

Full Length Research Paper

Prevalence of metabolic syndrome amongst apparently healthy Nigerian adults in a hospital setting

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This study was conducted to determine the prevalence of metabolic syndrome amongst healthy subjects and to identify the patterns of the parameters that are diagnostic criteria for the condition. One hundred and twenty-five (125) apparently healthy adult Nigerians aged between 40-70 years were evaluated for metabolic syndrome using the National Cholesterol Education Program- Adult Treatment Plan III (NCEP-ATP III) criteria. These subjects comprising sixty-one (61) and sixty-five (65) females and males respectively, were staff drawn from departments in the hospital and individuals who came for routine biochemical evaluation for medical check-up. Metabolic syndrome prevalence rate was 16.8% amongst the subject group. Within sex prevalence rates were 18.8 and 14.8% for males and females respectively. Hypertension was the commonest component of the syndrome noted in the subject group while obesity and decreased high density lipoprotein cholesterol (HDL-c) were the second and third commonest components respectively. Hypertriglyceridemia was the least common component observed in the study group. A strong association was found between increased waist circumference (WC) and hypertension amongst these apparently healthy subject cohort ($p < 0.01$). Thirty-eight percent (38%) of the subject group with metabolic syndrome had greater than 3 components of the ATP III criteria, but none had 'full blown metabolic syndrome'. In addition 16% were found to have impaired fasting glucose (IFG). These results indicate that the prevalence of metabolic syndrome in our environment is relatively high and highlights the need for larger population-based studies to ascertain the overall prevalence within the country.

Keywords: Metabolic syndrome, obesity, triglyceride, hypertension, prevalence.

INTRODUCTION

Metabolic syndrome, first described as a clinical entity in 1988 by Reaven (1988), though of much older origin having been observed as early as 1923 by Kylin (Zimmet et al., 2005), has assumed great prominence in clinical discourse in the past decade. This is basically due to its central role as a cluster of risk factors for cardiovascular disease (CVD) and type 2 diabetes mellitus (D.M.) (Stern, 1995; Tokin, 2004). From its first description, it has been called various names; Reaven's syndrome, syndrome X, dysmetabolic syndrome, cardiometabolic syndrome, plurimetabolic syndrome, insulin resistance syndrome and the deadly Quartet (Tokin, 2004; DeFronzo and Ferrannini, 1991).

When it was first described, this syndrome was an ill-defined cluster comprising, hyperglycaemia, hyperuricaemia, dyslipidaemia and hypertension (Reaven, 1988), but has undergone various modifications over the years. The latter culminated in the World Health Organization (WHO) establishing defining criteria for the diagnosis of metabolic syndrome (WHO 1999). Additionally, two other closely related classes of criteria proposed by the National Cholesterol Education Programme (NCEP): Adult treatment Panel III (NCEP-ATP III 2002) and the American Association of Clinical Endocrinologists (AACE) are also in use for establishing the diagnosis of this syndrome (AACE, 2003).

In view of the increasing incidence of diabetes mellitus and the attendant health implications, metabolic syndrome which is a risk factor for it, deserves better appraisal. From an estimate of 135 million adults with

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diabetes mellitus in 1995, a projected rise to 300million is expected by 2025 (King et al., 1998). It is of note that the majority of this increase which is expected to be of the type 2 diabetes mellitus class, is being envisaged to occur in developing countries (King et al., 1998; Graede, 2001). This increasing incidence of diabetes mellitus for example in African communities is attributable to increasing ageing of the population and lifestyle changes engendered by rapid urbanization and westernization (Sobngwi et al., 2001).

The syndrome also has severe economic implications, with estimates that the related condition, obesity leads to health costs of about a hundred billion dollars yearly in the United States (Gloria, 2002). This is frightening as such an economic burden cannot be borne by most developing nations like ours.

Insulin resistance which is pivotal to metabolic syndrome aetiopathogenesis (Tenerez and Norhammer, 2003; Ferrannini et al., 1999) had been shown about a decade ago in Ibadan to have a prevalence rate of 34.6% (Ezenwaka, 1995). Judging by global trends, this rate would have risen (Tokin 2004).

Beyond CVD and DM, individuals with metabolic syndrome are prone to other conditions notably polycystic ovary syndrome, steatohepatitis, asthma, sleep disturbances and some forms of cancer (McGill, 1986; Reaven, 1988; Rimm et al., 1995). The above, and newer findings on genetic aetiopathogenic factors in addition to traditionally accepted environmental influences in the development of metabolic syndrome (Sobngwi et al., 2001; Langefield et al., 2004), has opened a flood of studies on this clinical condition. Suffice it to say however, that most studies are on Caucasians, Arabs and Asians, with very little on Africans.

