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Prevalence of dyslipidemia in normoglycemic subjects with newly diagnosed high blood pressure in Abuja, Nigeria

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BACKGROUND: High blood pressure and dyslipidemia additively increases the risk of cardiovascular disease. There is a high prevalence of high blood pressure in Nigeria, but there are little data regarding the prevalence of dyslipidemia in subjects with high blood pressure.

OBJECTIVE: In this observational prospective study, we examined the prevalence of dyslipidemia in newly diagnosed normoglycemic subjects with high blood pressure.

METHODS: A total of 171 subjects presenting with high blood pressure for the first time in the cardiology and nephrology clinics at the University of Abuja Teaching Hospital were studied. Height, weight, and blood pressure were measured. Total cholesterol, low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) were determined in fasting plasma. The total cholesterol/HDL-C and non–HDL-C values were calculated. These measures were then classified according to the 2001 report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults.

RESULTS: Of the 171 subjects studied, 84 (49%) were male and 87 (51%) were female. Low HDL-C was present in 71 (45.8%), elevated LDL-C in 29 (17%), elevated total cholesterol in 19 (11.1%), and elevated triglyceride in 13 (7.6%), whereas eight (4.7%) of the study population had combined elevated total cholesterol and triglyceride. Female subjects had higher total cholesterol and lower HDL-C than male subjects, but these differences were not statistically significant. Obese subjects, compared to the nonobese, had significantly higher LDL-C and total cholesterol/HDL-C ratios in males and significantly higher triglyceride levels in females.

CONCLUSIONS: Given the prevalence of dyslipidemia seen in this study, we suggest that fasting lipid measurements should be performed in all Nigerians with high blood pressure. These data suggest the need for health education and lifestyle modifications in hypertensive Nigerians to reduce both types of risk factors.

High blood pressure and dyslipidemia represent highly prevalent conditions in the western countries and Asia, with dyslipidemia occuring in 50% to 80% of patients with high blood pressure.[1,2] The combination of high blood pressure and hypercholesterolemia more than additively increases

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the risk of cardiovascular disease events compared to either of these risk factors alone.[3]

In Nigeria, the crude prevalence of high blood pressure has been documented to be 11.2% (based on blood pressure threshold of 160/95 mm Hg) with an age-adjusted rate of 9.3%.[4] However, the current definition of high blood pressure according to the seventh Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII) would include approximately 20–25% of Nigerians. A study by Kaufman et al[5] in an urban cohort in Nigeria put the prevalence at between 24% and 27%.

Despite this high prevalence and the well-established association between high blood pressure and dyslipidemia,[6–9] there are very few data defining the prevalence of dyslipidemia in Nigerian subjects with high blood pressure.

We therefore set out to study the lipoprotein and lipid concentrations in the blood plasma of newly diagnosed patients with high blood pressure and normal blood glucose presenting at the University of Abuja Teaching Hospital, Abuja, Nigeria.

Methods

Subjects

A total of 171 subjects presenting for the first time in both the Cardiology and Nephrology clinics of University of Abuja Teaching Hospital were studied. Subjects with diabetes mellitus as defined by the American Diabetic Association/World Health Organization criteria[10] were excluded from the study. Also excluded from the study were patients with a history of chronic kidney disease, those with creatinine concentrations >2 mg/dL, and patients with retroviral disease receiving reverse transcriptase inhibitors.

Measurements

Baseline clinical and demographic characteristics were obtained from the subjects using a structured questionnaire. Information obtained were age, gender, history of smoking, history of high blood pressure, and history of diabetes mellitus. The heights of subjects were measured with subjects without shoes or headgear. Body mass index (BMI) was calculated using the formula weight (kilograms)/height (meters squared). Blood pressure measurements were obtained according to standard guidelines with a mercury sphygmomanometer (Accoson, London). Systolic and diastolic blood pressures were measured at Korotkoff sounds I and IV, respectively. Blood pressure was measured at the right arm three times after a 5-minute rest with patient in a sitting position, and the average of the three measurements was obtained.

Subjects were asked to fast for 8–12 hours before blood sample collection. Blood chemical analysis was performed at a central certified laboratory. Blood fasting glucose and lipids were analyzed enzymatically by auto analyzer (Erber Spectrophotometer, Boehringer GmbH, Mannheim, Germany).

Serum total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein (HDL-C), and triglycerides were classified based on the Third Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (ATP III). High total cholesterol was defined as total cholesterol levels ≥240 mg/dL, low HDL-C as <40 mg/dL, and high LDL-C ≥160 mg/dL. In addition, high triglyceride was defined as ≥200 mg/dL. A total cholesterol/HDL-C ratio of ≥5 was considered high and non–HDL-C ≥190 mg/dl was also considered high.

