	0.519	1.208	0.680 – 2.147
Not smoking	**1**		
Smoking	0.574	1.295	0.526 – 3.192
No alcohol intake	1		
Alcohol intake	0.010	2.170	1.260 – 3.902

*NB : ** = Adjusted odds ratio*

Table 7. Sociodemographic determinants of components of MetS

Variables	High blood pressure		Reduced HDL-C		Abdominal obesity	
	p	OR*(95%CI)	P	OR*(95%CI)	p	OR*(95%CI)
Age	<0.001	1.046 (1.031 – 1.062)	0.560	1.004 (0.991 – 1.017)	<0.001	1.030 (1.016 – 0.045)
Male	**1**		**1**		**1**	
Female	0.487	1.184 (0.736 – 1.905)	0.130	1.427 (0.901 – 2.263)	<0.001	4.259 (2.573 – 7.050)
Rural Area	**1**		**1**		**1**	
Urban area	<0.001	2.092 (1.424 – 3.074)	<0.001	2.294 (1.582 – 3.327)	0.170	0.767 (0.526 – 1.120)
Secondary/tertiary	**1**		**1**		**1**	
Less than secondary	0.458	1.163 (0.780 – 1.735)	0.995	0.999 (0.687 – 1.470)	0.364	0.833 (0.563 – 1.235)
Unemployed	**1**		**1**		**1**	
Employed	0.001	2.269 (1.381 – 3.727)	0.211	1.334 (0.849 – 2.094)	0.590	0.883 (0.562 – 1.388)
Not smoking	**1**		**1**		**1**	
Smoking	0.232	1.548 (0.757 – 3.165)	0.132	0.569 (0.273 – 1.185)	0.799	0.906 (0.422 – 1.945)
No Alcohol intake	**1**		**1**		**1**	
Alcohol intake	0.892	1.036 (0.625 – 1.716)	0.127	1.475 (0.895 – 2.429)	0.278	1.333 (0.793 – 2.240)

*NB : * = Adjusted odds ratio, CI = confidence interval*

4. DISCUSSION

In this study, the prevalence of MetS among the apparently healthy non-diabetic subjects was 23%. This finding is lower than what was reported in a systematic review from Nigeria [13]. The different population groups and criteria for defining MetS considered in the systematic review maybe a possible explanation for the finding. In this study, there was gender difference in prevalence of MetS with the women having a higher prevalence than men. In addition, the odd of developing MetS was three-fold higher in females than males. These findings are similar to what was reported in studies from Nigeria, and Ghana [21-23]. In contrast, studies from India and Turkey demonstrated that the prevalence of MetS was higher among males [24-25]. Metabolic changes and oestrogen deficiency associated with women transition from pre-menopause to postmenopausal state may predispose women to developing MetS [26]. In this study, significant higher proportion of females had two and three components of MetS compared to males similar to what was reported in similar study from Nigeria and Ghana [15,23].

Age has been associated with MetS and studies have shown that prevalence of MetS increase with age [15,27-28]. Similarly, in this study there was increase in the prevalence of MetS with increasing age and the mean age of subjects with MetS was significantly higher. The increasing trend in the prevalence of MetS with advancing age might be attributed to an evolution of insulin resistance, hormonal alterations, and increase in visceral adipose tissue with age [29].

In addition, our study demonstrates that clustering of components of MetS was increased with age. In contrary to what was suggested in a similar study where the clustering of MetS components was reduced with age. It was suggested that MetS in younger subjects may be different form older subjects with different prognostic and treatment implications [30].

The prevalence of components of MetS varies across studies. In our study, central obesity, hypertension and low HDL-C were the most prevalent components of MetS. This is similar to what was obtained by Mabchour et al. and Sossa et al. [31,32]. Changes in diet and physical activities have been suggested to be responsible

for reduced HDL-C in African population [32]. However, studies by Isezuo et al. [33], Beigh et al. [34] and James Osei-Yeboah et al. [23] showed that Hypertension was the most common component of MetS. There is association between central obesity with metabolically active visceral fat, which produces free fatty acids and inflammatory cytokines that drains into the liver [35] which could elicit mechanisms that may result in atherosclerosis and CVD [36]. There was gender difference in the distribution of the components of MetS in our study. While abdominal obesity (74.3%) was the most prevalent component of MetS in females, hypertension (42.5%) was the most common component among males. Similar finding was obtained in studies from Ghana and Northern Nigeria [23,37,38]. Females had four-fold chance of having abdominal obesity than males in this study similar to what was reported by studies from other countries in the sub Saharan Africa [23,39]. The reason for this finding may not be determined from the present study, a complex socio-cultural interactions that predisposes female in sub Saharan Africa to gain weight have been suggested [40].

A multiethnic study showed that African Americans had lower prevalence of elevated triglyceride levels, higher rate of elevated fasting glucose, blood pressure and HOMA-IR. In addition, the prevalence of abdominal obesity was higher in African American women than white women [41]. Studies from Africa have shown that the cutoff for waist circumference used the conventional definitions of MetS is not appropriate [31,42,43].

In this study, there was an association between alcohol consumption and MetS. The relationship between alcohol consumption and MetS is not consistent. While studies have shown positive association [44], others have observed a negative association or no relation at all between alcohol consumption and MetS [45]. This controversy could be related to the complex relationship between alcohol consumption and each component of MetS. Mild to moderate alcohol consumption has a favorable influence on lipids metabolism, abdominal obesity and glucose regulation [46]. On the other hand, alcohol consumption causes hypertension [47] and hypertriglyceridaemia [48] constituting alcohol-related MetS. A study from Korea showed that MetS is negatively associated with light alcohol consumption. In addition, a dose response relation was found for the odd ratios of the MetS and increasing alcohol consumption [49]. Another study from the United States reported that people who drink alcoholic beverages have a lower prevalence of the MetS compared with nondrinkers after accounting for confounders. The inverse relation of alcohol consumption and the MetS was especially noticeable in people who consume less than 20 alcoholic beverages per month and was stronger when the beverage was beer or wine [50].

5. LIMITATION

The study did not consider post-menopausal women or last pregnancy in the determination of waist circumference which may constitute bias in this study. The JIS definition used in determining subjects with metabolic syndrome however did not specify what adjustment to be made for women in these categories. In addition, being a cross-sectional study, it was difficult to determine whether the cause preceded the effect.

6. CONCLUSION

Central obesity, hypertension and reduced HDL-C were the most prevalent components of MetS. In addition, age, gender, alcohol intake and location were socio demographic determinants of MetS in this study. The education of the population to adopt a life style modification to reduce the high prevalence of MetS and its components is required.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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