This study is to assess metabolic syndrome within a hospital setting, using NCEP ATP III criteria, among apparently healthy subjects.

MATERIALS AND METHOD

The study was undertaken among subjects attending the Metabolic Research Unit of the University College Hospital Ibadan; the latter is a unit in this tertiary level hospital involved in diagnostic evaluation and screening by laboratory assays for metabolic disorders, endocrinopathies toxicological disorders and health status assessment.

A total of 125 subjects were involved and were drawn sequentially on consecutive attendances. The bulk of these subjects (60%) were staff from various departments in the hospital spanning both junior and senior staff cadres. The remainders (40%) of the subjects were individuals who came for routine bio-

chemical evaluation for medical check-up.

Amongst these 125 apparently healthy subjects studied, 61 were females as against 64 male subjects. Subjects were aged 40-70years with a mean age of 56.1 years.

Informed, written and well understood consent was obtained from the subjects who took part in the study.

Any subject on any form of routine drug therapy that could affect the diagnostic parameters eg antihypertensive, steroids, lipid lowering drugs e.t.c, was excluded from the study.

Ethical approval was applied for, and was granted by the Joint Ethical Committee of the University of Ibadan and University College Hospital Ibadan, before the commencement of the project (IRC Protocol No: UI/IRC/05/0019). Subjects' biodata were obtained in the form of a standardized questionnaire.

The height and weight were measured with subjects wearing neither shoes nor head-ties, on a beam balance scale, and wearing light clothing. They were measured to the nearest 0.5cm and 0.1kg respectively. Body mass index (BMI) was calculated using the formula; $BMI = \text{weight} / \text{height}^2 \text{ (kg/m}^2\text{)}$

Waist circumference was measured to the nearest 0.5cm on bare skin of a standing subject, with a flexible tape measure, using the midpoint of the distance between the 10th rib and the iliac crest. Two independent measurements were done by two assessors and the average taken.

The blood pressure was measured on two different occasions (at least 2hours apart), to the nearest 2 mmHg with the subject supine after at least a 5-min rest, using a standard mercury sphygmomanometer. 8 mls of fasting venous blood was collected from each subject who must have fasted for not less than 8hours and not greater than 14hours, on the morning of presentation into vacutainer bottles of fluoride oxalate and K3 EDTA, for glucose and lipid profile analysis respectively.

The specimens were immediately centrifuged afterwards, to obtain plasma which was analyzed usually within 2-8hours after collection.

The analyses were done by spectrophotometric method using Randox glucose oxidase kits for glucose, and Randox triglyceride and HDL-c enzymatic assay kits for lipid profile. Metabolic syndrome was defined using the NCEP-ATP III criteria (Table 1).

Data entry and analysis were done using a statistical software package (SPSS version 10). Summary descriptive characteristics of the results and comparisons of variables, whether categorical or continuous, were done using student t-test and chi square. Regression analysis was done for waist circumference, triglyceride and HDL-c levels. A p value of < 0.05 was considered statistically significant.

Table 1. NCEP-ATP III criteria for Metabolic Syndrome

Risk Factor	Defining Level
* Abdomen obesity given as waist circumstance	
- Men	>102 cm
- Women	>88 cm
*Triglyceride	≥150mg/dl
*HDL Cholesterol	
- Men	<40 mg/dl
- Women	< 50 mg/dl
*Blood pressure	≥ 130/≥ 85 mmHg
*Fasting Plasma Glucose	≥ 110 mg/dl

Any 3 of the 5 risk factors defines metabolic syndrome in an individual.

RESULTS

From the study, the prevalence of metabolic syndrome was 16.8%, within sex prevalence rates were 18.8 and 14.8% for males and females respectively (Table 2). Thirty-eight percent (38%) of the subjects with metabolic syndrome had greater than 3 components of the ATP III criteria, but none had 'full blown metabolic syndrome' (Isezuo and Ezunu, 2005). Hypertension was the commonest component, being seen in 38.4% of the total subject group. A significant rise in percentage to 61.9% was observed in the sub-set of the group diagnosed with metabolic syndrome. HDL hypercholesterolemia was observed in 25.6% of the 125 subjects studied, while hypertriglyceridaemia was seen in only 8.8% of these subjects. It is of note that 63.6% of these patients with hypertriglyceridaemia had metabolic syndrome. Table 3 shows the anthropometric and biochemical indices of subjects studied.

Amongst these subjects, 20 (16%) and 38 (30.4%) had impaired fasting plasma glucose and high waist circumference (WC) respectively.

