PREVALENCE OF METABOLIC SYNDROME AMONG APPARENTLY HEALTHY ADULTS IN A RURAL COMMUNITY, IN NORTH-WESTERN NIGERIA.

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ABSTRACT

BACKGROUND
Metabolic syndrome (MetS) is a cluster of multiple metabolic abnormalities that increases the risk of cardiovascular morbidity and mortality, and a resultant severe economic implication. This study assessed the burden of MetS in a Nigerian rural community setting.

METHOD
This was a cross-sectional, community based study on apparently healthy subjects. A multi stage cluster sampling technique was employed to recruit the study subjects. A standardized pre-tested questionnaire was used to obtain data, and blood samples from subjects were analysed using standard laboratory techniques. MetS was defined using the NCEP-ATP3 criteria. Data were analysed using STATA version 11, and a p value of <0.05 was considered statistically significant.

RESULTS
A total of 450 subjects completed the study, with 38% being males, and a mean age of 40.27±16.41 years. MetS was found in 116 (25.78%) of the subjects. Of these, systemic hypertension was found in 91(78.45%), while all (116) had elevated cholesterol and triglycerides. Abdominal adiposity was found in 45 (38.79%) subjects and 44 (37.93%) had Type 2 diabetes mellitus.

CONCLUSION
The prevalence of MetS and its components in our studied population was high; hence the need for further large population based studies to determine its predictors in our environment.

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INTRODUCTION

Metabolic syndrome (MetS) is a cluster of multiple metabolic abnormalities that increase the risk of cardiovascular morbidity and mortality.[1] The specific components of the syndrome include: central obesity, glucose intolerance, elevated triglycerides, low levels of high density lipoprotein cholesterol (HDL-C) and hypertension.[2] The presence of the MetS is associated with an approximate doubling of the risk of cardiovascular diseases (CVD) and mortality.[3] The cardinal abnormality in metabolic syndrome is central obesity, which in itself increases the risk of insulin resistance.

The epidemiological significance of the MetS as a tool for identifying individuals at high risk for cardiovascular disease coupled with its rising prevalence worldwide has lead to wide interest in the condition by several expert groups resulting in different diagnostic definitions for the syndrome.

In 2005 the American Heart Association and the National Heart Lung and Blood Institute (AHA / NHLBI) and the International Diabetes Federation (IDF) published criteria for the metabolic syndrome designed to be of practical application in epidemiological studies.[4,5] The AHA / NHLBI criteria were essentially a revision of the 2001 National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATP III) criteria.[6] Both the IDF and the revised ATP III used the five components mentioned above but differed in that the IDF criteria regarded central obesity as a required component with the diagnosis being made if any two of the other components were present, while the revised ATP III criteria could be based on any three of the five components.

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Recently, in conjunction with representatives from the World Heart Federation, International Atherosclerosis Society, and International Association for the Study of Obesity, a revised set of criteria harmonizing the definition of MetS were published.[7] The prevalence of MetS varies between different populations. In developed countries MetS is estimated to affect around 25% of the population.[8] The prevalence of MetS tends to be even higher when cohorts of subjects already having cardiovascular risks such as hypertension or diabetes are evaluated as was demonstrated in Caucasians with type 2 diabetes where the prevalence was 75.6%.[9]

Diabetes Mellitus (DM) as an important component of the MetS has assumed epidemic proportion with a total global prevalence of 371 million in the year 2012 and a projected rise to 552 million by the year 2030. [10] It is of note that the majority of this increase, which is expected to be of the type 2 DM, is being envisaged to occur in developing countries.[10] This may be due to advancing age, physical inactivity, unhealthy diet, ever increasing incidence of overweight and obesity engendered by rapid urbanization and westernization in the African countries.[10]

The MetS has severe economic implications, with estimates that the related condition, (obesity) leading to health costs of about $100 billion yearly in the United States.[6] This is frightening as such economic burden cannot be borne by most developing nations.[11]

Studies on MetS in sub-Saharan Africa are scanty.[12] Previous studies in Nigeria have reported prevalence rates of MetS of up to 80% among persons with diabetes mellitus .[13, 14] Most of these studies were however, carried out mainly in urban populations. A study among rural dwellers in Southwestern Nigeria revealed a prevalence of MetS of 12.1%. [15] There is paucity of data on the prevalence of MetS among rural dwellers in Northern Nigeria. No such study has been conducted in Kano, northwestern Nigeria. In this study, we aimed to determine the prevalence of MetS among apparently healthy adults resident in a rural community using the NCEP-ATP III criteria.

