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Prevalence of Metabolic Syndrome According to Three Defining Criteria in Hypertensive Population in a Rural Hospital Setting

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Abstract

Aim: To determine the prevalence of metabolic syndrome using National Cholesterol Education Program-Adult treatment Panel III, American Heart Association-National Heart, Lung and Blood Institute and the Joint Interim Statement criteria and determine the prevalence of each of the cardiovascular risk factors in hypertensives attending a rural cardiology clinic in North central Nigeria

Methods: This cross-sectional study used the National Cholesterol Education Program-Adult treatment Panel III (NCEP-ATP III), American Heart Association-National Heart Lung and Blood institute (AHA-NHLBI) and the Joint Interim Statement (JIS) criteria to assess metabolic syndrome in 204 patients with arterial hypertension attending cardiology clinic of Federal medical centre, Bida, North central Nigeria from February 2010 to April 2013. The demographic and clinical history of the patients was taken.

Results: There were 97 men (47.5%) and 107 (52.5%) women. The mean age was 53.44 ± 11.71 years and range from 21-84years. Using the NCEP-ATP III, eighty three (40.7%) hypertensives had metabolic syndrome (33 males: 16.2%, 50 females: 24.5%) while the application of AHA-NHLBI criteria, resulted in metabolic syndrome in 96 (47.1%) of hypertensives (42 males: 20.6%, 54 females: 26.5% females) and with the JIS, 108 (52.9%) hypertensives (46 males: 22.5%, 62 females: 33.9% females). The prevalence of metabolic syndrome increases with age. In both male and female hypertensives with metabolic syndrome, low high density lipoprotein cholesterol (HDL-C) and abdominal obesity were the most common cardiovascular risk factor.

Conclusion: The prevalence of metabolic syndrome in hypertensives in rural Nigeria is high and varies considerably depending on the definition used. The need for public health promotion, screening and management of hypertension and other components of metabolic syndrome is hereby recommended.

Keywords: Metabolic syndrome; Cardiovascular risk; American heart association

Introduction

Metabolic syndrome represent constellation of several cardiovascular disease risk factors that is associated with more than two-fold increase in the risk of cardiovascular events [1]. Some of these factors include abdominal obesity, atherogenic dyslipidemia, high blood pressure, insulin resistance, glucose intolerance and or diabetes mellitus, proinflammatory and prothrombotic state [2]. Although, cardiovascular disease is the primary clinical outcome, individuals with metabolic syndrome are seemingly susceptible to type 2 diabetes, polycystic ovary syndrome, fatty liver, cholesterol gallstones, asthma, sleep disturbances, and some forms of cancer [3,4].

Several organizations including the World Health Organization (WHO) [5], National Cholesterol

Education Program -Adult Treatment Panel III (NCEP-ATP III) [6], American Heart Association-National Heart Lung and Blood Institute (AHA-NHLBI) [7], and International Diabetes Federation (IDF) [8] have published diagnostic criteria for metabolic syndrome. These criteria agreed on some aspects, but they also reveal fundamental differences in positioning of the predominant causes of the syndrome and the cuff marks for the various components. This lack of agreement led to the most recent Joint Interim Statement (JIS) to attempt to unify the various clinical criteria [9].

The prevalence of metabolic syndrome in hypertensive population varies according to the clinical criteria used for its definition. In a cross-sectional hospital study involving hypertensive population in South west, Nigeria, the prevalence rate ranged from 34.3% to 42.9% using the WHO, NCEP-ATP III and IDF respectively [10]. However, a lower prevalence (13%) of hypertensives had metabolic syndrome in Abuja, Nigeria when WHO criteria was used [11]. There is therefore both medical and economic imperative to assess the various cardiovascular risk factors in hypertensives so that lifestyle modification and treatment can be instituted. However, neither of these studies used the American Heart Association-National Heart Lung and Blood Institute (AHA-NHLBI) nor the more recently proposed stricter Joint Interim Statement (JIS) to the determine metabolic syndrome. The use of different defining criteria would inform our clinicians on the performance of each and the one to apply on their patients. The objective of this study therefore was to determine the prevalence of metabolic syndrome and the prevalence of each the cardiovascular risk factors in hypertensives attending the cardiology clinic of Federal Medical Centre, Bida, North-central

Nigeria using three diagnostic criteria: NCEP-ATP III, the AHA-NHLBI and the JIS.

