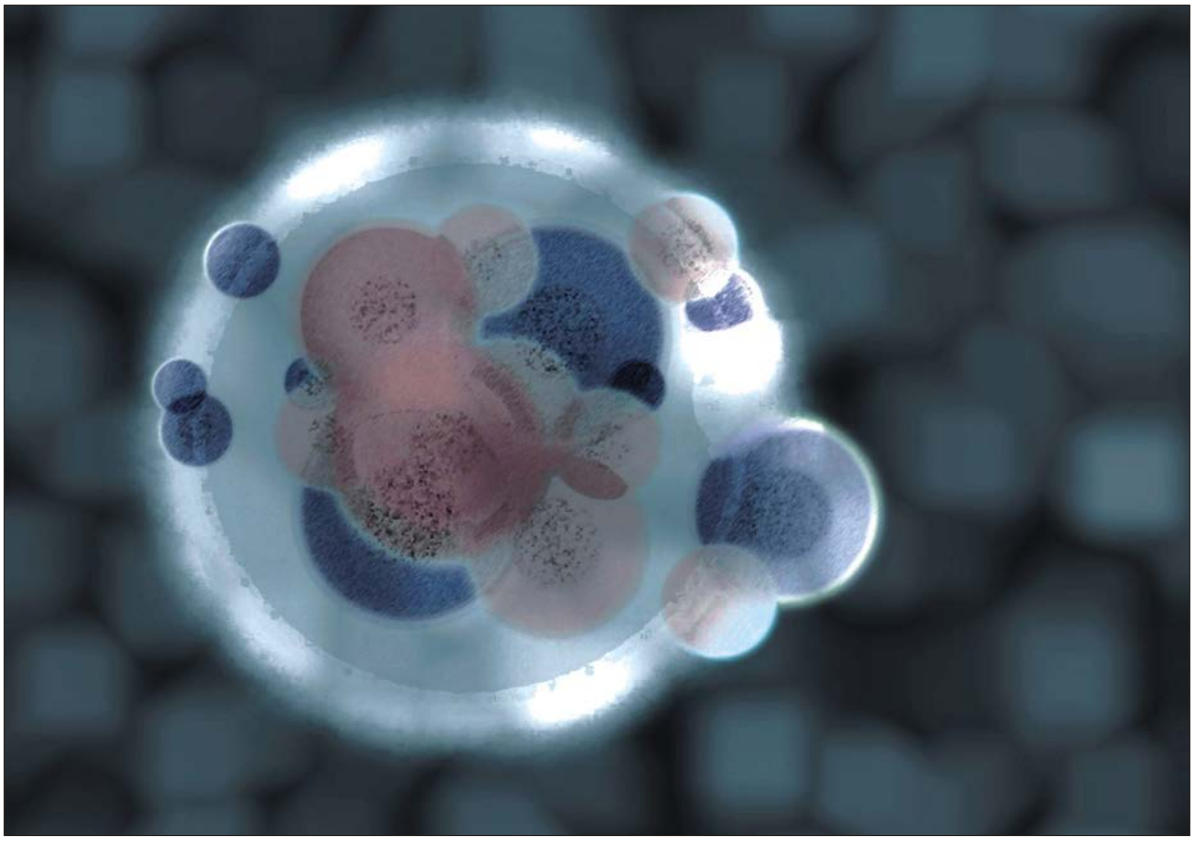

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Prevalence of Metabolic Syndrome and its Individual Components among Diabetic Patients in Ghana

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Abstract: The aim of this study was to determine the prevalence of metabolic syndrome and its individual components in diabetic patients in Ghana. This prospective study included 456 diabetic patients and was conducted at the Komfo Anokye Teaching Hospital in the Ashanti Region of Ghana from January 2006 to May 2007. Metabolic syndrome was defined according to the National Cholesterol Education Programme Adult Treatment Panel 3 diagnostic criteria. The prevalence of metabolic syndrome was 55.9% in the studied population. Low HDL cholesterol was the commonest component (47.4%) of metabolic syndrome, followed by hypertension (46.9%). Female diabetic patients had higher prevalence of metabolic syndrome and its components and individually carried more components than male diabetics. Future cardiovascular disease (CVD) prevention strategies in Ghana should not overlook metabolic disease risk factors.

