

THE RELATIONSHIP BETWEEN METABOLIC SYNDROME AND TARGET ORGAN DAMAGE IN GHANAIAN WITH STAGE-2 HYPERTENSION

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SUMMARY

Objectives: To determine the frequency of Metabolic syndrome (MetS) in stage-2 hypertension and to assess the influence of MetS components over target organ damage (TOD) in Ghanaian patients.

Methods: Forty adult patients with stage-2 hypertension were enrolled in a cross-sectional study developed at the Police Hospital, Accra, between 1st February 2009 and 31st January 2010. Diagnosis of MetS was based on The National Cholesterol Education Program in Adult Treatment Panel Revised in 2005 criteria. The alterations on the heart, aortic and carotid arteries, retina, and kidneys were evaluated through the clinical examination including retinal funduscopy, chest X-Ray, ECG, and serum creatinine quantification. The Brain CT-scan was performed on the patients with clinical cerebrovascular disease manifestations.

Results: MetS was diagnosed in 25 cases (62.5%); female sex revealed significant association with MetS (OR, 4.88; 95% CI, 1.19-19.94; P=0.027). Ninety-five percent of patients had TOD. Coronary disease was associated with MetS (OR, 4.43; 95% CI, 1.026-19.27; P=0.047) and diabetes mellitus as single MetS component (OR, 14.00; 95% CI, 1.56-125.61; P=0.018). A positive significant correlation was shown of age with cerebrovascular disease (r=0.381; P=0.015) and coronary disease (r=0.623; P=0.000). Non-significant correlation or association (P>0.05) was shown between number of MetS components and number of TOD.

Conclusions: In stage-2 hypertension patients a high frequency of MetS with a risk increase in female sex was observed. This stage hypertension is for itself an individual risk to develop cardiovascular disease with high frequency none related with MetS, although coronary disease risk was increased in diabetic patients.

Keywords: Cardiovascular Disease, Ghana, Hypertension, Metabolic Syndrome, X Syndrome

INTRODUCTION

The term "Metabolic Syndrome" (MetS) has been proposed to define a cluster of several risk factors for cardiovascular disease. Hypertension (high blood pressure, HBP), dyslipidemia, disturbed glucose metabolism and central obesity are often referred to as major components.¹ Patients with MetS have a two- to three-fold increased risk for the development of cardiovascular morbidity and mortality.²

The World Health Organization (WHO) in 1998 provided a provisional definition for MetS,³ which was lately revised in 2005. This and other definitions based on different aspects have a worldwide use nowadays such as: the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III),⁴ and the International Diabetes Federation (IDF).⁵

The working definition of the metabolic syndrome proposed in the NCEP-ATP III is based on the presence of three or more of the following characteristics: abdominal obesity, high BP, high fasting glucose, high triglycerides, and reduced levels of high-density lipoprotein (HDL) cholesterol.⁴ Some modifications of the NCEP-ATP III definition have been developed. The NCEP-ATP III definition established in 2001 was revised by lowering the threshold for fasting glucose from 6.1 to 5.6 mmol/L in 2005 (NCEP-ATP III-R), in keeping with the American Diabetes Association criteria for impaired fasting glucose.⁶

On the other hand, the HBP is considered one of the major international public health problems at this moment affecting more than 1 billion individuals, and originating approximately 7.1 million deaths per year. The WHO reported that suboptimal blood pressure (BP) (>115 mmHg Systolic BP) is responsible for 62%

of cerebrovascular disease (CVD) and 49% of coronary heart disease (CHD), with little variation by sex. In addition, suboptimal BP is the number one attributable risk of death throughout the world.⁷

Undiagnosed, untreated, and uncontrolled HBP clearly places a substantial strain on the health care delivery system. The awareness of HBP has improved from a level of 51% of Americans in the period 1976-1980 to 70% in 1999-2000. The percentage of patients with HBP receiving treatment has increased from 31% to 59% in the same period, and the percentage of persons with high BP controlled to below 140/90 mmHg has increased from 10% to 34%.⁸ Nevertheless, some studies developed in Ghana showed that around 34% of subjects with HBP had prior knowledge of their condition but less than half of them were treated, and only 4% to 17% on treatment was well controlled.⁹⁻¹¹

Furthermore, HBP is an increasing public health problem in Ghana and most cases were attributed to obesity. The association between the two conditions may be attributed to increase in urbanization and westernization of the society.⁹⁻¹¹ A review of medical admission in large city hospital in Ghana also showed that cardiovascular and renal diseases were important contributors to morbidity and mortality in HBP patients.¹² However, the report of morbidity of MetS and their relationship with cardiovascular disease (target organ damage, TOD) in Ghanaian patients with HBP was not found in the revised literature.