Methods

This was a cross-sectional study carried out on hypertensive attending the cardiology clinic of Federal medical centre, Bida, an ancient rural settlement in Niger State, North-Central Nigeria between January 2010 and December 2012. The population of Bida based on 2006 census figures was 459,022 and mainly inhabited by the Nupes. Their predominant occupation is substance farming with many educated elite working in government or private establishments outside of the town. The hospital is a 200 bedded tertiary health facility that serves as a referral centre to all health facilities in Niger State and environs. Individuals were considered hypertensive if their systolic blood pressure was ≥ 140 mm Hg and or diastolic BP ≥ 90 mm Hg on 2 consecutive visits or on antihypertensive treatment. Those excluded include individuals with co-mobid conditions like thyrotoxicosis, cerebrovascular accidents and those on lipid lowering medications. Using a semi-structured questionnaire, the baseline socio-demographic characteristics like age, sex, history of hypertension and diabetes of all consecutive adult hypertensive were collected. Others include the history of smoking, alcohol consumption and use of antihypertensive and lipid lowering drugs.

Blood pressure and anthropometric measurements

Blood pressure was measured in the left arm in the sitting position after 5-minutes rest with the aid of a mercury sphygmomanometer (Accoson, London) according to the standard guidelines. Waist circumference (WC) in centimeters was measured at the midpoint between the lowermost rib margin and the iliac crest and the hip circumference (HC) in centimeters was taken across the greater trochanters to the nearest 0.1 cm by using nonstretchable measuring tape with the patients standing erect.

Biochemical analysis

Venous blood sample was collected from the patients after about 10-12 hours overnight fast for plasma glucose and serum lipid profile: total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) by enzymatic reference method and low density lipoprotein cholesterol (LDL-C) was calculated.

Definition of terms

Metabolic syndrome was defined according to 3 sets of criteria: NCEP-ATP III [6], AHA-NHLBI [7], and JIS [8] (Table 1). For this study, history or treatment of hypertension was considered the first criterion. Ethical approval was obtained from the Research, Ethics and Review committee of Federal Medical Centre, Bida.

	NCEP ATP III (≥ 3 criteria out of 5)	AHA/NHLBI (≥ 3 criteria out of 5)	JIS (≥ 3 criteria out of 5)
BP (mm Hg)	≥ 130/85	≥ 130/85	≥ 130/85
WC (cm)	≥ 102 (men) ≥ 88 (women)	≥ 102 (men) ≥ 88 (women)	≥ 94 cm (men) ≥ 80 cm (women)
HDL-C (mmol/L)	≥ 1.03 (men) ≥ 1.04(women)	≥ 1.03 (men) ≥ 1.04(women)	≥ 1.03 (men) ≥ 1.04(women)
TGs (mmol/L)	≥ 1.7	≥ 1.7	≥ 1.7
Glu mmol/L)	≥ 110	≥ 100	≥ 100

Table 1: Definitions of Metabolic Syndrome by the 3 criteria.

Abbreviations: NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III; AHA-NHLBI: American Heart Association-National Heart Lung and Blood Institute; JIS: Joint Interim Statement; WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBG: Fasting Blood Glucose; TG: Triglycerides; HDL-C: High Density Lipoprotein Cholesterol

Statistical analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) software (version 16, SPSS, Inc, Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables expressed with frequency and percentage. The prevalence estimates of metabolic syndrome according to the three definitions were determined. For comparison of categorical variables, the Chi-square test was used and independent student's t-test for continuous variables. Multiple comparisons between groups were performed by one way analysis of variance with Scheffe's post hoc test. P ≤ 0.5 was considered statistically significance.

Results

Of the 256 individuals with arterial hypertension that were referred to the cardiology clinic, 241 had complete data. Those excluded from analysis include individuals with previous history of diabetes mellitus (17), prior stroke (7), 10 due to use of lipid-lowering therapy and 3 because of psychiatric medications. Finally, 204 hypertensives, made up of 107 (52.5%) females and 97(47.5%) males, were included in the analysis. The mean age, waist circumference and systolic blood pressure of the study population (52.52 ± 11.08 years versus 52.47 ± 12.22 years, 91.95 ± 13.06 cm versus 93.90 cm and 147.37 ± 25.26 mmHg versus 150.32 ± 26.96 mmHg) were similar for both male and females hypertensives (p=0.211, 0.307 and 0.421) respectively (Table 2). The fasting blood glucose, triglyceride and high density lipoprotein cholesterol of the male hypertensives corresponding to 5.95 ± 2.81 mmol/L, 1.34 ± 0.63 mmol/L and 1.06 ± 0.49 mmol/L did not also differ from that of the female hypertensives 5.46 ± 2.22 mmol/L, 1.37 ± 0.73 mmol/L and 1.10 ± 0.48 mmol/L, p=0.07, 0.786 and 0.829, respectively.

