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Prevalence of Hypertension and Impaired Renal Function in Diabetic Patients Attending Ahmadu Bello University Teaching Hospital (Abuth), Shika, Zaria, Kaduna State, Nigeria

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To determine the prevalence of hypertension and impaired renal function in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria. Two hundred subjects (one hundred and twenty diabetic and eighty control subjects) attending the diabetic clinic of the hospital were evaluated between the months of May and June, 2012. From the results, the prevalence of hypertension among diabetic patients attending the hospital was 78.33%. A total of 63.33% of the patients have type II diabetes mellitus, while 36.67% had type I. The urea, potassium, bicarbonate and glucose levels were normal and creatinine (58.33%) and sodium (88.1%) levels were abnormal in most patients. The result shows that 80% of female patients between 50 to 59 years were hypertensive, while 40% of the males within the same age range were also hypertensive. Also, 30% of unemployed diabetic patients attending the hospital were hypertensive, while none of the control subjects were hypertensive. Most of the diabetic patients (40%) were primary school certificate holders, while 2.5% of the patients had a post graduate degree. In conclusion, the high prevalence of hypertension and renal impairment are public health challenges and so educational programs on monitoring of blood sugar and screening of risk factors for hypertension, early diagnosis and treatment of hypertension should be given periodically.

Key words: Diabetes, hypertension, prevalence, renal function

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INTRODUCTION

The elevation of systolic blood pressure 140 mm Hg and diastolic pressure 90 mm Hg is termed hypertension (WHO, 2008). Previous studies have attributed the co-existence of hypertension and diabetes in affected individuals to similarities in genetic and environmental factors of both diseases. Also, it has been reported that people with hypertension are more likely to develop type II diabetes than those without hypertension (The National High Blood Pressure Education Program Working Group, 1994). Similarly hypertension is twice as prevalent in diabetic as in non-diabetic individuals (Simonson, 1988). Furthermore, it has been clearly shown that hypertension in diabetic patients is associated with accelerated progression of both microvascular (retinopathy and nephropathy) and macrovascular (atherosclerotic) complications (Grundy *et al.*, 1999). These complications are increased by the co-existence of hypertension (Epstein and Sowers, 1992).

Diabetes Mellitus is defined by World Health Organization on the basis of the laboratory finding as fasting venous plasma glucose concentration more than or equal to 7.0 mmol L⁻¹ or a random venous plasma glucose concentration more than or equal to 11.1 mmol L⁻¹. It can also be defined as a clinical syndrome characterized by hyperglycaemia due to absolute or relative deficiency of insulin (Grundy *et al.*, 1999). The risk of coronary heart disease in diabetic patients with hypertension has generated interest in studying the relationship between the two conditions (Garcia *et al.*, 1974). Obesity and other risk factors such as smoking, alcohol consumption, diet and lack of physical activities predispose individuals to these diseases hence life style modification by affected individual becomes necessary.

The prevalence of diabetes and hypertension has been reported to be on the increase, with a projected rise of 366 million diabetics in 2030 compared to the 171 million in 2000 and a 60% rise in people with hypertension by 2025. Presently, about 60% of Nigerian diabetics are hypertensive (WHO, 2008). The high cost of antihypertensive drugs makes most patients non compliant, making blood pressure control unsatisfactory and their reno-protective benefits missed. Thus, there is a need to investigate the prevalence of impaired renal function in diabetic patients and to determine the current prevalence of high blood pressure in patients with diabetes in order to enlighten the populace about the effects and risks associated with the disease. This study therefore, aims at determining the prevalence of hypertension and impaired renal function in diabetic patients attending Ahmadu Bello University Teaching

Hospital, Zaria, Kaduna State, Nigeria and the effects of some risk factors on their physical wellbeing.

MATERIALS AND METHODS

A total of Two hundred samples were allocated for the research. Samples were obtained from one hundred and twenty diabetics (sixty-two males and fifty-eight females) and eighty control subjects (comprising thirty-four males and forty-six females) attending the diabetes clinic of Ahmadu Bello University Teaching Hospital (ABUTH) Zaria, Kaduna State, Nigeria. Ethical approval was obtained from the ethics committee of Ahmadu Bello University Teaching Hospital (ABUTH) Zaria before commencement of the experiment.

Inclusion criteria and exclusion criteria: Patients studied had been diagnosed as having diabetes mellitus using the WHO (1999) criteria with FBG 7.0 mmol L⁻¹ (126 mg dL⁻¹) and 2 h post prandial glucose 11.1 mmol L⁻¹ (200 mg dL⁻¹), attending ABUTH, Zaria and within the age of 20-70 years. Only those who consented were included in the study. Healthy patients attending the hospital for routine check-up were selected as control. Individuals below 20 years and those who refused to give their consent were excluded.

Blood collection and sampling: Five milliliters of venous blood was aseptically collected from all subjects, after 12 h fasting into well-labelled test-tubes. The samples were allowed to clot at room temperature, serum obtained and stored at -20°C until assay period.