We hypothesized that this syndrome has a high frequency and it is associated with a bigger cardiovascular damage in those patients. Therefore, a cross-sectional study was developed in the Ghanaian patients that more frequently participated in the specialized consultation of hypertension at the Ghana Police Hospital (severe or stage-2 HBP) with the aim of determining the frequency of MetS in these patients and to assess the influence of MetS components over TOD.

SUBJECTS AND METHODS

Study population

The universe for the study (76 patients) was the total adult Ghanaian patients with stage-2 hypertension that received medical attention at the Cuban Medical Brigade Physician Specialist's Consulting Room at the Ghana Police Hospital (GPH), Accra. These patients were referred to the physician specialist from the outpatient department with Hypertension. After obtaining their informed consent, the inclusion/exclusion criteria were assessed. Forty patients (40) patients were thus included in the research (52.63% of those invited). The study period was between February 1, 2009 and January 31, 2010.

The stage-2 hypertension was established on *The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* (JNC-7) criteria for adults.¹³ Stage-2 hypertension was considered with systolic BP \geq 160 mmHg and/or diastolic BP \geq 100 mmHg. All procedures were carried out according to a study protocol approved by the Committee on Human Research Publication and Ethics, Police Hospital, Accra. The information sheet and consent form (available in English) were read and explained by the authors and a nurse assistant (both in English and Twi) to each participant who, if agreed to take part, gave consent either by signing his or her name or applying a left thumbprint.

Inclusion and exclusion criteria

After obtaining the informed consent of clients the following inclusion criteria were assessed:

- Classification as stage-2 hypertension
- Age - 18 years and above
- Ability to communicate in English or Twi (a local language)
- Appropriate mental state to respond to the interview (as part of the clinical examination)

The exclusion criteria were as follows:

- Absence from the assessment consultation
- Inability to provide all the laboratory test results requested
- Severe disability that prevented the client from partaking in the required anthropometric measurements such as weight and height.

Data collection

At inclusion, patients were asked to complete a standardized structured questionnaire on medical history, symptoms and risk factors for cardiovascular disease, and current medication use. Furthermore, a standardized diagnostic protocol was performed including physical examination (general exam which included cardiovascular, neurological and abdominal examination as well as retinal funduscopy, height, weight, waist circumference, and systolic/diastolic BP, and laboratory tests to determine fasting serum lipid, glucose, and creatinine levels).

Height was measured without shoes, using a wooden platform and a height rule, to the nearest 0.5 cm. Weight was measured to the nearest 0.5 kg with manual Seca 761 scales (Vogel & Halke, Germany) after the participants had removed their outer garments and footwear. Body mass index (BMI) was calculated as weight (kg) divided by height (m²). Blood pressure was measured, after the participant had been sitting upright for at least 30 minutes, with a mercury sphygmoma-

nometer (MERCUREX, Spengler; France) with pressure accuracy of ± 3 mmHg. The appropriate adult cuff size (cuff bladder encircling at least 80% of the arm) was used. The systolic and diastolic blood pressure was obtained as the average of at least two manual measurements as was recommended before.¹³

Laboratory measurements were performed at the Police Hospital's laboratory as described previously.¹⁴ Blood samples were taken after 12 hours of fasting. Chest X-ray and electrocardiogram (ECG) were obtained for all participants. Keeping in mind the high cost of the Brain Computer Tomography (CT-scan), it was only performed to assess the brain complications on the patients with old or recent clinical CVD manifestations, with or without previous medical past history of stroke and transient ischemic attack (TIA): motor, visual, cognitive or other transient or permanent neurological alterations. In participants with brain CT-scans from previous strokes, the image was used if it was available. Waist circumference was measured halfway between the lower rib and the iliac crest.

Definitions

MetS was defined according to NCEP-ATP III-R.⁶ This definition included three or more of the following abnormalities: abdominal obesity (waist circumference >102 cm in men and >88 cm in women), low serum HDL cholesterol (<1.04 mmol/L in men, and <1.29 mmol/L in women), high serum triglycerides (≥ 1.70 mmol/L), high serum fasting glucose (≥ 5.6 mmol/L), and elevated BP (≥ 130 mmHg systolic and/or ≥ 85 mmHg diastolic BP). The last four conditions were also considered if the patients had previously known history of them and were receiving specific treatment.