Diabetes mellitus was defined according to the American Diabetes Association (ADA) criteria of 1997 as fasting plasma glucose ≥126 mg/dL.[10]

According to the World Health Organization (WHO) criteria, obesity was defined as BMI ≥30 kg/m^2, whereas smoking was defined as smoking at least one cigarette everyday and continued for at least one year.

All subjects gave written informed consent before they were enrolled into the study. Ethical clearance was obtained from the Medical Research Ethical Committee of the University of Abuja Teaching Hospital.

Statistical analysis

Data was analyzed using SPSS version 10.0 (SPSS Inc., Chicago, IL). Baseline variables were expressed as mean ± SD. To evaluate the association between diastolic and systolic blood pressures and lipid levels, linear regression analysis was used with total cholesterol, LDL-C, HDL-C, and triglycerides levels as dependent variables and diastolic and systolic blood pressures as independent variables. A P value < .05 was considered statistically significant.

Results

Demographic characteristics of subjects

All the subjects were between 24 and 80 years of age (mean 50.0 ± 10.9). Table 1 shows the characteristics of the subjects as stratified by gender. Although men had a higher blood pressure profile compared to women, and women had a higher BMI, higher total cholesterol and triglyceridse, and lower HDL-C levels, these were not statistically significant.

Prevalence of dyslipidemia in the study population

The most common form of dyslipidemia is low HDL-C, which occurred in 45.8% of the study population (Table 2). High LDL-C (>240 mg/dL) was found in 17% of the

Table 1 Demographic and lipid status of subjects by gender

Variable	Males (n = 84)	Females (n = 87)	*P* value
Age, y	51.1 ± 9.9	48.9 ± 11.8	.19
BMI, kg/m^2	28.5 ± 5.7	29.8 ± 6.0	.13
SBP, mm Hg	150.6 ± 27.7	143.5 ± 23.8	.08
DBP, mm Hg	96.3 ± 18.7	93.4 ± 15.1	.27
PP, mm Hg	54.3 ± 18.3	50.1 ± 15.9	.11
MAP, mm Hg	114.4 ± 20.4	110.1 ± 16.9	.14
TC, mg/dL	177.7 ± 53.1	184.2 ± 47.5	.40
TG, mg/dL	111.3 ± 52.7	112.0 ± 54.2	.94
LDL, mg/dL	120.9 ± 51.2	119.4 ± 48.3	.84
HDL, mg/dL	44.5 ± 16.8	43.1 ± 18.2	.62
TC/HDL	4.59 ± 2.11	4.73 ± 2.60	.39
Non-HDL, mg/dL	135.9 ± 50.4	142.2 ± 43.8	.70

BMI, body mass index; DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; MAP, mean arterial pressure; PP, pulse pressure; SBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride.

subjects, with high total cholesterol occurring in 11.1% and high triglyceride levels in 7.6%. High triglycerides with high LDL-C was observed in only 4.7% of cases. The total cholesterol/HDL-C ratio was ≥5 in 31.6% of the study population, whereas non–HDL-C was ≥190 mg/dL in 12.9% of the study population.

Mean total cholesterol, LDL-C, HDL-C, and triglyceride in the study population

The mean total cholesterol was 181 ± 50 mg/dL, mean LDL cholesterol was 119 ± 52 mg/dL, mean HDL-C was 43 ± 19 mg/dL, and mean triglyceride level was 112 ± 54 mg/dL.

Demographic and lipid status of subjects when stratified according to gender and BMI (those with BMI above or below 25 kg/m^2)

Table 3 shows significantly higher LDL-C concentrations and higher total/HDL-C ratios in male subjects and significantly higher triglyceride levels in female subjects, with BMIs of ≥25 kg/m^2.

Linear regression analysis between blood pressure and lipid levels

There was a positive correlation between triglyceride concentrations and high diastolic blood pressure (P = .018, R^2 = 0.242), as well as triglycerides and high systolic blood pressure (P = .037, R^2 = 0.216).