METHODS

The study was a community-based cross-sectional evaluation of metabolic syndrome of apparently healthy individuals living in a rural area (Kumbotso local government area) of Kano state, north-west Nigeria. Kumbotso is a rural community with a mixed population of farmers, traders, Islamic scholars and students. It has a primary health care centre and a general hospital with very limited number of health workers.

We recruited subjects who gave informed consent to participate in the study after adequate information on the study objectives and its potential benefit to the participants and community. Ethical approvals were obtained from the research and ethics committee of Aminu Kano Teaching Hospital Kano, and Kumbotso local government council before the commencement of the study. Six out of twelve political wards were selected randomly by balloting. A multistage cluster sampling was used. One settlement was randomly selected from the list of all settlements in each ward. Households in each of the settlement were then selected systematically, using a sample interval. All persons aged 18 years and above in each selected household were recruited until sample size of 500 subjects was obtained. Participants with comorbidity e.g. hypertension, renal disease and diabetes mellitus were excluded.

Subject's biodata were obtained using a standardized questionnaire. The anthropometric parameters of the subjects were measured using standard techniques. The height and weight of each subject was measured to the nearest 0.1m and 0.1kg respectively. The body mass index (BMI) was calculated using the Quetelet's [16] index ; BMI= Weight (kg) / height $(m)^2$ Waist circumference was measured to the nearest 0.5cm on bare skin of an erect subject using a non-stretchable tape measure with landmarks as mid-point of the 10th rib and iliac crest (at approximate level with the umbilicus in a horizontal plane). Two independent measurements were done by two assessors and the average taken. The Waist-hip ratio was taken in all subjects.

The blood pressure was measured at two different times at least 30mins apart, using the right arm to the nearest 2mmHg with subjects sitting on a chair beside a consulting table after at least 5 minutes rest using standard mercury sphygmomanometer. Using a prominent ante-cubetal vein after observance of appropriate asepsis, 10ml of venous blood was drawn for fasting plasma glucose and serum lipids with 5ml each dispensed into appropriate specimen bottles stored in ice packs and subsequently transported to the chemical pathology laboratory within 2 hours for analysis. The glucose oxidase method of Trinder [17] was used to analyse plasma glucose while the serum total cholesterol, high density lipoprotein (HDL), triglycerides (TG) were analysed using relevant assay techniques. The serum low density lipoprotein (LDL) cholesterol was calculated for each subject using the Friedwald's [18] equation with the exception of samples in which TG is more than 400mg/dl (in which case LDL was measured directly). We confirmed the presence of the metabolic syndrome in a subject if he / she fulfilled the criteria defined by the NCEP-ATP III.[6]

Data analysis

Quantitative variables were summarized using mean, and standard deviation, or median and quartiles, as appropriate. Categorical variables were tabulated using frequencies and percentages. The differences in means were determined by t-test when normally distributed and by Mann Whitney test when non-parametric. Data was analyzed using STATA version 11 (Stata Corporation, College Station, USA). We considered $p < 0.05$ as attaining statistical significance.

RESULTS

A total of 450 persons were enrolled. Of these, 171 (38.0%) were males, with a mean±SD age of 40.27±16.41years; 95% C.I. [38.75 - 41.79]. The prevalence of metSynd identified among the study population is 25.78%. the proportion females with metSynd was significantly higher (77.57%) than in males (22.43%), p <0.05. Those with metabolic syndrome have significantly higher age, Table 1. Of all studied persons, 129 (28.7%) were employed while 71.3 % are unemployed. Furthermore, 330 (73.3%) were married with 26.7 were either single divorced/widowed. There is also a significant difference in marital and occupational status between those with and without metabolic syndrome. Table 1.

Of the study participants, 292(54.2%) had systemic hypertension; 116(25.8%) had hypercholesterolemia; while 56 (12.4%) had hypertriglyceridemia. We found 78(17.3%) persons having high waist circumference; while 67(14.89%) were diabetic. Figure 1

Among the study participants with metabolic syndrome, 91 (78.45%) had systemic hypertension; while all persons with metabolic syndrome 116 (100%) had high cholesterol. Equally, 116(100%) of them had high triglyceride levels. 45(38.79%) of them had high waist circumference, with 44 (37.93%) being diabetic. All variable mean measures were higher in persons with metabolic syndrome compared to those without. Furthermore, the differences were all statistically significant. Table 2

There is a positive correlation between waist circumference and cholesterol level (p <0.003) though with a weak association (Pearson correlation = 0.136). Similarly, there is a positive correlation between waist circumference and triglyceride level; (Pearson correlation= 0.11); it was significant at (p <0.02). Figure 2.