CHD, other heart diseases (OHD), CVD, chronic kidney failure (CKF), aortic (AAD) and carotid (CAD) arterial damage, and retinal alterations (RA) were considered as TOD (cardiovascular diseases). CHD was diagnosed with typical clinical picture of angina, past history of myocardial infarction, very well demonstrated, and ECG criteria.¹⁵ OHD was established with ECG criteria of left ventricular hypertrophy (LVH), and/or clinical-electrocardiographic-radiological signs of congestive cardiac failure (CCF). LVH was defined according to the Cornell and Sokolow voltage indexes.¹⁶

CVD was considered when the brain CT-scan confirmed ischemic or hemorrhagic signs (recently or old) with absence of vascular malformation or tumors, and if tomography signs do not show these signs but clinical picture was very well documented of TIA. CKF was diagnosed when creatinine serum level was >1.5 mg/dL in men or >1.3 mg/dL in women.¹⁷ AAD was considered through chest X-ray signs of thoracic aortic

aneurysm.¹⁸ CAD was determined with clinical diagnosis of carotid murmur. RA was obtained with inspection of the retina by direct ophthalmoscopy, diagnosing hypertensive retinopathy (Keith-Wagener-Barker classification) or diabetes retinopathy.

Statistical analysis

Data analyses were performed in SPSS (Release 16.0, 2007, USA). Scatter plots were obtained to evaluate the data and to confirm a normal distribution of the analyzed variables. Descriptive statistics were generated including means and standard deviations (SDs) for continuous variables and relative frequencies for discrete variables. We estimated the proportions of men and women who met criteria for MetS and their components. The TOD proportions were also calculated.

Student's *t* test for independent samples was performed to compare age between group with and without MetS, and between sexes; a non-significant difference of variances was previously demonstrated with Levene's test for equality of variances. Bivariate correlation of MetS components with age, BMI, total cholesterol, LDL and number of TOD was performed by Pearson's correlation coefficient (for parametric variables) and Spearman's rho correlation coefficient (for non-parametric). The effect of MetS and their components on the risk of TOD was estimated calculating hazard ratio (Odds Ratio, OR); the effect of sexes on the MetS also was evaluated. For all statistical analysis, a significant result was considered if the *P*-value was <0.05 .

RESULTS

In general, coincidentally 20 patients were female and 20 were male. MetS was diagnosed in 62.5% of cases (25 patients). It was present in 80.0% of female and 45.0% of male patients. Descriptive characteristics of the study sample are shown in Table 1. The age range was 29-76 years old (54.13 ± 10.33 years); a significant low HDL cholesterol in female, high triglycerides, and high BMI were found in MetS group comparative with the No MetS group ($P < 0.05$).

A significant association was shown of MetS with female sex (OR, 4.88; 95% confidence interval [CI], 1.19-19.94; $P = 0.027$). The age was not a significant difference ($t = 1.852$; $P = 0.072$) between group with MetS (57.4 ± 9.2 years) and without MetS (51.3 ± 11.3 years), and between sex ($t = -1.541$; $P = 0.132$; male, 57.6 ± 11.1 years; female, 52.6 ± 9.1 years).

The low HDL cholesterol serum level was diagnosed as the most frequent individual component of MetS (72.5%) after HBP; abdominal obesity, hyperglycaemia, and hypertriglyceridemia were found as the MetS components less frequent in the sample (Table 2).

Table 1 Descriptive Characteristics of the Study Sample

| Characteristics | MetS (n=25) | | No MetS (n=15) | |
|-----------------------------------|-------------|------------|----------------|-----------|
| | Range | Mean±SD | Range | Mean±SD |
| Age (years) | 44-76 | 57.4±9.2 | 29-70 | 51.3±11.3 |
| BMI (kg/m ²)* | 21.1-46.8 | 32.4±6.6 | 20.9-37.8 | 27.4±6.4 |
| Waist circumference, Female (cm) | 84-124 | 106.5±12.4 | 77-115 | 95.0±16.3 |
| Waist circumference, Male (cm) | 87-121 | 105.7±14.2 | 74-107 | 90.9±11.6 |
| Total Cholesterol (mmol/L) | 3.0-11.9 | 5.2±1.9 | 2.6-5.9 | 4.5±1.0 |
| LDL Cholesterol (mmol/L) | 2.0-9.9 | 3.6±1.7 | 1.3-5.6 | 2.9±1.1 |
| HDL Cholesterol, Female (mmol/L)* | 0.4-1.4 | 0.9±0.3 | 0.9-1.7 | 1.3±0.3 |
| HDL Cholesterol, Male (mmol/L) | 0.2-0.9 | 0.8±0.1 | 0.3-1.6 | 1.0±0.5 |
| Triglycerides (mmol/L)* | 0.5-2.8 | 1.5±0.6 | 0.5-1.5 | 1.0±0.3 |
| Number of components of MetS* | 3-4 | 3.6±0.5 | 1-2 | 1.8±0.4 |