Key words: Diabetes mellitus, cardiovascular risk factors, obesity, hypertension, dyslipidaemia

INTRODUCTION

Today, there is a growing interest in a cluster of synergistically interacting cardiovascular risk factors called metabolic syndrome, which is mainly characterized by insulin resistance, hyperglycaemia, dyslipidaemia, hypertension and abdominal (central) obesity (NCEP ATPIII, 2001). The syndrome is increasingly recognized as a risk factor for diabetes mellitus, CVD (Ford *et al*., 2002; Isomaa *et al*., 2001) and cardiovascular mortality (Trevisan *et al*., 1998). Disturbances such as microalbuminuria, endothelial dysfunction, abnormalities in fibrinolysis and coagulation, nonalcoholic fatty liver and elevated markers of chronic inflammation have lately been linked to metabolic syndrome (Yudkin, 1999; Steinberg *et al*., 1996; Groop *et al*., 1993; Laaksonen *et al*., 2004). Two main different sets of criteria have been put forth for the definition of metabolic syndrome; one by the World Health Organization (WHO) (Aberti and Zimmet, 1998) and a related but not identical definition from the National Cholesterol Education Programme Expert Panel on Detection, Evaluation and treatment of high blood cholesterol in adults, Adult Treatment Panel 3 (NCEP ATPIII) (2001). Disease risk is directly affected by genetics and also by life style factors such as diet and exercise patterns. Thus prevalence varies by race/ethnicity and other predictor variables (Park *et al*., 2003) and hence from one country or area to the other. The prevalence of metabolic syndrome in the adult diabetic population of the Republic of Cyprus by the NCEP ATP III criteria (Loizou *et al*., 2006) was found to be 68.5%. Limited information is available on the prevalence of metabolic syndrome and its individual components among diabetic patients in Ghana. Thus the objective of this study was to determine the prevalence of metabolic syndrome and its individual components among diabetic patients in Ghana by the NCEP ATPIII criteria.

MATERIALS AND METHODS

This study was carried out at the School of Medical Sciences, Kwame Nkrumah University of Science and Technology (KNUST) Komfo Anokye Teaching Hospital (KATH) Kumasi in the Ashanti region of Ghana. This was a prospective study covering the period from January 2006 to May 2007. All written study protocols were approved by the Committee for Human Research Publications and Ethics of KNUST. All participants consented to participate in the research. Diabetic patients on insulin and/or diet with oral hypoglycaemic drugs

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were consecutively selected until a sample size of 456 was achieved. Diabetes was defined according to the WHO criteria (Alberti and Zimmet, 1998). A standardized questionnaire and patient medical history folders were used to collect information on demographic and clinical characteristics such as age, sex, ethnicity (tribe), duration of diabetes, age of onset and family history of diabetes and hypertension. Others included stress, diabetes and hypertension medication profile and other physician-diagnosed diseases. Height and weight were measured with subjects wearing lightweight clothing and without shoes and Body Mass Index (BMI) calculated (kg m^{-2}). Waist circumference was measured with a plastic anthropometric tape on bare skin of standing subjects during midrespiration at the bending point and at the narrowest indentation, midway between the lowest rib and the iliac crest and at the level of the umbilicus to the nearest 0.1 cm. Systolic and diastolic blood pressures were obtained with a mercury sphygmomanometer and auscultory methods. Two blood pressure recordings were obtained from the right arm of each patient in a sitting position, after 30 min of rest at 5 min intervals and their mean value calculated. Blood specimens were obtained after 12 to 14 h overnight fast. Fasting glucose, triglycerides and HDL cholesterol were measured by enzymatic methods using the procedures of ATAC PAK glucose reagent kits (product No. 532-018) USA, ATAC PAK triglyceride reagent kits (product no. 589-018) USA, ATAC PAK HDL cholesterol reagent kits (product No. 541-004) USA and ATAC 8,000 Random Access Chemistry System (autoanalyzer élan diagnostics, A4-001-1198), USA. The procedures for glucose, triglycerides and HDL cholesterol are described by the manufacturer in the ATAC 8,000 Random Access Chemistry System Operator's Manual (1998 and 1999). Metabolic syndrome was diagnosed using the NCEP ATPIII (2001) criteria, that is, the presence of three or more of the following factors: (1) Central obesity, i.e., waist circumference in males >102 cm and in females >88 cm, (2) Triglycerides = 1.70 mmol L^{-1}, (3) HDL cholesterol in males <1.00 mmol L^{-1} and in females <1.30 mmol L^{-1}, (4) Blood pressure≥130/85 mmHg or on antihypertensive medication and (5) Fasting glucose >6.1 mmol L^{-1}. All patients in this study were coded as positive for hyperglycaemia (i.e., glucose ≥ 6.1 mmol L^{-1}). Metabolic score was calculated as the number of metabolic syndrome factors each patient fulfilled. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) for windows programme version 11.0. Student's t-test was used for comparing mean differences of continuous variables to determine the statistical significance. The χ^2 test was used to determine the statistical significance of differences in proportions. A p-value of less than 0.05 was considered significant.

