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Epidemiology of metabolic syndrome among adult Nigerians in a rural hospital in Eastern Nigeria

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Abstract: Background: Biological and socio-behavioural variations exist in the epidemiology of metabolic syndrome (MetS). As the case detection of MetS increases in Nigeria describing its prevalence and risk factors remain relevant for proactive control interventions. Aim: This study was designed to describe the epidemiology of MetS among adult Nigerians in a rural hospital in Eastern Nigeria. Materials and Methods: A cross sectional study was carried out on 365 adult patients who were screened for MetS using International Diabetes Federation(IDF) criteria: An Individual was considered to have MetS in the presence of WC ≥94 cm for men and ≥80 cm for women plus any two or more of the following: systolic and/or diastolic blood pressure ≥130/85 mmHg and/or hypertension on treatment; fasting blood glucose ≥ 100mg/dL and/or diabetes mellitus on treatment; triglyceride level ≥150 mg/dL and/or hypertriglyceridaemia on treatment and high density lipoprotein(HDL-C) cholesterol <40mg/dL for men or <50 mg/dL for women and/or HDL-C dyslipidaemia on treatment. The data collected included basic demographic variables, metabolic and nutri-behavioural risk factors. Results: The prevalence of MetS was 34.0%. MetS was significantly associated with old age(p=0.029), female sex(p=0.016) and physical inactivity(p=0.002). The most significant predictor of MetS was physical inactivity.(p=0.014, OR=4.58(1.52-9.63). The patients with MetS were four and half times more likely to be physically inactive compared to their non-MetS counterparts. Conclusion: This study has shown that MetS exist among the study population. The risk factors significantly associated with MetS were old age, female sex and physical inactivity. The most significant predictor variable was physical inactivity. Early primary and secondary prevention interventions should be a compelling health priority in the study area.

Keywords: Epidemiology, Hospital, IDF criteria, MetS, Rural Nigeria

1. Introduction

Metabolic syndrome(MetS) is a global health problem currently occupying the front burner in clinical and public health practice[1,2] It is a cluster of biochemical and anthropometric abnormality that has high predictive ability for the development of atherosclerotic cardiovascular diseases.[3] and has been variously defined with sets of convergent and divergent diagnostic criteria which vary in specific principal elements but generally include hypertension, obesity, glucose intolerance, hypertriglyceridaemia and high density lipoprotein(HDL)-dyslipidaemia.[1,4] Metabolic syndrome is a constellation of cardiovascular risk factors that has multi-factorial aetiology.[4] The diagnostic criteria for MetS have been published by different Working Groups with modifications and revisions towards finding a common ground.[2] These diagnostic criteria include World Health Organization(WHO) criteria,[6] The European Group for the study of Insulin Resistance(EGIR) criteria.[7] the revised Third Report of National Cholesterol Education Panel(NCEP) in adult (ATP III) criteria(NCEP-ATP III),[8] American College of Endocrinology criteria(ACE)[9] and International Diabetes Federation(IDF) criteria,[3] The most widely use clinic-based diagnostic criteria are those of IDF and NCEP-ATP III .[4,10-13] Using IDF-criteria, an Individual is considered to have MetS in the presence of waist circumference(WC) ≥94 cm for men and ≥80 cm for

women plus any two or more of the following: systolic and/or diastolic blood pressure ≥130/85 mmHg and/or hypertension on treatment; fasting blood glucose ≥ 100mg/dL and/or diabetes mellitus on treatment; triglyceride level ≥150 mg/dL and/or hypertriglyceridaemia on treatment and high density lipoprotein(HDL-C) cholesterol <40mg/dL for men or <50 mg/dL for women and/or HDL-C dyslipidaemia on treatment.[3,12]