Table 2 Frequency of Metabolic Syndrome Components and Cardiovascular Diseases in the Study Sample

| Characteristics | MetS (n=25) | No MetS (n=15) | Total (N=40) |
|----------------------------|-------------|----------------|--------------|
| MetS Components | | | |
| Hypertension | 100.0 | 100.0 | 100.0 |
| Low HDL cholesterol | 96.0 | 33.3 | 72.5 |
| Abdominal obesity | 72.0 | 33.3 | 57.5 |
| Hyperglycaemia | 56.0 | 13.3 | 40.0 |
| Hypertriglyceridemia | 32.0 | 0.0 | 20.0 |
| Target Organ Damage | | | |
| Heart disease (Total) | 88.0 | 73.3 | 82.5 |
| Coronary heart disease | 76.0 | 40.0 | 62.5 |
| Other heart diseases | 84.0 | 60.0 | 75.0 |
| Retinal alterations | 84.0 | 73.3 | 80.0 |
| Cerebrovascular disease | 40.0 | 60.0 | 47.5 |
| Aortic arterial damage | 36.0 | 53.3 | 42.5 |
| Chronic kidney failure | 12.0 | 13.3 | 12.5 |
| Carotid arterial damage | 8.0 | 0.0 | 5.0 |

*All data are reported as percentage of subjects (n and N).

All patients with high fasting glucose criteria had type-2 diabetes. The age was not correlated with number or intensities of MetS components (abdominal circumference, HDL cholesterol and triglyceride) ($P>0.05$). A significant correlation of abdominal circumference was present with BMI ($r=0.817$; $P=0.000$), total cholesterol ($r=0.387$; $P=0.018$), LDL cholesterol ($r=0.423$; $P=0.009$), and the number of MetS manifestations ($r=0.537$; $P=0.000$).

Using BMI, 50.0% of participants were obese (≥ 30.0 BMI), 17.5% were overweight (25.0-29.9 BMI), and 32.5% had a normal weight (24.9-18.5 BMI). MetS was present in 36.6% of patients with normal weight and in 85.7% with overweight. The 20.0% of the men and 66.7% of the women with normal weight presented MetS; the frequency of MetS was increased in the overweight and obese groups, and was more frequent in the female sex (Table 3). Abdominal obesity was present in 71.4% of the participants with overweight but not in those with normal weight. Female sex was associated with overweight or obese BMI in comparison with male sex (OR, 6.29; 95% CI, 1.37-28.85; $P=0.018$).

Table 3 Estimated Frequency of the Metabolic Syndrome among Normal Weight, Overweight, and Obese

| Category | BMI, kg/m ² | MetS Frequency (%) | |
|---------------|------------------------|--------------------|-------|
| | | Men | Women |
| Normal weight | <25.0 | 20.0 | 66.7 |
| Overweight | 25.0-29.9 | 66.7 | 100.0 |
| Obese | >30.0 | 71.4 | 76.9 |

Ninety-five per cent of participants had TOD (the sample showed a mean of 2.3 TOD injured with a standard deviation of ± 1.2 , with a range from 0 to 5), and 3 to 5 organs were disturbed in 45.0% of cases. MetS was present in 65.8% of participants with TOD. The most frequent TOD was identified in heart (82.5%), continued by retinal alterations (80.0%), CVD (47.5%) and AAD (42.5%); less frequently were CKF (12.5%) and CAD (5.0%) (Table 2). The main heart alterations were CHD (62.5%), LVH (30.0%), cardiomegaly (25.0%), and CCF (22.5%). The hypertensive retinopathy stage I was presented in 32.5%, stage II in 32.5%, stage III in 7.5%, and stage IV in 7.5%. The CT-scan showed ischemic infarction in 89.5% of participants with CVD, and intra-parenchyma haemorrhagic in 10.5%.

Lacunar infarction was diagnosed in 58.8% of participants with ischemic infarction, and it was not associated with MetS diagnosis (OR, 0.40; 95% CI, 0.04-3.42; $P=0.403$). Subarachnoid haemorrhage and TIA were not diagnosed in the study sample.