Administration of questionnaires: A questionnaire was administered to obtain information about the age, sex, type of diabetes, weight, lifestyle associated with diabetes and hypertension, as well as demographic characteristics.

Analysis of blood samples

Estimation of blood glucose: Serum blood glucose was measured by glucose oxidase method (Trinder, 1969). Briefly, phenol reagent (2 mL) was added into three test tubes labeled blank, test and standard. This was followed by 50 µL distilled water, serum and standard added into the blank, test, standard, respectively. Glucose colour reagent (2 mL) was then added to all tubes. The contents were mixed, incubated at 37°C for 20 min and absorbance was read at 510 nm.

Creatinine: Creatinine was estimated using the method of Jaffe in 1919. Briefly, 3 test tubes were labeled test, standard and blank. About 1.5 mL of distilled water and

0.5 mL each of 10% sodium tungstate and 2/3N sulphuric acid were added to the test and blank. The contents were mixed and centrifuged for 10 min. The supernatants (1.5 mL) were transferred to new test tubes, while 1.5 mL standard solution was transferred into the standard tube. Picric acid (0.5 mL) and 0.75 N sodium hydroxide (0.5 mL) were added to all test-tubes and incubated for 15 mins at room temperature, before taking absorbance at 520 nm.

Determination of chloride: Chloride was estimated as described by Schales and Schales (1971). Briefly, to 2 mL of deionized water, 200 mL of sample and 2 drops of the indicator were added and mixed. This was titrated against mercuric nitrate until a violet-blue coloured complex was observed.

Bicarbonate: Bicarbonate was estimated as described by Scribner and Caillouette (1954). Into a universal glass bottle, 200 µL serum and 100 µL of 0.01N HCl were added. This was followed by the addition of 500 µL of CO₂ free water and a drop of phenol red indicator. Titration was done using 0.01 N sodium hydroxide to a faint pink colour as the end point. Concentration of bicarbonate was calculated thus: 1 L×50 mEq L⁻¹×1 (mmol).

Urea: This was determined using the diacetylmonoxime method. Three universal glass bottles were labeled test, standard and blank. Into the test and standard bottles, 10 mL of distilled water was added. Then, 100 µL of sample and 100 µL of standard solution was added with homogenous mixing into the test and standard tubes, respectively. The supernatant (1000 µL) obtained from both test-tubes was transferred into freshly labeled test tubes and 1000 µL distilled water added; while 2000 µL of distilled water was added into the test-tube labeled blank. A 2 mL volume of working reagent and mixed acid reagent were sequentially added into the test-tubes and mixed thoroughly. All test-tubes were then placed into a hot block at 100°C for 20 min, allowed to cool and absorbance was read at 520 nm:

$$\text{Calculation: } \frac{\text{Abs}(\text{test})}{\text{Abs}(\text{std})} \times 10 \text{ mmol L}^{-1}$$

Determination of Na⁺ and K⁺: Sodium and Potassium were estimated using flame photometric method.

RESULTS

Table 1 shows the percentage of male and female diabetic and non-diabetic subjects in the study population. There were 62 (51.7%) male and 58 (48.5%) female patients, while the control subjects were made up of 36 (42.5%) females and 46 (57.5%) males.

A total of 78.33% of diabetic patients were found to be hypertensive, while 21.67% were not hypertensive. Among the diabetic hypertensive patients, 36.66% were females and 41.67% were males, while only 10% female and 11.67% male diabetics were not hypertensive (Fig. 1).

Figure 2 shows that 63.33% of the diabetic patients attending ABUTH have type II diabetes mellitus, while 36.33% have type I diabetes mellitus. Among the patients with type II, 43.33% were hypertensive; while 33.33% of the patients with type I were found to be hypertensive.

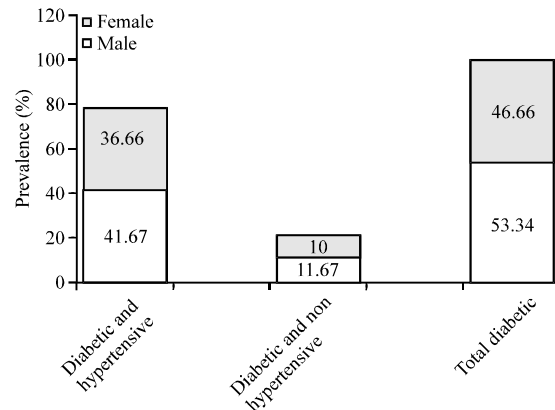


Fig. 1: Prevalence of hypertension in male and female diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

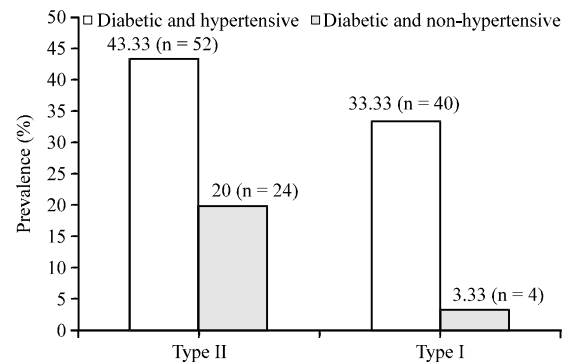


Fig. 2: Prevalence of hypertension (based on the diabetes type) in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