The prevalence of MetS has increased globally in the past 2 decades. [1,4] This trend is expected to continue particularly in developing countries if no control interventions are implemented.[10] The prevalence of metabolic syndrome varies by definitions and diagnostic criteria across different parts of the world population. In United States of America the prevalence varies from 16% of black men to 37% of Hispanic women[14], prevalence of 39.3% was reported in Saudi Arabia[15], 29.7% was reported in India,[13] 43.3% was reported in Ethiopia,[16] 35.9% was reported in Ghana,[17] 15.9% was reported in South eastern Nigeria[18] and 14.9% was reported in Abuja, North central Nigeria.[19]

The prevalence of metabolic syndrome has also been reported in specific high risk patients such as those with type 2 diabetes mellitus,[20-23], hypertensive patients[24,25] and obese patients. [12,26,27] Among the patients with type 2 diabetes mellitus, the prevalence of metabolic syndrome of 77.2% was reported in diabetics in India.[20], 66.7% was reported in diabetics in Eastern Nigeria,[21] 25.2% was reported in diabetics in Western Nigeria[22] and 54.3%% was reported in Northern Nigeria.[23] In hypertensive patients prevalence of 15.9% was reported in South eastern Nigeria [18] and prevalence of 42.9% was reported in Western Nigeria.[11] whilst in obese patients, prevalence of 46.3% was reported in Quatar, [12] 40.2% was reported in Malaysia[24] and 53.0% was reported in Italy[25]

Studies have demonstrated that the variability of MetS syndrome within and across the world populations arise as a consequence of actions and interactions of genetic,[26] and non-genetic (socio-environmental) factors [27-29] The predominant underlying risk factors of MetS appear to be insulin resistance[30] and abdominal obesity.[31] The associated clinical conditions include physical inactivity [14] and other enhancing risk factors.[32-36] The magnitude of these MetS risk factors vary based on the components of the MetS risk factors and non-MetS risk factors present in a particular individual. These MetS risk factors interact in different path- physiological pathways to produce the various clinical pictures of MetS in an individual and populations.

Studies have shown that the health of adult Nigerians is in epidemiological transition. [37,38] This is in consonance with the trend of epidemiological transition reported in other developing economies which are related to westernization and modernization of lifestyles in addition to the genetic and socio-environmental factors that have been shown to influence the prevalence of MetS in certain populations.[39] Describing the epidemiology of MetS in adult Nigerian patients will identify individuals who had constellations of MetS and the persons at risk of developing the full complement criteria for the syndrome . Screening the study population for MetS therefore avails great opportunity for primary and secondary prevention especially in resource-poor rural settings where health seeking behaviour and utilization are largely driven by the need for curative services rather than the imperative for preventive care. This study was therefore designed to describe the epidemiology (prevalence and risk factors) of metabolic syndrome in adult Nigerians in a resource-poor setting of a rural hospital in Eastern Nigeria.

2. Materials and Methods

2.1. Ethical Consideration

Ethical certificate was obtained from the Health Research and Ethics Committee of the hospital. Informed consent was also obtained from patients included in the study.

2.2. Study Design

This was a hospital-based cross sectional study conducted between June 2008 and June 2011. Three hundred and sixty five adult patients aged 18-91 years who had waist circumference (WC) ≥94 cm for men and ≥80 cm for women were screened for MetS using IDF criteria.

2.3. Study Setting

Amurie-Omanze is a rural community in Imo State, South-East Nigeria. Imo State is endowed with abundant mineral and agricultural resources with supply of professional, skilled, semi-skilled and unskilled manpower. Economic and social activities are low compared to industrial and commercial cities such as Onitsha, Port Harcourt and Lagos in Nigeria.

St Vincent De Paul Hospital is a rural General Hospital in Imo state, South-east Nigeria and renders twenty four hours service daily including public holidays to the community.

2.4. Study Population

The study population was made up of 365 adult patients who had WC ≥94 cm for men and ≥80 cm for women using IDF criteria and met the inclusion criteria

2.5. Inclusion and Exclusion Criteria

The inclusion criteria were patients with WC ≥94 cm for men and ≥80 cm for women aged ≥ 18 years who gave informed consent for the study. The exclusion criteria were critically ill patients, pregnant women, women in pueperium, patients with demonstrable ascites and intra-abdominal masses determined by history and physical examination.