Although on logistic regression model, being a female was associated with 15% higher risk of developing metabolic syndrome, the association was weak without a statistically significant association. Other variable were also not strongly associated with it.

Table 1. Demographic characteristics of Study population

	Total	**Metabolic syndrome positive**	**Metabolic syndrome negative**	**P value**
Males (n)	171	26 (22.41%)	145 (77.59%)	0.0001
Females (n)	279	90 (32.26%)	189 (67.74%)	
All subjects	450	116 (25.78%)	334 (74.22%)	
Mean Age (years)	40.27±16.41	48.49±16.04	37.41±15.57	< 0.001
Marital status				< 0.001
Married	80 (100)	10(12.50)	70(87.50)	
Single	330(100)	90(27.27)	240 (72.73)	
Divorced	2(100)	1(50)	1(50)	
Widowed	36(100)	15(41.67)	21(58.33)	
Separated	2(100)	0(0)	2(100)	
Occupation				< 0.001
C/ Servant	36(1000	4 (11.11)	32(88.89)	
Business	129(100)	4031.01)	89(68.99)	
Farmer	43(100)	8(18.60)	35 (81.40)	
Housewife	99(100)	28(28.28)	71(71.72)	
Student	29(100)	0(0)	29)100)	
S/E	56(100)	13(23.21)	43(76.79)	
Unemployed	58(100)	23(39.66)	35(60.34)	

C/ Servant = Civil Servant; S/E = Self Employed

Table 2. Components of the metabolic syndrome among persons with and without Metabolic syndrome.

Components of Metabolic Syndrome	TOTAL STUDY POPULATION	Metabolic syndrome positive	Metabolic syndrome negative	P value
Mean (SD)				
WC (cm)	81.25 (±11.15)	88.84 (±12.95)	78.61 (±9.10)	0.0001
BMI (Kg/m^2)	23.78 (±5.09)	27.15 (±6.39)	22.61 (±3.94)	0.0001
TG (mg/dl)	88.082(±49.87)	110.54(±58.66)	80.28 (±43.92)	0.0001
HDL-c (mg/dl)	167.76(±45.27)	187.69 (±47.42)	161.34 (±41.58)	0.0001
FPG (mmol/l)	96.06 (±45.48)	117.48 (±59.65)	88.62 (±36.67)	0.0001

WC = Waist Circumference; BMI = Body Mass Index; TG = Triglycerides;
HDL-c = High Density Lipoprotein Cholesterol; FPG = Fasting Plasma Glucose

Table 3. Logistic regression modeling for determining predictors of metabolic syndrome

VARIABLES	**UNIVARIATE ODDS RATIO**	**P value**
Age	0.98	0.111
Sex	1.15	0.517
Waist circumference	0.98	0.256
BMI	0.99	0.910
Cholesterol	0.99	0.532
Triglyceride	0.99	0.952
FPG	0.99	0.101