	Males n: 97	Females n: 107	P value 0.008*
Age (years)	52.52 ± 11.08	52.47 ± 12.22	0.211
WC (cm)	91.95 ± 13.06	93.90 ± 15.03	0.307
SBP (mmHg)	147.37 ± 25.26	150.32 ± 26.96	0.421
DBP (mmHg)	90.75 ± 15.71	90.83 ± 16.03	0.992
FBG (mmol/L)	5.95 ± 2.81	5.46 ± 2.22	0.169
TG (mmol/L)	1.34 ± 0.63	1.37 ± 0.73	0.780
HDL-C (mmol/L)	1.06 ± 0.49	1.10 ± 0.48	0.519

Table 2: Clinical and laboratory characteristics of the study population based on gender

WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBG: Fasting Blood Glucose; TG: Triglycerides; HDL-C: High Density Lipoprotein Cholesterol

*-significant

Prevalence of metabolic syndrome

The prevalence of metabolic syndrome in the study population according to the NCEP-ATP III, AHA-NHLBI and JIS criteria was 40.7%, 47.1% and 52.9% respectively. This is significantly higher in both males and females using JIS criterion compared to the NCEP ATP III (JIS P=0.001 and P=0.005) but only between males using the AHA-NHLBI and JIS (P=0.001) (Table 3). The prevalence of metabolic syndrome increased with age to reach a peak in the 41-50 year age group and declined sharply until the older ages. The burden of metabolic syndrome is more in the age group between 41- 60 years (Figure 1).

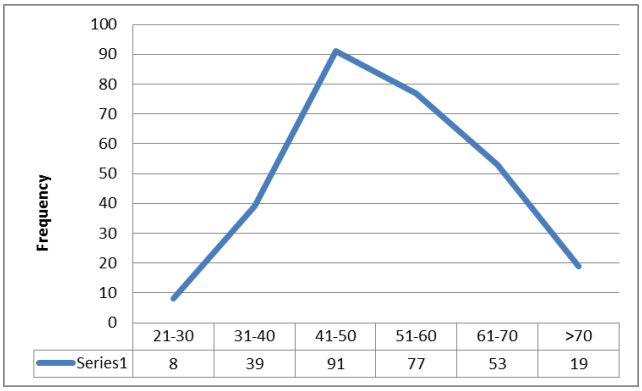

Figure 1: Prevalence of metabolic syndrome according to age group

	NCEP ATP III		AHA/NHLBI		JIS	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
N (%)	33 (39.8)	50 (60.2)	42 (43.8)	54 (56.3)	46 (42.6)	62 (57.4)
Age (years)	52.45911.42	53.16 (12.97)	52.57 (11.12)	52.76 (12.24)	53.22 (10.96)	53.35 (12.76)
WC (cm)	99.94 (16.05)	99.74 (12.87)	98.67 (15.17)	100.91 (13.15)	98.26 (14.74)	98.68 (13.62)
SBP (mmHg)	147.73 (27.25)	147.12 (20.71)	146.55 (27.02)	147.48 (23.40)	148.80 (27.75)	147.65 (24.70)
DBP (mmHg)	89.67 (16.33)	88.58 (13.25)	90.07 (15.51)	89.98 (14.79)	90.28 (15.88)	89.02 (14.79)
FBG (mmol/L)	6.15 (3.86)	6.10 (2.91)	6.90 (3.56)	6.15 (2.80)	6.96 (3.54)	5.97 (2,67)
TG (mmol/L)	1.67 (0.67)	1.68 (0.88)	1.59 (0.69)	1.58 (0.80)	1.55 (0.61)	1.57 (0.84
HDL-C (mmol/L)	0.84 (0.44)	0.91 (0.40)	0.82 (0.40)	0.95 (0.41)	0.81 (0.39)	0.93 (0.39)

Table 3: Prevalence of metabolic syndrome according to the 3 criteria.

Abbreviations: NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III; AHA-NHLBI: American Heart Association-National Heart Lung and Blood Institute; JIS: Joint Interim Statement; WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBG: Fasting Blood Glucose; TG: Triglycerides; HDL-C: High Density Lipoprotein Cholesterol

Components of metabolic syndrome

The prevalence of each components of metabolic syndrome using the three criteria is depicted in Figures 2. The occurrence of the components varied with the defining criteria used. With the three criteria, the most common features were low high density lipoprotein cholesterol and obesity. The prevalence of low HDL-C was 81.9% (68), 78.9% (85) and 78.1% (75) using the NCEP-ATPIII, AHA-NHLB and JIS respectively while that of obesity was 65.1%, 76% and 79.6%. All the patients that participated in the study were hypertensive and or on antihypertensive medications. The least components are triglycerides and fasting blood glucose.

According to the NCEP ATP III definition, most of the components of metabolic syndrome varied significantly (P=0.000) between hypertensive patients with metabolic syndrome and those without

metabolic syndrome (Table 4). This is same when the other defining criteria are used.