2.6. Sample Size Determination

Sample size estimation was determined using the formula[40] for calculating minimum sample size $N=Z^2pq/d^2$ where N=Minimum sample size, Z=Standard normal deviation usually set at 1.96 which corresponds to 95% confidence interval, P=Proportion of the population estimated to have a particular characteristic. Proportion was taken from previous study in Enugu, South-eastern Nigeria [18] = 15.9% (0.16). q=1.0 - p=1.0- 0.16=0.84, d=degree of accuracy set at 0.05. Hence N= (1.96)2 x 0.16x0.84/ (0.05)2. Therefore, N=206.

The calculated minimum sample size was 206. However, to improve the precision of the study, the estimated sample size=Ns was determined considering an anticipated response rate of 90%(0.9). The estimated sample size (Ns) was determined by dividing the original calculated sample size (N) by the anticipated response rate as follows, Ns= N/0.9, [40] where N=Minimum calculated sample size, Ns=Selected sample size, anticipated response rate=0.9. Thus, the estimated sample size = 206/0.9= 228. However, selected sample size of 365 patients was used based on the duration of the study.

2.7. Sampling Technique

The sample selection was done consecutively using every adult patient who registered to see the clinicians on each consulting day during the study period and who met the inclusion criteria. This sampling technique was judgementally chosen by the authors based on the fact that the researchers believed that those selected were likely to be representative of the study population.

2.8. Diagnostic Procedures for Components of Metabolic Syndrome

Metabolic syndrome components were evaluated by anthropometric determination of waist circumference, clinical evaluation of blood pressure and laboratory assessment of fasting plasma glucose and lipid profile.

The WC was measured using flexible non-stretchable tape.[41,42] The subject stood erect with arms at the side and feet together. The researcher faced the subject. The iliac crest and lower rib cage were first identified by palpation. The WC was taken as the midpoint between the lower border of lower rib cage and iliac crest in a horizontal plane parallel to the floor.

The blood pressure was measured using auscultatory method with standard mercury in glass Accuson sphygmomanometer.[41,42] Prior to the measurement, the patient was seated and rested for 5 minutesin sitting position on a chair that supported the back comfortably. The left arm muscles were relaxed and the forearm was supported with the cubital fossa at the heart level. A cuff of suitable size was applied evenly to the exposed arm. The cuff was rapidly inflated until the manometer reading was about 30 mmHg above the level at which the pulse disappeared and then slowly deflected. During this time, the Korotkoff sounds were monitored using a Litman stethoscope placed over the brachial artery. The systolic blood pressure was noted at the pressure at which the first heart sounds were heard(Korotkoff phase I). The diastolic blood pressure was taken as the pressure at the point when the heart sounds disappeared(Korotkoff phase v). The blood pressure was also measured in the right arm as described for the left arm in order to rule out significant inter-arm blood pressure difference and the arm that gave the higher reading was subsequently used.

The blood glucose was determined after an overnight fast between 8.00 hours to 10.00 hours using venous plasma by glucose oxidase method. The fasting lipid profile: triglycerides and high density lipoprotein cholesterol were determined after an overnight fast between 8.00 hours to 10.00 hours by enzymatic method.

2.9. Diagnostic Criteria for Metabolic Syndrome Using IDF Criteria

The Metabolic syndrome was defined using IDF-criteria, [3] an Individual was considered to have MetS in the presence of waist circumference(WC) ≥94 cm for men and ≥80 cm for women plus any two or more of the following: systolic and/or diastolic blood pressure ≥130/85 mmHg and/or hypertension on treatment; fasting blood glucose ≥ 100mg/dL and/or diabetes mellitus on treatment; triglyceride level ≥150 mg/dL and/or hypertriglyceridaemia on treatment and high density lipoprotein(HDL-C) cholesterol <40mg/dL for men or <50 mg/dL for women and/or HDL-C dyslipidaemia on treatment.