Figure 1 shows a diagrammatical distribution of the components of the metabolic syndrome amongst the subject group, excluding glycaemic indices.

A significant relationship was observed between waist circumference and impaired fasting glucose ($p < 0.01$), though with a weak association (Pearson correlation=0.323) among these subjects. Similar striking relationship was noted between waist circumference and blood pressure ($p < 0.01$).

On linear regression analysis, subjects with metabolic syndrome showed a low measure of association of TG to metabolic syndrome (Beta=0.191), compared to the other two predictor variables with higher and similar values. (HDL-c; Beta=0.337, WC; Beta=0.341).

This finding on TG was further highlighted on logistic regression where hypertriglyceridaemia showed an insignificant association with metabolic syndrome in the study group ($p=0.75$).

DISCUSSION

This study was undertaken to determine the prevalence of metabolic syndrome among a group of apparently healthy subjects, and to define the patterns of the clinical phenotypes which serve as the diagnostic criteria.

Among these apparently healthy subjects, the prevalence of metabolic syndrome was 16.8%, with more males affected than females.

This prevalence among the subjects though less than values quoted amongst Caucasians generally, is considerably high given that rates of between 20-25% on the average, have been recorded in the United States and across Europe. In the United States, 24% of the adult population were found to have metabolic syndrome using the ATP III criteria (Stern, 1995). The closeness of the prevalence in this study to the Caucasians could be as a result of the higher age range of the set of subjects studied. Whereas in the NHANES study in the US stated above, where subjects 20 years and above were used, the lower age limit here was 40 years. It is of note that for individuals 50 years and above in the aforementioned NHANES study, the prevalence rose to 44% (Stern, 1995). However, for us to explain the differences in prevalence explicitly we need hard data on morbidity and mortality with regards to HDL-c, triglyceride and obesity cut-offs in relation to our environment. Suffice it to say however that even in aforementioned NHANES study, African-Americans had lower prevalence rates compared to Hispanics and whites (Stern, 1995).

Hypertension was the predominant parameter in the study group. This is in keeping with findings from other studies on Nigerians, which were however done on type 2 diabetic subjects only (Adediran, 2003; Alebiosu and Odusan, 2004). Additionally a lot of studies have documented elevated blood pressure as the predominant feature in blacks with metabolic syndrome (Hanley et al., 2003). The prevalence rate of hypertension at 38.4% corroborates the findings of Cappuccio et al. (2003)

Table 2. Metabolic syndrome prevalence

Subjects			Metabolic syndrome positive	Metabolic syndrome negative
No of Males	64		12 (18.8%)	52 (81.3%)
No of Females	61		9 (14.8%)	52(85.2%)
All subjects	25		21 (16.8%)	104(83.2%)
Age;mean(SD)	56.1(9.8)		67.2(9.2)	53.8(10.1)

Table 3. Anthropometric and biochemical indices of subjects studied

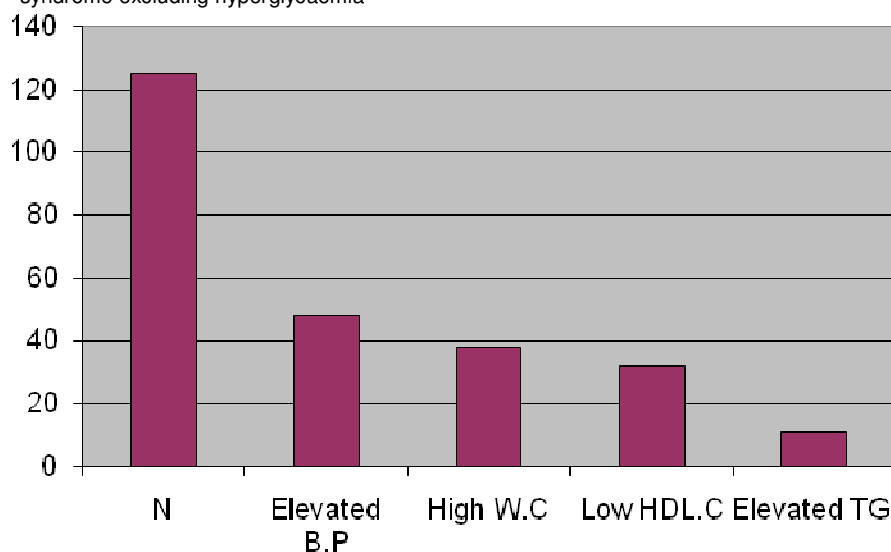
Subjects	Mean(SD)	Metabolic syndrome positive	Metabolic syndrome negative
WC	90.7(10.7)	102(9.7)	88.4(9.4)
BMI	26.9(3.8)	29.2(1.5)	24.6(3.5)
TG	103(30.9)	122(33.6)	99.1(28.9)
HDL-c	53(12.9)	40.9(7.9)	55.4(12.4)
FPG	93.3(15.6)	106.7(15.1)	90.6(14.3)

