INTRODUCTION

High-normal blood pressure (BP) or prehypertension has been found to be associated with increased risk of cardiovascular (CV) events, including progression to hypertension.\(^{[1]}\) It is associated with more than 2-fold increase in the relative risk of developing CV disease (CVD) in 10 years compared with optimal BP.\(^{[1]}\) High-normal BP (HNBP) is associated more frequently than normal BP with other CV risk factors and target organ damage (TOD) such as dyslipidemia, dysglycemia, overweight/obesity, microalbuminuria, and increased left ventricular mass (LVM).\(^{[2]}\)

This clustering of risk factors is considered to be principally responsible for the TOD in subjects with...
HNBp. Identifying such subjects will thus provide an opportunity to modify the risk factors and avoid future complications in them. Data from the Sub-Saharan Africa that explore the relationship between HNBp and TOD are scarce. This study, therefore, aimed to assess TOD among subjects with HNBp in comparison with subjects with hypertension and those with optimal BP.

MATERIALS AND METHODS

The study was carried out in Aminu Kano Teaching hospital, a tertiary health institution in Kano State, Nigeria. Ethical Approval was obtained on 4th January 2010 by the Research Ethics Committee of Aminu Kano Teaching Hospital. (NUREC /21/08/2008/AKTH/EC/194). It conformed to the Declaration of Helsinki on investigations involving human subjects.\[3]\n
Patient selection

The study population comprised of patients at least 18 years of age, attending the cardiology and general outpatient (GOP) clinics of the hospital. There were three subject groups: Group 1 – subjects with optimal BP who presented to the GOP with minor ailments; Group 2 – subjects with HNBp who also presented to the GOP with minor ailments; and Group 3 – hypertensives on treatment attending the cardiology clinic. Three hundred patients were recruited and evaluated, 100 in each group. The sample size was estimated using the prevalence of HNBp of 16.9% in a community-based study in Edo State, Nigeria.\[4]\n
The study was carried out in Aminu Kano Teaching hospital, a tertiary health institution in Kano State, Nigeria. Ethical Approval was obtained on 4th January 2010 by the Research Ethics Committee of Aminu Kano Teaching Hospital. (NUREC /21/08/2008/AKTH/EC/194). It conformed to the Declaration of Helsinki on investigations involving human subjects.\[3]\n
In a standardized manner, information was obtained on relevant sociodemographic characteristics such as age, gender, drug history, and history of hypertension and DM with the aid of an interviewer-administered semistructured questionnaire. The weight (taken with patients in light clothing) and height (without cap/head gear/shoes) of the patients were measured using a stadiometer. The body mass index (BMI) was then calculated using the following formula: BMI = weight (kg)/height (m^2). BP was measured according to the recommendations of the American Society of Hypertension.\[5]\n
The average of two readings taken 15 min apart was recorded.

All subjects were fasted overnight for 10–12 h after which venous samples were obtained for fasting plasma glucose, total cholesterol (TC), and creatinine. The samples were analyzed in the hospital chemical pathology laboratory using the auto-analyzer machine (Chiron Diagnostic – Bayer, made in England).

The CVD risk factors and TOD assessed were recognized in the 2003 World Health Organization (WHO)/International Society of Hypertension guidelines for the management of hypertension.\[6]\n
HNBP was defined as systolic BP (SBP) of 130–139 mmHg and/or diastolic BP (DBP) of 85–89 mmHg. Hypertension was defined as SBP ≥140 mmHg and/or DBP of ≥90 mmHg whereas optimal BP was defined as SBP of <120 mmHg and/or DBP of <80 mHg. The diagnosis of DM was based on the WHO criteria.\[7]\n
TC was considered to be high if it was >200 mg/dl (5.2 mmol/L).\[6]\n
The presence of TOD is defined as the presence of any or all of the following:\[8]\na. LV hypertrophy (LVH): This was determined using echocardiography. Transthoracic echocardiography was performed using Aloka SSD 4000 machine with 3.5 MHz transducer. The procedure was performed according to the recommendations of the American Society of Echocardiography.\[9]\n
LVM was calculated using the formula (Devereux modified ASE cube formula).\[10]\n
LVM was indexed to the allometric power of height.\[11]\n
LVH was considered present if LVM index>46 g²/m².

b. Proteinuria and/or slight elevation of plasma creatinine concentration: It was defined as protein excretion >300 mg/days. It was determined with the use of urine dip stick and was considered present when more than or equal to 1+ was detected on the dip stick on the urine sample.

c. Microalbuminuria: It was defined as persistent protein excretion between 30 and 300 mg/day.\[12]\n
It was determined with the use of Micral strips and was considered positive when a reaction color appears on the test pad of the strip.\[12]\n
d. Slight elevation of plasma creatinine: It was defined by the presence of 1.2–2 mg/dl (105.6–176 umol/L) of creatinine in the patient’s plasma.\[6]\n
e. Early hypertensive retinopathy: This was determined with the use of ophthalmoscope. Fundoscopy was...
done in a darkened room. Assistance was sought from the ophthalmologists when necessary. It was considered to be present if there is generalized or focal narrowing of retinal arteries with or without arteriovenous nipping.\[13\]

**Statistical analysis**

Statistical analysis was performed with Statistical Package for Social Sciences (SPSS software version 19, Inc, Chicago, IL, USA). software version 19.0. Data are reported as mean ± standard deviation for continuous variables and as frequency for categorical variables. One-way analysis of variance was used to compare means across the three groups (optimal BP, HNBP and hypertension). \( P \leq 0.05 \) was considered statistically significant.