The presence of MetS was associated with CHD (OR, 4.43; 95% CI, 1.03-19.27; $P=0.047$) showing 4.43-fold increase risk from CHD in patients with MetS, but not with other TOD ($P>0.05$). Diabetes Mellitus was associated with CHD (OR, 14.00; 95% CI, 1.56-125.61; $P=0.018$) but the other MetS components were not associated ($P>0.05$) with TOD. The sex was not associated with TOD in participants with and without MetS ($P>0.05$). A significant positive correlation was shown between age and CVD ($r=0.381$; $P=0.015$) and CHD ($r=0.623$; $P=0.000$), but not with other TOD. Non-significant correlation or association ($P>0.05$) was shown between a number of MetS components and a number of TOD.

DISCUSSION

The frequency of MetS is variable depending on the definition used to determine it, as well as age, sex, ethnic origin and lifestyle.¹⁹⁻²² MetS definition has been modified continuously to date with diverse diagnosis criteria. Therefore, it is difficult to compare the frequency among countries. Nevertheless, MetS was diagnosed in the Ghanaian patients with stage-2 HBP more frequently than in other studies.^{16,23-29}

In Nigeria, the frequency of metabolic syndrome in adult patients attended at two hospitals in Rivers State was 19.8% according to NCEP-ATP III and 23.2% according to IDF at urban hospital, and 34.2% according to NCEP-ATP III and 35.4% according to IDF at suburban centre.²³ Other study, in newly diagnosed hypertensive Nigerian subjects (on Cardiology unit of LAUTECH Teaching Hospital, Osogbo) the frequency of MetS was 34.5% according to WHO, 35.0% according to NCEP-ATP III, and 42.5% according to IDF criteria.²⁴

In Cameroon, adult urban dwellers had a higher frequency of the MetS than rural dwellers (17.7% vs. 3.5%, $P<0.001$) using NCEP-ATP III criteria.²⁵ In a rural South African black adult community, the crude frequency of MetS was 23.3% according to IDF and 18.5% according to NCEP-ATP III-R criteria.²⁶

In a semi urban South Indian population of Mangalore the frequency was 29.7% using IDF criteria.²⁷ In young (≤ 45 years old) Asian Indian patients with acute myocardial infarction, as defined by NCEP-ATP III and IDF criteria, was diagnosed in 61.0% and 60.1%, respectively.²⁸ In elderly Japanese hypertensive patients,

the MetS was more frequently in non controlled cases than controlled patients.²⁹

In Ghana, Professor Pobee JO was the first to warn about the high prevalence of hypertension.^{30,31} Nevertheless, the frequency of MetS in stage-2 HBP was not reported in the literature reviewed but a frequency of 43.3% of MetS (using NCEP-ATP III criteria) was found among recently diagnosed diabetic patients in Tamale Teaching Regional Hospital (Northern Region, Ghana).³²

Although the frequency of MetS increases with the age,^{5,24-27,33} this phenomenon was not observed in the Ghanaian study sample; this is an important observation to be considered when designing interventions and health promotion strategies in young people. Nevertheless, MetS was more frequent in females and it showed a significant association with this sex. The Ghanaian women presented higher frequency of MetS independently of BMI. Similar results were found by other authors in Africa and other world regions.^{24-27,33}

The high frequency of MetS in Ghanaian women, specifically in obese and overweight groups may be related with the cultural characteristics of the country as was revealed in a sociodemographic study carried out in 2003.³⁴ It was found that the rate of overweight and obesity was higher in females than in males. Obesity was more prevalent in the Akan and Ga tribes and the highest prevalence of obesity was among people with tertiary education. The authors concluded that urban dwellers were more prone to obesity due to westernization and transition in dietary habits; it was the educated urban dwellers who can afford the fast food introduced though globalization and westernization that is further reinforced through media presentation of what constitutes the good life. There is more frying of food and the consumption of soft drinks, which were previously consumed only during Christmas.³⁴

In that study it was also stated that Ghanaians appear to be taking exercise less regularly because in the past people used to walk long distances to school or to work. Likewise, that Ghanaians generally associate fatness with beauty in women and success in both men and women; generally, men in Ghana are known for their preference for fuller women to thin women. Consequently, with affluence people are eating more leading to over nutrition.³⁴

In this study all participants with and without MetS presented severe HBP because of the inclusion criteria. The low HDL serum level was diagnosed as the most frequently individual component of MetS.