BMI = Body Mass index; FPG = Fasting Blood Sugar

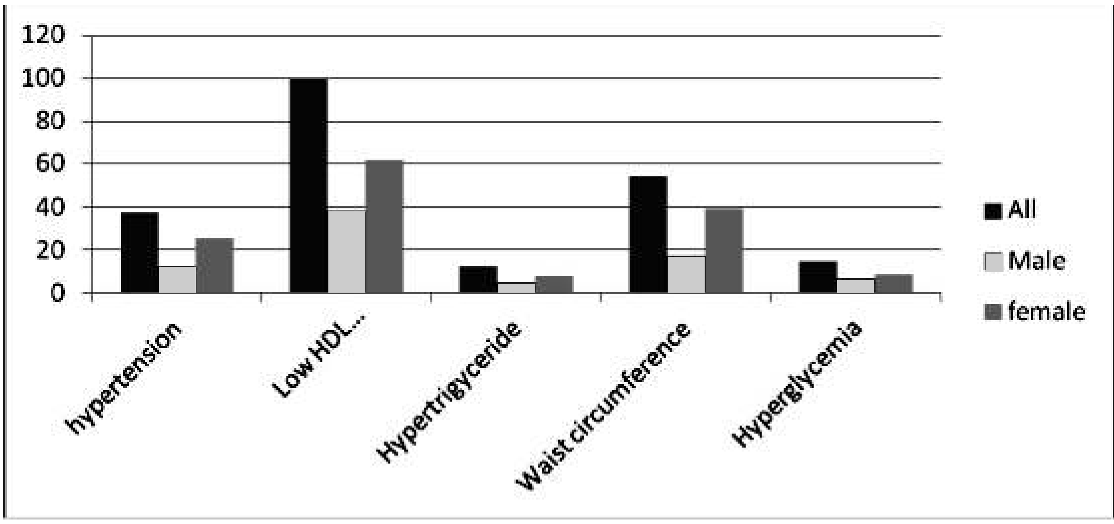

Figure 1.Prevalence of cardiovascular risk factors among study population by gender (Height represent percentages)

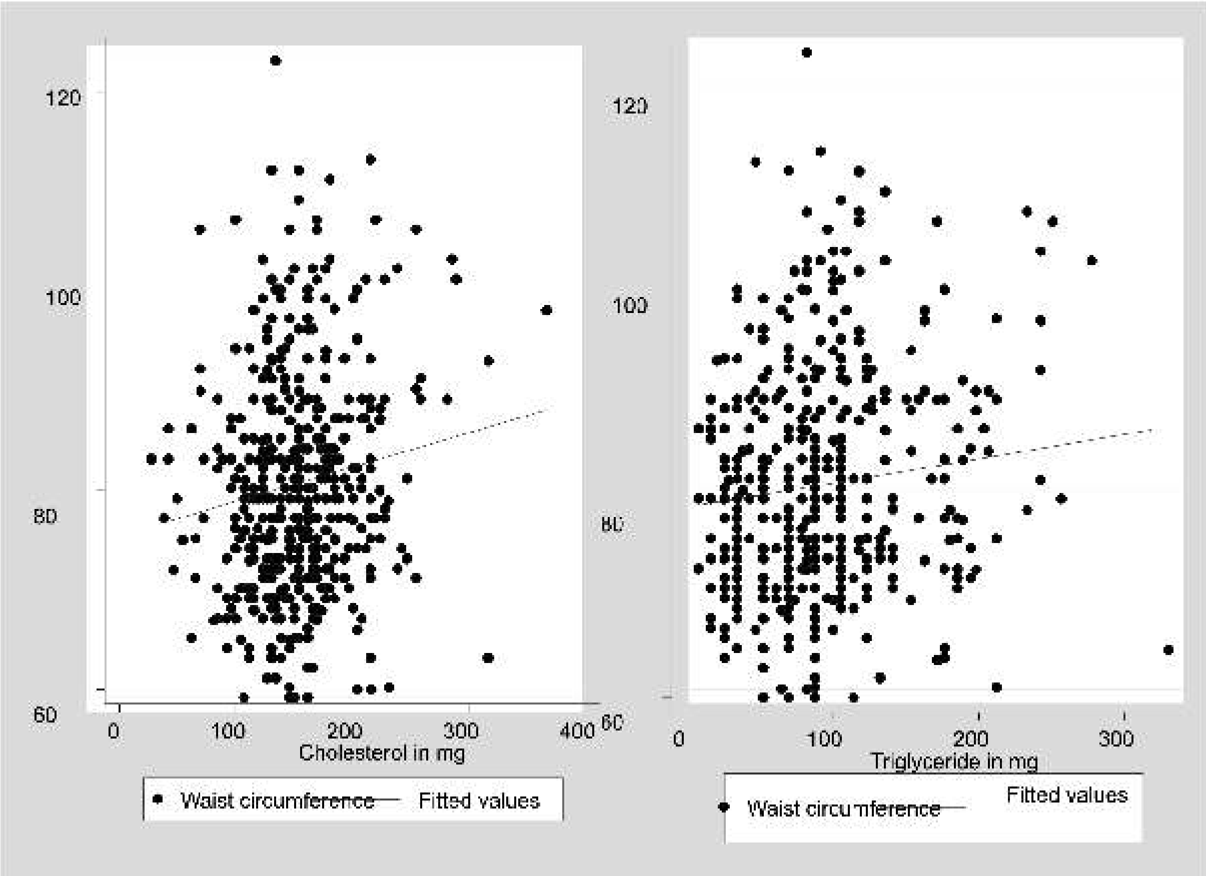

Figure 2. Correlation between waist circumference, cholesterol and triglyceride levels