RESULTS

The study population comprised 456 diabetes mellitus patients, made up of 141 (30.9%) males and 315 (69.1%) females. The selected diabetic population included 250 (54.8%) Twi-speaking peoples, 30 (6.6%) Fantes, 38 (8.3%) Guans, 40 (8.8%) Ga-Adangbes, 66 (14.5%) Northern peoples, 23 (5.0%) Ewes and others 9 (2.0%) who belonged to other minor tribes that could not be distinctly classified. The distribution shows that all the major tribes of Ghana were fairly represented. The mean age of the patients was 55.8±12.3 years. The mean age of onset of the patients was 49.7±12.4 years. The mean duration of diabetes was 6.0±3.5 years. The mean BMI was 25.1±4.8 kg m^{-2}. The corresponding values in males and females are indicated in Table 1. Male and female values for age, age of onset, duration of diabetes and BMI

Table 1: Clinical characteristics of diabetic patients

Clinical characteristics	Diabetic patients N = 456	Males N = 141	Females N = 315	p-value
Mean age (years)	55.8±12.3	55.4±12.2	56.0±12.4	0.51
Mean age of onset (years)	49.7±12.4	49.6±12.2	49.7±12.5	0.91
Mean diabetes duration (years)	6.0±3.5	5.8±2.9	6.1±3.6	0.45
BMI (kg m^{-2})	25.1±4.8	24.1±4.8	25.6±4.6	0.27

Table 2: Prevalence of metabolic syndrome and its components in diabetic patients in Ghana

Metabolic syndrome and its components	Diabetic patients N = 456		Males N = 141		Females N = 315		p-value
	No.	%	No.	%	No.	%	
Metabolic syndrome	255	55.9	47	33.3	208	66.0	0.001
Central obesity	199	43.6	19	13.5	180	57.1	0.0001
Hypertriglyceridaemia	171	37.5	51	36.2	120	38.1	0.18
Low HDL cholesterol	216	47.4	49	34.8	167	53.0	0.001
Blood pressure ≥ 130/85 mmHg and/or on medication	214	46.9	56	39.7	158	50.2	0.001

Table 3: Metabolic score of diabetic patients in Ghana

	Diabetic patients (N = 456)		Males (N = 141)		Females (N = 315)	
Metabolic score	No.	%	No.	%	No.	%
5	26	5.7	2	1.4	24	7.6
4	99	21.7	16	11.3	83	26.3
3	131	28.7	29	20.6	102	32.4
2	134	29.4	58	41.1	76	24.1
1	66	14.5	36	25.5	30	9.5

were not significantly (p = 0.52, 0.91, 0.45 and 0.27 respectively) different (Table 1).

Prevalence of the metabolic syndrome and its components were calculated in the male, female and the overall diabetic patients. Metabolic syndrome was observed in 255 (55.9%) patients including 47 (33.3%) males and 208 (66.0%) females. Table 2 shows that 199 (43.6%) diabetic patients had central obesity, made up of 19 (13.5%) males and 180 (57.1%) females; 171 (37.5%) patients had hypertriglyceridaemia, consisting of 51 (36.2%) males and 120 (38.1%) females. Low HDL cholesterol was observed in 216 (47.4%) patients, made up of 49 (34.8%) males and 167 (53.0%) females (Table 2). Among the same group of patients, 214 (46.9%) had blood pressure ≥ 130/85 mmHg and/or on hypertensive medication, consisting of 56 (39.7%) males and 158 (50.2%) females (Table 2). In addition to hyperglycaemia, low HDL cholesterol was the commonest component (47.4%) of metabolic syndrome among diabetic patients in Ghana, followed by hypertension (46.9%). In females central obesity (57.1%) was the commonest component, followed by low HDL cholesterol (53.0%). In males, hypertension (39.7%) was the commonest component, followed by hypertriglyceridaemia (36.2%). Metabolic scores were calculated in the male, female and the overall diabetic patients. Table 3 demonstrates that 26 (5.7%) patients had a metabolic score (metabolic syndrome factors) of five; 99 (21.7%) a metabolic score of four; 131 (28.7%) had three factors; 134 (29.4%) had two factors; and 66 (14.5%) had one factor. The corresponding values for males and females are also shown in Table 3.