2.10. Methods

Data collection instrument was adapted from the generic WHO-STEPS instrument approach to surveillance of chronic non-communicable diseases risk factors [43] and was modified to suit Nigeria environment through robust review of relevant literature [10,12,18,23,24,27-29,44-46] Personal histories and diagnoses of principal components of metabolic syndrome were obtained. The socio-demographic variables of age, sex, marital status, education, occupation, and social class The behavioural factors assessed were physical activity profile, alcohol and tobacco use, dietary fruits and vegetables consumption during meal times and the type of oils used in meal preparations.

The social classification of patients was divided into lower, middle and upper occupational classes to suit Nigerian environment.[41,42,44] The behavioural risk factor of physical activity was assessed by inquiring how many times the respondents engaged in physical activities in the previous 7 days. Those who engaged in activities that cause a moderate or large increase in breathing or heart rate for ≥ 30 minutes for ≥ 3 days/week are considered physically active while the level of activity below this was considered physical inactivity. Subject's occupational and activities of daily living were taken into account in assessing for the physical activity. Physical activity

responses were graded into: never (0 times/week), rarely (<30 minutes in <3 days/week) and often times (≥30 minutes in ≥3 days/week). Physical activity was categorized as active or inactivity. Those who had 0 time/week(never) or <30 minutes in <3 days/week(rarely) are considered physically inactive while those who had ≥30 minutes in ≥3 days/week (oftentimes) are considered physically active. Alcohol consumption was assessed in the previous 12 months preceding the study and coded yes or no for someone who used less than a unit or a unit of any type of alcohol daily or occasionally in 12 months preceding the study or someone who had never used alcohol in the previous 12 months preceding the study respectively. A unit of alcohol is equivalent to 10 g of alcohol. Similarly, tobacco use was evaluated with respect to the use of smoked and smokeless tobacco in the lifetime and coded yes or no for someone who had used smoked or smokeless tobacco in any form either daily or occasionally in their lifetime or someone who had never used tobacco in their lifetime respectively. The dietary fruits and vegetables consumption were evaluated by asking how many days in the previous 7 days did the respondents eat fruits and vegetables. The dietary responses were graded into: never (0 serving/week), rarely (<3 servings/week) and oftentimes (≥3 servings/week). Those who had ≥3 servings/week had adequate dietary fruits intake while those who had 0 serving/week and <3 servings/week had inadequate dietary fruits and vegetables consumption respectively. The question on dietary use of oils was got by inquiring in the previous 7 days the type of oil used in household meal preparations. The dietary oils were classified into saturated and unsaturated oils based on the type of oils available in Nigeria.

The information on personal behavioural measurements was based on previous 7 days physical activity and dietary recall method. This method was expected to give required information on physical activity and dietary assessment based on the feasibility and the Nigerian practice population setting. The researchers explained briefly the concept of the study and made vigorous effort to maximize positive response in order to minimize the potential for information bias especially response acquiescence and social desirability response.

The pre-testing of the questionnaire was done internally at the hospital using five abdominally obese patients from the outpatient clinic. The pre-testing of the questionnaire lasted for two days. The respondents for the pre-testing of the questionnaire were selected haphazardly from the clinic. The pretesting was done to find out how the questionnaire would interact with the respondents and ensured that there were no ambiguities. However, no change was necessary after the pre-test as the questions were interpreted with the same meaning as intended.

The questionnaire instrument was interviewer-administered. Language used was English Language. However, local languages were used to explain verbally to the patients who could not understand the medical language in the questionnaire. The questionnaire was administered once to each eligible respondent.