**RESULTS**

The mean age of subjects in group 1 was 27.86 ± 8.6 years, 34.04 ± 6.25 years for group 2 and 52.62 ± 11.8 years for group 3. The subjects in group 2 were significantly older than those in group 1 \((P \leq 0.001)\) and those in group 3 were significantly older than those in group 2 \((P \leq 0.001)\). There were 60% females in group 1, 53% in group 2, and 56% in group 3. There were, however, no significant differences in the gender distribution between the three groups \((P = 0.3)\) for each comparison. Subjects with HNBP had higher mean SBP, DBP, BMI, fasting plasma glucose, and TC when compared with those with normal BP [Table 1]. LVH was the most common TOD among the subjects with HNBP and hypertensives followed by proteinuria and microalbuminuria. The pattern of TOD among study and comparative groups is shown in Table 2. Among subjects with HNBP, 22% had 1 TOD and 8% had 2 TOD. Figure 1 shows the number of TOD among the study groups. Comparison of TOD across the three BP categories showed a statistically significant increasing trend [Table 3].

**DISCUSSION**

In the present study, subjects with HNBP had higher burden of TOD, than subjects with optimal BP but lower than with hypertensives. The relationship between TOD and hypertension has been well established, and the presence of TOD is associated with increased CV mortality.\[14\] HNBP is also associated with TOD and other CVD risk factors, and their presence of which may contribute to the development of the TOD.\[15-17\] LVH was the most prevalent TOD followed by proteinuria, microalbuminuria, and slight increase in creatinine.

Subjects with HNBP had increased left ventricular mass index than subjects with optimal BP, with LVH detected in only 2% of subjects with optimal BP, but in up to 14% of subjects with HNBP. This finding is consistent with previous reports.\[17-19\] Jugal et al. reported LVH in up to 17% of prehypertensives while Segura et al. reported a lower prevalence of 10%.\[19,20\] The reason for these observations is not clear. The high prevalence of LVH observed among the hypertensives (66%) is also consistent with previous reports.\[19-24\]

We found a prevalence of 12.9% of microalbuminuria among subjects with HNBP, 25.7% among subjects with hypertension, and 4.1% among subjects with optimal BP. Some other studies reported a prevalence of 10% and 4.9% among subjects with HNBP.\[16,21\] Microalbuminuria is a widely identified marker of vascular dysfunction including endothelial dysfunction, and it is associated with other CVD risk factors. Its presence markedly increases the risk for CV morbidity and mortality.\[25-30\] Urinary albumin excretion has also been reported as a predictor of developing hypertension and BP progression, irrespective of the baseline BP level and other predisposing factors.\[28\]

[Figure 1: Number of target organ damage in the affected subjects. BP: Blood pressure; HNBP: High-normal blood pressure; TOD: Target organ damage]
Prehypertension increases the risk of renal arteriosclerosis which can lead to gradual decline renal function that may lead to rise in serum creatinine. Levels of serum creatinine tend to rise with increasing SBP and DBP, starting from prehypertensive to full-blown hypertension.[31] We however report in this study the prevalence of slight increase in creatinine 6%, 25%, and 3% hypertensive subjects and nonhypertensive controls. This finding is similar to previous reports.[20,32] In another study, normal serum creatinine was found in all 771 participants of African descent with prehypertension, suggesting that the condition is not an independent risk factor for renal disease.[33]

Recent studies using quantitative measurements of retinal vascular caliber have demonstrated a graded association of narrowed retinal arterioles with increasing BP in different populations.[34-37] Findings from some studies showed that retinal arteriolar narrowing is a preclinical marker of hypertension risk.[35-37] All the studies reported that, among persons without hypertension at baseline, those with narrowed retinal arterioles had a higher risk of hypertension in the subsequent 3–7 years, independent of baseline BP levels, BMI, and other known hypertension risk factors.[35-37] Retinal arteriolar narrowing may therefore be considered as surrogate marker of an individual’s genetic predisposition to hypertension development.[38] In this study, none of the subjects with HNBP or optimal BP had retinopathy. This finding suggest that HNBP plays little role in mediating retinal TOD in the population studied although an association could be demonstrated in future larger studies. The limitations of the present study, thus, include the modest sample size and cross-sectional approach. A community-based cohort study could reveal some novel risk factors in our population, which is still in epidemiologic transition.

**CONCLUSION**

The present study suggests that subjects with HNBP had higher prevalence of target organ changes than subjects with optimal BP but lower than those of hypertensives, with LVH being the most prevalent TOD. Individuals in the HNBP category should therefore be identified and screened for other CVD risk factors and TOD which should be corrected to prevent them from developing hypertension and related complications.

**Financial support and sponsorship**
Nil.

**Conflicts of interest**
There are no conflicts of interest.

**REFERENCES**