Discussion

The main finding in this study is the relatively high prevalence of dyslipidemia (11.2%) in Nigerian patients with high blood pressure. This is quite remarkable compared to the prevalence of 0.4% of hypercholesterolemia in subjects with high blood pressure in the 1988 National Non-communicable Disease Survey.[4] This supports the fact that there is a rapid change in the cardiovascular disease pattern, as more people in this part of the world are adapting to a more sedentary lifestyle and a western diet. Despite this, these patients have a lower prevalence of dyslipidemia compared to their Asian and Caucasian counterparts.[2,11,12]

Eleven percent of our subjects had high total cholesterol (>240 mg/dL). Previous findings in the United States of

Table 2 Pattern of distribution of dyslipidemia

Lipid status	No. of subjects
High TC (≥240 mg/dL)	19 (11.1%)
High LDL-C (≥160 mg/dL)	29 (17%)
High triglyceride (≥200 mg/dL)	13 (7.6%)
Low HDL Cholesterol(<40 mg/dL)	71 (45.8%)
Isolated hypercholesterolemia (TC ≥240 mg/dl + TG <200 mg/dL)	18 (10.5%)
Mixed hyperlipidaemia (TC ≥200 mg/dl +TG ≥200 mg/dL)	8 (4.7%)
Normotriglyceridemia and low HDL-C (HDL<40 mg/dL + TG <200 mg/dL)	30 (17.5%)
Percentage of subjects with TC/HDL-C ≥5	53 (31.6%)
Percentage of subjects with non–HDL-C ≥190 mg/dL	22 (12.9%)

HDL-C, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides.

Table 3 Demographic and lipid status of subjects by body mass index (BMI) and gender

Variables	Males (BMI ≤25 kg/m²) (n = 22)	(BMI >25 kg/m²) (n = 62)	*P* Value	Females (BMI ≤25 kg/m²) (n = 25)	(BMI >25 kg/m²) (n = 62)	*P* value
Age, y	44.95 ± 10.06	53.06 ± 9.12	.93	53.22 ± 14.40	47.52 ± 10.37	.02*
BMI, kg/m²	22.91 ± 2.09	30.40 ± 5.66	.018*	22.83 ± 4.10	32.46 ± 4.98	.000*
SBP, mm Hg	150.53 ± 36.59	151.02 ± 25.04	.06	140.87 ± 29.53	144.19 ± 22.29	.22
DBP, mm Hg	93.42 ± 19.30	97.26 ± 18.50	.68	91.91 ± 20.73	93.85 ± 12.96	.01*
PP, mm Hg	53.75 ± 15.39	57.11 ± 27.05	.001*	48.96 ± 19.53	50.34 ± 14.84	.08
MAP, mm Hg	112.46 ± 23.06	115.18 ± 19.61	.27	108.23 ± 22.19	110.63 ± 15.12	.08
TC, mg/dL	173.11 ± 50.71	179.77 ± 53.49	.62	170.95 ± 49.80	189.60 ± 46.70	.91
LDL-C, mg/dL	105.57 ± 47.56	111.32 ± 67.97	.006*	117.00 ± 59.29	119.53 ± 46.80	.29
TG, mg/dL	110.84 ± 46.50	121.01 ± 56.52	.65	105.13 ± 10.28	121.79 ± 56.14	.009*
HDL-C, mg/dL	42.74 ± 19.11	42.34 ± 18.00	.42	39.96 ± 16.57	43.87 ± 19.73	.14
TC/HDL	4.47 ± 1.73	4.99 ± 3.08	.013*	4.69 ± 3.85	4.75 ± 1.99	.61
Non-HDL, mg/dL	130.53 ± 50.24	137.41 ± 50.74	.60	132.23 ± 46.90	145.69 ± 42.50	.24

DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; MAP, mean arterial pressure; PP, pulse pressure; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides.

Data are presented as mean ± SD.

*Statistically significant.

America have figures ranging from 15% to 31%[13] and in China a prevalence of 18% was reported.[11] The prevalence of hypercholesterolemia (11.1%) seen in this study is quite high compared to findings of the Nigerian National Non-communicable Disease Survey of 1988.[4] This sharp difference may be attributable to the rapid westernization that is being experienced in the developing nations like Nigeria with a diet higher in animal fat and less daily exercise.Our study has therefore revealed an alarming trend, consistent with the ongoing "epidemiologic transition" that is being experienced by low-income countries, including Nigeria. The mean values of total cholesterol and HDL-C in this study were 181 ± 50.30 and 42.62 ± 18.48 mg/dL, respectively, compared to 174.62 ± 60.00 and 49.23 mg/dL reported by Oghagbon et al[8] in their study of 50 newly diagnosed subjects with high blood pressure in Ilorin, North-Central Nigeria. The more favorable lipid profile in the Ilorin subjects compared to the Abuja subjects may be partly due to the more westernized lifestyle in Abuja compared to Ilorin, and also the higher BMI in the Abuja cohort compared to that in the Ilorin study (29.28 ± 28 vs 26.42± 4.75 kg/m²). This is consistent with the effect of westernization on the lipid profile of Nigerian hypertensives.