3. Operational Definitions

The researchers defined young adult patients as those aged less than 40 years and old adults as those ≥ 40 years. Biosocial risk factors of MetS refer to antecedent condition(s) whose presence is(are) positively associated with an increased probability that abdominal obesity will develop later. Artisans refer to manual workers and include masons (bricklayers), fitter mechanics, electricians, tailors, seamstresses, hair dressers and carpenters.[44]

4. Statistics

The results generated were analyzed using software Statistical Package for Social Sciences (SPSS) version 13.0, Microsoft Corporation, Inc. Chicago, IL, USA. Categorical variables were described by frequencies and percentages. Bivariate analysis involving Chi-square test was used to test for the significance of associations between categorical variables. To determine the odds ratio, the authors controlled for the patients with MetS using those without MetS within the study population. Furthermore, to identify predictor variables independently related with MetS, logistic regression analysis was performed at 95% confidence limit. The level of significance was set at $p<.05$.

5. Results

Of the 365 patients with abdominal obesity who were screened for MetS, 124(34.0%) had MetS.(Table 1) The ages of the patients with MetS range from 18 years to 88 years with mean age of 48.0 ± 6.10 years. There were 47(37.9%) males and 77(62.1%) females with male to female ratio of 1.0: 1.6.[Table 2]

Table 1. *Prevalence of MetS using IDF diagnostic criteria*

Parameter	Number	Percentage
MetS present	124	34.0
MetS absent	241	66.0
Total	365	100.0

Bivariate analysis of socio-demographic and behavioural variables as related to MetS showed that variables such as old age(X^2=5.16, p-value=0.029); female sex (X^2=7.20, p-value=0.016), and physical inactivity(X^2=9.04, p=0.00) were statistically significant while other variables such as marital status(p=0.07), educational attainment(p=0.083), occupation(p=0.560), social class(p=0.065), alcohol consumption(p=0.180), tobacco use(p=0.558), dietary fruits consumptions(p=0.091), dietary vegetables consumptions(p=0.086) and dietary oils consumption(p=0.177) were not statistically significant. [Table 2].

Table 2. *Socio-demographic and behavioural variables as related to MetS*

Variables	Metabolic syndrome		X^2	P-value
	Present (Number(%)	Absent (Number(%)		
Age(years)				
< 40	38(30.6)	132(54.8)		
≥ 40	86(69.4)	109(45.2)	5.16	0.029*
Sex				
Male	47(37.9)	140(58.1)		
Female	77(62.1)	101(41.9)	7.20	0.016*
Marital status				
Single	13(10.5)	31(12.9)		
Married	79(63.7)	167(69.3)		
Widowed	26(21.0)	40(16.6)		
Separated/Divorce	6(4.8)	3(1.2)	2.18	0.07**
Education				
Primary & less	46(37.1)	71(29.5)		
Secondary & more	78(62.9)	170(70.5)	6.02	0.083**
Occupation				
Housewives	33(26.6)	31(12.9)		
Student/apprentice	4(3.2)	10(4.1)		
Trading	13(10.5)	49(20.3)		
Farming	7(5.6	60(24.9)		
Public/civil servants	20(16.1)	44(18.3)		
Artisans	9(7.3)	20(8.3)		
Driving	5(4.1)	4(1.7)		
Clergy	7(5.6)	10(4.1)		
Retirees	26(21.0)	13(5.4)	7.13	0.560**
Social class				
Lower	79(63.7)	119(49.4)		
Middle	34(27.4)	85(35.3)		
Upper	11 (8.9)	37(15.3)	7.88	0.065**
Physical activity				
Active	31(25.0)	85(35.3)		
Inactive	93(75.0)	156(64.7)	9.04	0.002*
Alcohol consumption				
Yes	41(33.1)	66(27.4)		
No	83(66.9)	175(72.6)	3.02	0.180**
Tobacco use				
Yes	31(25.0)	24(10.0)		
No	93(75.0)	217(90.0)	3.73	0.558**
Dietary fruit consumption				
Adequate	43(34.7)	76(31.5)		
Inadequate	81(65.3)	165(68.5)	5.55	0.091**
Dietary vegetable consumption				
Adequate	59(47.6)	89(36.9)		
Inadequate	65(52.4)	152(63.1)	8.73	0.086**
Dietary oil consumption				
Saturated	89(71.8)	197(81.7)		
Unsaturated	35(28.2)	44(18.3)	3.67	0.177**