The high triglyceride serum level was found as the less frequently MetS component, preceded upwardly by diabetes and abdominal obesity. Similar results were found in subjects with Acute Coronary Syndrome.³⁵

BMI is related to the MetS in both men and women. In addition, because abdominal obesity is also correlated with the MetS, NCEP-ATP III uses it rather than BMI. This becomes important in overweight individuals with a BMI 25.0 to 29.9 kg/m² and large waist circumference who may have MetS in spite of being obese.⁴ The high frequency of abdominal obesity in Ghanaian patients with overweight but not in patients with normal weight shows the profit of the first measure to identify earlier the cases at risk. Therefore, we can infer that at least in the sample population a high MetS frequency without obesity was present. New designs of epidemiological researches in Ghana and their extension to other African regions will be necessary to explain this phenomenon. It is possible that racial and genetic characteristics as well as sociocultural aspects are involved.

Hypertension is associated frequently to some conditions that can be the direct consequence of hypertension (CHD, OHD, CKF, recurrent CVD, and others) or commonly as co-morbidity (diabetes, high CHD risk).¹³ The high frequency of TOD in the Ghanaian patients may be related with the characteristics of the sample such as the stage-2 of HBP in keeping with 7-JNC.¹³ Some studies in Ghana showed association of HBP with low levels of awareness, drug treatment, and blood pressure control that can also be related with high TOD. Nonetheless, TOD was not evaluated in these studies.⁹⁻¹¹

Data from multiple studies have indicated that death from both ischemic heart disease and stroke increases progressively and linearly from BP levels as low as 115 mmHg systolic and 75 mmHg diastolic upward. The presence of other factors increases the risk of cardiovascular diseases.¹³ For this reason the higher frequency of Ghanaian patients with cardiovascular disease and MetS is explained. However, MetS was associated with more than a 4-fold increase risk from CHD but was not associated with other TOD, regardless of sex. Other studies also found association of the MetS with CHD in men and women.^{33,36,35,37} Diabetes Mellitus was the individual MetS component that was associated with increased CHD risk in Ghanaian patients. In the same way, CVD, CKF and the aortic alteration were more frequent in people without MetS. Therefore, HBP intensity was the biggest factor that influenced on the other cardiovascular diseases in the Ghanaian patients.

The main heart alterations in Ghanaian patients were CHD, LVH, cardiomegaly, and CCF. Hypertensive patients are at increased risk for myocardial infarction or other major coronary events and may be at higher risk of death following an acute myocardial infarction.¹³ Myocardial oxygen supply in hypertensives may be limited by coronary artery disease while myocardial oxygen demand is often greater because of the increased impedance to left ventricular ejection and the frequent presence of LVH.¹⁵ Therefore, the high frequency of CHD found in Ghanaian patients may contribute to mortality in the coming years. The low frequency of LVH in Ghanaian patients may be related with the criteria diagnosis including electrical evaluation alone without echocardiographic test,³⁸ which was one of the study limitations.

The risk of clinical complications of CVD including ischemic stroke, hemorrhagic stroke, and dementia increases as a function of BP levels. Given the population distribution of BP, most ischemic strokes occur in individuals with prehypertension or stage-1 hypertension.¹³ Nonetheless, in the Ghanaian patients with stage-2 HBP ischemic etiology predominated over hemorrhagic. It may be related with the high frequency of MetS in the sample, similar to other researches that demonstrate an increase of the risk for ischemic CVD in patients with MetS mainly lacunar infarction.^{36,39-42} Contradictorily, in this study CVD was not associated with MetS but a high frequency of lacunar infarction was diagnosed. The non-significance association may be explained by itself- HBP stage or by the research design used; the no achieved brain CT-scan for all the sample was considered as further justification, which was the other study limitation.

The frequency of severe retinopathy, CKF, aortic and carotid arterial damage increase progressively in the severe HBP patients.¹³ However, Ghanaian patients presented lower frequency of these TOD than other reports.^{37,43,44} This can be due to the diagnose techniques used that did not include the microalbuminuria quantification, CT-scan, magnetic resonance, doppler ultrasound or other methods used in assessing those cardiovascular diseases.

In conclusion, Ghanaian patients with stage-2 hypertension presented a high frequency of MetS with an increased risk in females. This stage of hypertension is by itself an individual risk to developing cardiovascular disease with high frequency not related to MetS, although coronary disease risk was increased with MetS mainly in diabetic patients.

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