	Patients with metabolic syndrome, n: 83	Patients without metabolic syndrome, n: 121	P value
Age (years)	52.88 ± 12.31	53.83 ± 11.31	0.578
WC (cm)	99.82 ± 14.13	88.33 ± 12.13	0.000*
SBP (mmHg)	147.36 ± 23.66	149.98 ± 27.94	0.468
FBG (mmol/L)	6.68 ± 3.35	5.08 ± 1.47	0.000*
TG (mmol/L)	1.68 ± 0.80	1.13 ± 0.48	0.000*
HDL-C (mmol/L)	0.88 ± 0.42	1.22 ± 0.49	0.000*

Table 4: Components of metabolic syndrome in patients with and without metabolic syndrome according to NCEP ATP III

Abbreviations: NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III; WC: waist circumference; SBP: Systolic blood pressure; FBG: Fasting blood glucose; TG: triglycerides; HDL-C: High density lipoprotein cholesterol

*-Significant

Discussion

This descriptive cross-sectional hospital based study concludes that metabolic syndrome is common among adults Nigerians with arterial hypertension. The use of the newer and stricter diagnostic criteria resulted in significantly higher numbers of hypertensive patients with metabolic syndrome. The prevalence of metabolic syndrome showed a direct relationship with increasing age up to the middle age.

The prevalence of metabolic syndrome in our hypertensives varied according to the defining criteria used. The prevalence was lowest with NCEP-ATP III (40.7%) followed by AHA-NHLBI (47.1%) and highest when JIS criteria was used (52.9%). The prevalence of Mets in this study is however higher than that in other cross-sectional studies in Nigeria [10-12] but similar results were observed in developed world [13,14]. A study on newly diagnosed hypertensives in South west Nigeria reported the prevalence of metabolic syndrome to range from 34.3% to 42.9% based on the IDF, NCP ATP III and WHO criteria [10]. A much lower prevalence of 31.2% was reported in a study of hypertensives in South East Nigeria [12]. However, Ojji et al. in Abuja noted that 13% of the hypertensives referred to the Cardiology clinic using the WHO criterion had metabolic syndrome [11]. The observed differences in prevalence across Nigeria might probably be related to the methodology and the criteria used to diagnose metabolic syndrome, inclusion criteria and the higher occurrence of individual cardiovascular risk factors in our hypertensive patients. In a study in the United States, the prevalence of metabolic syndrome using NCEP ATP III was 34.04%, however, it ranged between 50.3% to 68% across Europe, lowest in the Mediterranean and highest in Central Europe with the NCEP ATP III, WHO, IDF and AHA/NHLBI criteria [13-17]. It was adduced to be due to nutritional, exercise, and genetic factors. This is to show that the stricter the defining criteria especially with regards to the cut off points for glucose and waist circumference, the higher the number of individuals that would be diagnosed with metabolic syndrome.

The prevalence of the metabolic syndrome have been reported by several studies to increase with age regardless of the definition used [13-17]. Although it peaked at the seventh decade of life in both sexes and then a decline [13-17] but only in men [14,15]. In the present study the prevalence of metabolic syndrome increases linearly with age in both sexes irrespective of the criteria (Figure 1), but reaching peak in the fifth decade and declined sharply until the older ages. The burden of metabolic syndrome is more in the age group between 41-60 years. This might not be unconnected to the fact that adversities like sedentary lifestyle, overnutrition, obesity and dyslipidaemia, untreated hypertension, environmental and physiological factors accumulate that may trigger a genetic expression of metabolic syndrome which becomes more prominent with biological maturation [15,17-19]. The life expectancy among Nigerians is also between 45 to 50 years and justifies the fewer number of hypertensives that reaches the sixth decade of life.

The two commonest cardiovascular risk factors in hypertensive patients with metabolic syndrome are low HDL-C and obesity as measured by waist circumference. Abdominal obesity is on the increase among Nigerians even in rural communities mainly due to adoption of western lifestyle and sedentary life. Abdominal obesity predisposes individuals to insulin resistance, and will certainly lead to more individuals with metabolic syndrome.

Limitations of this study include that it was a hospital based study and that the patient recruited are the ones that already has several of this risk factors and the findings could not be representative of the general populace. It is also a cross-sectional study and patients are not seen again to further evaluate the effect of metabolic syndrome years later. It is therefore important that effort should be geared toward screening of all adults for cardiovascular risk factors through appropriate public health services and institution of therapy where appropriate.

Conclusion

The prevalence of metabolic syndrome in hypertensives in rural Nigeria is high and varies considerably depending on the definition used. The need for public health promotion, screening and management of hypertension and other components of metabolic syndrome is hereby recommended.

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