DISCUSSION

The Metabolic syndrome (MetS) is a cluster of risk factors that predispose to cardiovascular disease (CVD) morbidity and mortality.[19] These risk factors include obesity, dysglycaemia, dyslipidaemia and hypertension.[20] The prevalence of MetS is increasing rapidly worldwide in parallel with the increasing prevalence of type 2 diabetes and obesity.[21] In our study, we found the prevalence of MetS to be 25.8%, a figure that is higher than the 18.0% reported by Ulasi et al [22], but lower than the 36.7% reported by Ghazali et al [23] in an urban Nigerian population. The latter study was carried out in Ibadan, Southwest Nigeria. Regional differences in the prevalence of obesity (including central adiposity) have been observed by Okafor et al [24] in a multicenter study among urban dwelling Nigerians drawn from five geopolitical zones of the country with subjects from the South having higher rates of overweight and obesity than their Northern counterparts, a finding that may explain the higher prevalence of the MetS, considering the pivotal role of obesity in its pathogenesis. The higher prevalence of MetS among women compared with men in the index study is in tandem with reports from studies done elsewhere.[11, 25, 26] This observation has been attributed to higher rates of obesity and lower levels of physical activity among women compared with men. Other workers have however, reported higher prevalence of MetS among men than women.[13, 14, 27] Both elevated triglycerides and reduced HDL were found in 100% of our subjects with MetS. Hypertriglyceridaemia and low HDL are the two main types of dyslipidaemia associated with MetS. Puepet et al [14] also reported high rate of hypertriglyceridaemia among their subjects with MetS. Other studies did not find hypertriglyceridaemia to be a significant contributor to dyslipidaemia among subjects with MetS.[15, 28-30] Low HDL has been reported to be highly prevalent among persons with MetS in studies from Nigeria and Bostwana.[31-33]

Hypertension was the second most common component of MetS identified in this study with a prevalence of 78.5%. Hypertension is one of the most common cardiovascular disorders in Africa today.[20, 32,34] In a Nigerian national survey reported in 1997, Kano State had the highest prevalence of hypertension in the country.[35] In a recent Nigerian multicentre study of 535 diabetics by Uloko et al,[36] the prevalence of hypertension was found to be 60.9% with a large proportion of the patients having abnormal anthropometric indices (especially central obesity), atherogenic dyslipidaemia and markers of insulin resistance. With the prevailing epidemiologic transition and increasing urbanization being experienced in the State, it is not surprising to find this level of hypertension among our subjects.

Increased waist circumference was the third most common parameter noted among subjects with MetS in this study. This is in concordance with the findings of Alzahrani et al [37] in a study of MetS among apparently healthy Saudi adults. Nwegbu et al [28] however, reported central obesity to be the second most common component of MetS among their subjects. The mean WC in patients with MetS in that study is higher than the corresponding value among our subjects reflecting regional differences in the prevalence of central adiposity between the Southern and Northern parts of the country respectively as noted by Okafor et al. [24]

Raised fasting plasma glucose (FPG) was the least common component of MetS found among our subjects, with an overall prevalence of 37.9%. This is much higher than the 10.7% reported by Awosan et al [25] using the NCEP-ATPIII criteria. Majority of our subjects with MetS who had elevated FPG were in the pre-diabetes state. Unless drastic measures are taken, this finding portends greater surge in the prevalence of diabetes in our setting. Although we found female gender to be associated with a 15% increase in the risk of developing MetS, the finding did not attain statistical significance. Multivariate logistic regression analyses fail to detect any independent predictor of MetS among our subjects, a finding that probably suggests the importance of clustering of several risk factors in an individual leading to an exaggerated risk of cardio-metabolic abnormalities defined by the MetS.

The limitations of our study include its cross-sectional design as well as the relatively small sample size employed. The strength of the study on the other hand, is the fact that it is a population based study in which trained interviewers carried out data collection. In addition, it provides baseline data on which future studies can build upon.

CONCLUSION

The prevalence of MetS and its components in a northern Nigerian rural community is high contrary to the long held belief that it is only a clinical condition restricted to urban dwellings. There is need for further studies, preferably larger, population-based, to determine the predictors of MetS in our environment.

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