Remark: *=Significant; **=Not significant

However, on logistic regression of the statistically significant variables, old age and physical inactivity remained statistically significant with physical inactivity being the most statistically significant predictor variable of MetS. A significantly higher proportion of patients with MetS were physically inactive compared to those without MetS(OR=4.58, CI=1.52 – 9.63, p-value=0.014). The patients who had MetS were four and half times more likely to be physically inactive compared to their non-MetS counterparts.[Table 3]

Table 3. *Predictor socio-behavioural variables as related to MetS.*

Variables	Odds ratio	Confidence interval(95%)	P-value
Age(years)			
<40	1.00		
≥40	3.10	1.26 – 8.04	0.041
Sex			
Male	1.00		
Female	2.07	1.40 – 11.85	0.053
Physical activity			
Active	1.00		
Inactive	4.58	1.52 – 9.63	0.014

6. Discussion

The prevalence of MetS of 34.0% in this study is less than that reported in Enugu, South-east Nigeria(15.9%)[18], Abuja, North-central Nigeria(14.9%)[19] and India(29.7%).[13] However, the prevalence of MetS of in this study is lower than that reported in Ghana(35.9%)[17], Ethiopia(43.3%)[16], Turkey(34.6%)[,47] and Saudi Arabia(39.3%)[15]. The prevalence of MetS in this study is a reflection of the study population which included previously diagnosed hypertensive and diabetic mellitus on treatment in accordance with IDF diagnostic criteria. It is also possible that variations in the prevalence of MetS could be due to differences in socio-biological characteristics of the study population. The finding of this study has buttressed the reports that MetS is an issue of phenomenal medical importance in Nigeria[11,18,19,21-23,27] and has demonstrated that MetS is no longer the exclusive disease of affluent countries. This has corroborated the reports that MetS exists in different parts of Nigeria in variable proportions and the trend is changing rapidly.[11,18,19,21-23] The most deleterious effects of MetS have been shown to be on cardiovascular system and associated disorder of lipid and glucose homeostasis. [48,49] The MetS clinical condition could therefore predispose these patients to increase cardiovascular morbidity and mortality. It is pertinent to detect early the development of MetS particularly among the study population as early interventions may alter morbidity, specific cause and all cause mortality.

This study observed that MetS was significantly higher among females compared to their male counterparts (p=0.016). This finding is similar to reports from Nigeria,[18,19,21-23] other parts of Africa such as Ghana[17] and other parts of the world like India[13] and turkey[47]. The higher prevalence of MetS among the females in this study could be a reflection of IDF cut off criteria which is lower for females than males in Nigeria.[11] In addition, the higher prevalence of MetS in females could be due to socio-cultural factors in the study area where males are predominantly the breadwinner and involved in work-related physical activities while the females are basically home makers . This traditional disposition of females as home makers and housewives encourage sedentary lifestyles which have been documented to promote the occurrence of MetS.[12,14,28,29,32] Apart from the physical inactivity and diagnostic criteria, the genetic differences between the sexes may be contributory.

The finding in this of a higher prevalence of of MetS among old adults aged ≥40 years is in consonance with the reports from Nigeria[18,19] and other parts of the world such as India.[13] According to these reports, the prevalence of MetS as defined by IDF criteria increases with age. This could be a reflection of the socio-epidemiological characteristics of the old adults. Each of the principal defining components of MetS has been reported to occur disproportionately higher in old adults than the young adults. [41,42,44] This is attributed to the fact that ageing is associated with emergence of insulin resistance, diversion of fat from peripheral to the central sites with progressive redistribution of the fat stores more to the intra-abdominal visceral region.[50] In addition, neuro-hormonal alterations associated with ageing can predispose, promote and enhance mechanistic pathogenesis of MetS.[32]