DISCUSSION

Metabolic syndrome has attracted much attention as a risk cluster for CVD in type 2 diabetes (Isomaa *et al*., 2001), non diabetic subjects (Lakka *et al*., 2002) and recently in type 1 diabetes (Thorn *et al*., 2005). The NCEP ATPIII criteria of metabolic syndrome were chosen to assess the prevalence of metabolic syndrome. This is because the NCEP ATPIII proposal, but not the WHO criteria, more clearly identifies the burden of coronary heart or cerebrovascular disease associated with metabolic syndrome and it is associated with a 38% increased risk (Marchesini *et al*., 2004; Scuteri *et al*., 2005). Metabolic syndrome was found in more than half (55.9%) of the Ghanaian diabetes mellitus patients (both types 1 and 2). It was more prevalent (P = 0.001) in female diabetics (66.0%) than in males (33.3%). Individuals with metabolic syndrome are at increased risk for coronary heart disease (CHD) (Lakka *et al*., 2002). Once detected vigorous and early management of the metabolic syndrome may have a significant impact on the prevention of CVD (Eriksson and Lindegard, 1991). The prevalence of metabolic syndrome in the adult diabetic population of the Republic of Cyprus (68.5%) by the NCEP ATPIII criteria (Loizou *et al*., 2006) was only slightly higher than the value of 55.9% obtained among Ghanaian diabetics in this study. This could be explained by the differences in the prevalence of the components of metabolic syndrome between different ethnic groups.

In the total diabetic population (i.e., both types 1and 2 diabetes), low HDL cholesterol was the commonest component of metabolic syndrome in the diabetic patients in Ghana. Knowing the commonest risk factor in different populations will give a guide to prevention and treatment. These results are in fair agreement with those of Al-Lawati *et al*. (2003), who using the NCEP ATPIII criteria found low HDL cholesterol to be the commonest component, though followed by abdominal (central) obesity. Similarly, a significantly (p = 0.0001) larger proportion of female diabetics (57.1%) had central obesity as compared to males (13.5%), a result that is consistent with Al-Lawati *et al*. (2003). Moreover, it was found that hypertension and low HDL cholesterol prevalence were markedly higher (p = 0.001; p = 0.001) in female diabetics than males. This may explain the higher prevalence of the metabolic syndrome in female diabetics as compared to males. Hypertriglyceridaemia prevalence was comparable in both sexes. Low HDL cholesterol was the commonest component of the metabolic syndrome in total diabetic patients in Ghana. In comparison with type 1 and 2 diabetes, hypertension was the most frequent in type 1 diabetes (Thorn *et al*., 2005) and dyslipidaemia the commonest in type 2 diabetes (Isomaa *et al*., 2001), all by the NCEP ATPIII criteria. Typically, the reduced HDL levels in plasma of patients with type 2 diabetes are manifest as reductions in the HDL_{2b} subspecies and

relative or absolute increases in smaller denser HDL_{3b} and HDL_{3c}. It is well documented that reduced HDL cholesterol levels are associated with an increased risk of coronary heart disease (CHD) (Gordon *et al*., 1989).

A sizable number, 27.4% of the Ghanaian diabetes mellitus patients had metabolic scores of five and four and hence carry higher risk for cardiovascular disease. Another 28% of the diabetic patients had a metabolic score of three, that is, they satisfy the minimum requirements of metabolic syndrome and hence carry cardiovascular risk. Further, 43.9% had metabolic scores of two and one and did not have metabolic syndrome. Nevertheless, the management of diabetic patients with metabolic score of one and two should focus on strategies for reduction of these minimal CVD risk factors. This is because alone, each component of the cluster conveys increased CVD risk, but as a combination, they become much more powerful (Kaplan, 1989). A greater percentage of female diabetics (33.9%) had higher metabolic scores than their male (12.7%) counterparts. Conversely, a smaller percentage of female diabetics (33.6%) had lower metabolic scores than their male (66.6%) counterparts. These translate to the fact that female diabetics individually carry more metabolic syndrome factors and hence higher risk for CVD than their male counterparts. This may be due to consumption of high fat and energy dense diets and sedentary lifestyles (adverse physical activity patterns) usually observed more in females than males in Ghana and genetic factors.

In conclusion, more than half of the diabetic patients in Ghana had metabolic syndrome. Low HDL cholesterol was the commonest component of metabolic syndrome, followed by hypertension, among the studied population. In females, central obesity was the commonest component of the syndrome, followed by low HDL cholesterol. In males, hypertension was the commonest component, followed by hypertriglyceridaemia. Metabolic syndrome, central obesity, hypertension and low HDL cholesterol were more prevalent in females, while prevalence of hypertriglyceridaemia was comparable in females and males. Additionally, female diabetics individually carried more metabolic syndrome factors than males and hence female diabetics were more prone to cardiovascular disease than their male counterparts.

It is therefore, being recommended that in the management of diabetes mellitus, risk factors of the metabolic syndrome should be assessed from time to time and the appropriate treatment given. This will help to reduce, if not prevent, CVD and cardiovascular mortality.

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