Low HDL-C was found to be the most common form of dyslipidemia in 45.8% of the hypertensive subjects studied, whereas the ratio of total cholesterol to HDL-C ≥5 occurred in 31.6%, and non–HDL-C levels ≥190 mg/dL occurred in 12.9%. Similar to our study, isolated low HDL-C was found to be the most common lipid abnormality in hypertensive subjects in India[12] (in 23.7% of cases). The prevalence of low HDL-C concentrations (45.8%) seen in our study is quite high compared to findings among Caucasians and Asians.[2,12] Previously, native Africans have been said to have higher HDL-C compared to Caucasians and Asians; this has been attributed to genetics,[14] a diet rich in vegetables,[15] and relatively high physical activity.[16] However, with migration of people into urban areas, there has been a change in both diet and lifestyle that may be affecting this parameter. A diet poor in fresh vegetables, fresh fruits, and high in carbohydrates, and reduced physical activity may be playing a role in this change. The rising prevalence of low HDL concentrations portends a high risk of coronary heart disease in Nigeria, particularly when combined with high blood pressure.[17,18] The National Cholesterol Education Program's ATP report clearly defined serum HDL-C <40 mg/dL as an independent risk factor for coronary heart disease.[19] Similarly, a finding of 31.6% of the subjects in this study with a total cholesterol to HDL-C ratio of ≥5 portends a high risk of coronary heart disease in Nigerians with high blood pressure.[20]

Hypertriglyceridemia was seen in 7.6% of the study population. Opadijo et al,[21] in a study of newly diagnosed hypertensives in Ilorin, Nigeria, had reported a prevalence of 20.4%. The lower value in our study can be attributed to the fact that diabetic subjects were excluded from our study, unlike the study by Opadijo et al,[21] as it has been

shown that several factors, including diabetes mellitus, cause hypertriglyceridemia.[22]

Several studies have reported the disparities between serum lipids and gender.[23–25] In this study, there was no gender difference in the lipid profile of subjects. This is similar to findings by Adedeji[26] among healthy adult Nigerians and also the findings of the National Non-Communicable Disease Survey in Zimbabwe where there was no gender difference in lipid profile of subjects, including HDL levels.[27] The lack of gender difference in the lipid profile of subjects in this study can be partly explained by the lack of significant difference in the BMI between males and females, as BMI was a strong determinant of lipid profile in this study. Most of the women in the study were premenopausal, with an average age of 48.9 ± 11.8 years. It is well documented that postmenopausal women are susceptible to having dyslipidemia in addition to being overweight, and this promises to enhance the impact of lower HDL already evident in these relatively young women with high blood pressure as they grow older.[28,29]

Excess body weight is closely associated with dyslipidemia.[30] In our study, there was higher LDL-C and total cholesterol/HDL-C in male subjects, and higher triglyceride level in female subjects, when those with BMI ≥25 kg/m^2 were compared to those with BMI <25 kg/m^2. Brown et al[31] and Xingang Zhang et al[11] showed similar findings. The association between high BMI and dyslipidemia has been attributed to biological variability in lipids and other factors, such as exercise, diet, and heredity.[31]

A positive relationship between serum cholesterol and blood pressure has been reported in many epidemiologic studies,[32,33] although the results have not been consistent across population subgroups. A study in Norway[34] showed that total cholesterol, HDL-C, and triglyceride levels had an independent positive association with diastolic and systolic blood pressures. In another study in rural China,[11] high blood pressure was associated with high total cholesterol and reduced HDL-C. In Japan,[35] it was found that subjects with hypercholesterlemia had significantly higher diastolic blood pressure during exercise than those without hypercholesterolemia. In our study, using a linear regression analysis, there was a positive correlation between high diastolic blood pressure and hypertriglyceridemia. The level of smoking in this population was low and so was not analyzed in relation to dyslipidemia.

Our study has shown that dyslipidemia in hypertensive subjects is not only a problem among Caucasians and Asians, but also among Nigerian Africans. This further supports the concept of emerging epidemiologic transition in disease patterns that is currently being experienced by the developing nations, including Nigeria. It will therefore be necessary to screen for dyslipidemia in all our citizens with high blood pressure and institute therapy when necessary. However, this can be a great challenge in a region were resources are either scarce and/or poorly managed. The need to include education on lifestyle modifications in the treatment of our hypertensive subjects cannot therefore be over-emphasized.

The main limitation of this study is the fact that only hypertensive subjects were studied with no normotensive subjects for comparison. However, the finding that at least one third of hypertensive patients have some form of dyslipidemia is clinically relevant given that these are a particularly high risk group in whom one would have a low threshold to commence medical therapy early if lifestyle measures fail. Another limitation is the fact that this was a hospital-based study, which might have introduced selection bias in the subjects studied. It is possible that the prevalence of dyslipidemia may be lower in hypertensive patients managed in the general community.

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