Units for parameters;

WC: cm

BMI: kg/m²

TG, HDL-c, FPG: mg/dl

Figure 1. Diagrammatic representation of the prevalence of the components of metabolic syndrome excluding hyperglycaemia

B.P- Blood Pressure

T.G- Triglycerides

HDL-c - High Density Lipoprotein cholesterol

W.C- Waist Circumference

N - Total No of Subjects per group (i.e 125)

amongst the Ashanti in Ghana where the prevalence was 28.7%, and instructively highlighted an existing problem of suboptimal detection rates (Capuccio et al., 2003).

Family history of hypertension was closely associated with the high blood pressure in the subject group.

Increased waist circumference was the second most common parameter noted in individuals with metabolic syndrome among the subjects. This differs from the reports of two studies done in this country among type 2 diabetics where obesity was not commoner in prevalence

than dyslipidaemia (Isezuo and Ezunu, 2005; Alebiosu and Odusan, 2004). The difference in those studies in relation to our findings could be due to different study subjects as they used diabetics. Another plausible explanation may be the fact that these studies were done using the WHO criteria which uses BMI and/or waist hip ratio as indices of obesity. It is of note that in this study a subtle insignificant relationship was noted between waist circumference and BMI among the subjects ($p=0.053$). This warrants the need for ethno-specific cut-offs for this environment in line with experiences from some studies in Asia (Tan et al., 2004; McGill 1986). It is also of note that waist circumference is a better index of obesity and its related complications than BMI (Rimm et al., 1995; Sowers 1998).

Another plausible reason for the higher prevalence of obesity in this study is the fact that the prevalence of obesity defined by waist and hip related indices is higher than that defined by BMI $> 30\text{kg/m}^2$ (Martinez-Larrad et al., 2003). A study done among type 2 diabetics in LUTH typified this in that 24% of those studied had obesity as defined by BMI $> 30\text{kg/m}^2$, as against 42.2% using waist circumference (Adediran, 2003).

It is of note however that obesity may not be as low in prevalence as was initially thought of in Africans. Studies amongst factory workers in South Africa showed a prevalence rate of 22.2% (Erasmus et al., 2001). Supportive data from Ilorin in Nigeria showed a prevalence rate of 55.3% for obesity though among diabetics (Adebisi and Oghagbon, 2003).

These findings on obesity (this study inclusive), call for attention as it has been shown that people of Sub-Saharan Africa appear oftentimes not to perceive obesity as a health risk (Van der Sande, 2001).

The finding of greater prevalence of obesity among females in the study groups is in keeping with findings from other studies (Gloria, 2002; Alebiosu and Odusan, 2004; Erasmus et al., 1999).

In this study a strong association was noted between waist circumference and hypertension among the subjects. This relationship corroborates the findings by Sanusi et al among market men and women in Ibadan (Sanusi et al., 2005).

Low HDL cholesterol (HDL-c) was the third commonest parameter noted in the group though the prevalence rate was low. This low prevalence is in keeping with other studies (Alebiosu and Odusan, 2004; Isezuo, 2005).

Hypertriglyceridemia was the least common feature noted. A strong association was observed between hypertriglyceridemia and low HDL-c amongst those with metabolic syndrome but nil such association was seen in those without metabolic syndrome. This study showed low prevalence of dyslipidaemia among the study group which is in keeping with findings in blacks generally (Hanley et al., 2003). Suggestions have been adduced to the effect that the increased consumption of fiber-rich foods could be factorial (Isezuo and Ezunu, 2005).

The finding that 16.8 and 16% of subjects that felt they were in apparent good health status had metabolic syndrome and impaired fasting glucose is quite revealing. This gives a good glimpse into what the prevalence in the general population could be in this environment. When these findings are juxtaposed with the findings of Oyati et al., (2005) from Ahmadu Bello University Teaching Hospital (ABUTH) which pointed to increasing incidence of myocardial infarction in Nigerians, a call for refocusing on these risk factors for CVD is obviously pertinent.

CONCLUSION

The findings from this study are pointers to the probable magnitude of the co-morbid factors of cardiovascular disease as encapsulated in the metabolic syndrome in our environment. This carries some implications especially since the culture of regular and routine medical evaluation is yet to take root here. This study also highlights the need for a large national population survey for a more comprehensive assessment of the prevalence of this condition.

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