This study has shown that MetS was significantly higher in the subjects who were physical inactive (p=0.002). Physical inactivity is reportedly associated with each of the principal component defining criteria that contributes to MetS.[50,51] Apart from the metabolic homeostasis associated with physical activity, physical activity reduces cardio-metabolic risk through reduction of blood pressure, improve glucose tolerance, lipid profile and endothelial function, enhance fibrinolysis and parasympathetic autonomic tone and through other yet undetermined mechanisms.[51-53] The growing scientific consensus on the deleterious effects of physical inactivity mandates that physicians be informed and prepared to assist patients with MetS in living a physically active life. Clinicians should therefore explain to their patients with MetS in sufficient details the health implications of physical activity. Physical activity is therefore not an activity that anybody outgrows because of its beneficial effect in primary and secondary prevention of metabolic disorders. Physical activity should not been seen as a burden but should be made part of the patients schedule as there is physical activity for everyone.

The most significant predictor variable associated with MetS in this study was physical inactivity. This finding is consistent with other reports on the relevance of physical inactivity as an important risk factor for dysmetabolic syndrome.[51,54] Apart from physical inactivity, genetic and other socio-behavioural factors could predispose to emergence of MetS.[32] Although not every physically inactive patient develops MetS but their chances are higher. This information should not be limited to the consequences of physical inactivity but also the benefits of physical activity as an adjunct to medications in MetS patients with personal history of obesity, hypertension, diabetes mellitus and dyslipidaemia. With the changing lifestyles in the study

area, eliciting history of physical inactivity during clinical encounter with patients who had MetS should provide guide for health education, health promotion and risk reduction. Physical inactivity can therefore have adverse metabolic effects on these patients and can trigger other acute and chronic complications of MetS. The earlier the primary prevention is started the more likely it is to be effective.

7. Implications of the Study

Studies have shown that considerable individual and racial variations exist in the clinical pattern of MetS especially in nations that are in epidemiological transition.[32] It is possible that the expression of each of the defining components of metabolic is under genetic control which influences the response to various socio-environmental risk factors. Although the individual effects of the components of MetS are independent but the risk of their combined effects is much greater. Screening adult Nigerians with abdominal obesity for defining components of MetS will detect early the addition of any of the elements of MetS before others are added to make up the defining criteria. This informed the need to sensitize clinicians and public health practitioners to screen abdominally obese patients for MetS and assess them for socio-behavioural epidemiological risk factors particularly in resource poor rural settings. This will provide guide in defining interventional programs for MetS among the study population.

8. Limitations of the Study

The authors had certain constraints which imposed some degree of limitations to the absolute generalization of the findings: First and foremost, the sample was drawn from hospital attendees in the study area as only patients who presented to the clinic were studied. Thus extrapolation and generalization of the results of the study to the entire population in the study area should be done with utmost caution because the findings may not be a true representation of what may be obtained in the community.

Moreover, this study was not an all inclusive study on conventional and novel metabolic syndrome risk factors but on some selected traditional risk factors such as hypertension, obesity, diabetes mellitus, physical activity, alcohol and tobacco use and diets.

In addition, this study was dependent on self-reported behavioural variables. However, some respondents were either reluctant to give correct information regarding social behaviour. This could have led to response acquiescence, social desirable response, and ceiling or floor effects.

Furthermore, the assessment for the behavioural risk factors of alcohol and tobacco use was not quantitative as regards the metabolic relevance of occasional or rarely use of alcohol or tobacco which may not predispose to metabolic derangements.

9. Conclusion

This study has shown that MetS exist among the study population. The risk factors significantly associated with MetS were old age, female sex and physical inactivity. The most significant predictor variable was physical inactivity. Early primary and secondary prevention interventions should be a compelling health priority in resource-constrained setting of the study area.

10. Further Research Direction

Further research is needed on the predictive risk factors of MetS in longitudinal studies for causal hypotheses to be made and inferences to be drawn.

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