Table 1: Percentage of male and female diabetic and non-diabetic subjects

	Diabetics		Control	
	Frequency	Percentage	Frequency	Percentage
Male	62	51.7	34	42.5
Female	58	48.5	46	57.5
Total	120	100	80	100

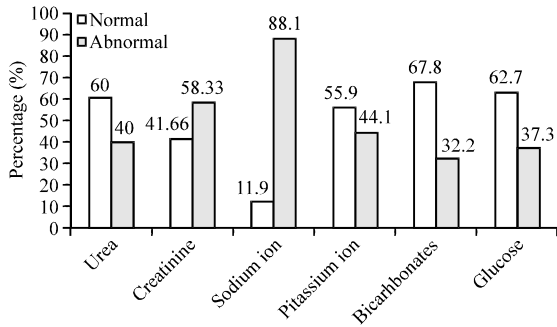


Fig. 3: Prevalence of impaired renal function in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

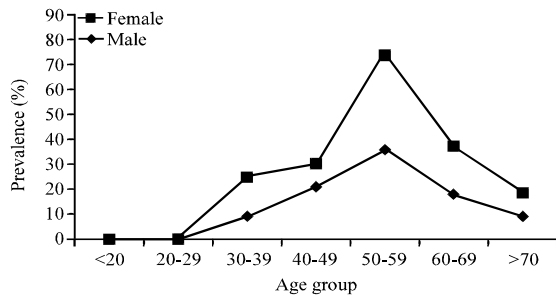


Fig. 4: Prevalence of hypertension by age group and sex in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

A large percentage of diabetic patients attending ABUTH had normal electrolyte levels, with 60, 55.9, 67.8 and 62.7% having normal levels of urea, potassium ion, bicarbonates and glucose, respectively. However, about 88.1% of the patients had abnormal levels of sodium ion, while 58.33% had abnormal creatinine levels (Fig. 3).

With respect to the prevalence of hypertension in diabetic patients by age group and sex; result from the study shows that 80% of female patients between 50 to 59 years were hypertensive, while 40% of the males within the same age range were hypertensive (Fig. 4).

Analysis showed that a large percentage of diabetic patients (34.69%) attending the hospital were unemployed; with 30% of them having high blood pressure, while only 11.22% of patients in the control group were unemployed. Also, about 13.26% of the diabetic patients were employed and 11.22% were retirees (Fig. 5).

From the results, it was obvious that all participants achieved some level of education with the following distributions: 40% of diabetic patients were primary

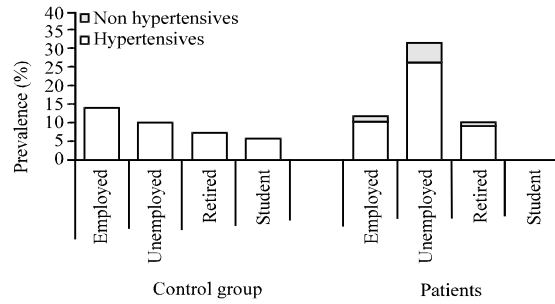


Fig. 5: Prevalence of hypertension by employment status in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

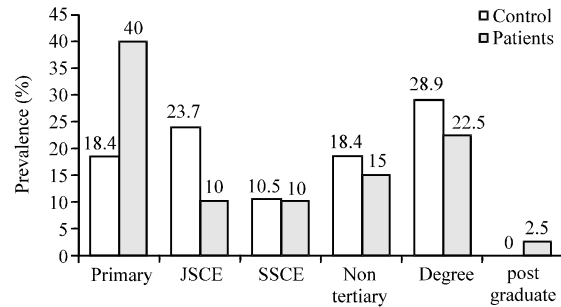


Fig. 6: Educational status of diabetic patients and control subjects attending Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria

school certificate holders, 10% were JSCE and SSCE holders, 22.5% were graduate degree holders and 2.5 had post-graduate degrees (Fig. 6).

For all the respondents, 85.96% of diabetic patients have had their blood pressures measured within twelve months, while only 14.04% of the control subjects measured their blood pressure within the same period. Also, 82.1% of diabetic patients were aware of their hypertensive status, 16.1% were not and 1.8% of them were not sure of their hypertensive status. Although only 5.4 and 17.9% of the diabetic patients were exposed to cigarette and indoor smoke, respectively; a large percentage of diabetic patients (61.9%) and control subjects (84.6%) took non-steroidal anti-inflammatory drugs, while only 7.7% of control subjects and 33.3% of the patients were not taking non-steroidal anti-inflammatory drugs (Table 2).

DISCUSSION

Several studies have demonstrated a very high prevalence of hypertension in Sub-saharan Africa

Table 2: Some characteristics of the study population

Characteristics	Diabetic	Control
BMI (kg m ⁻²)	30.48±5.78	22.23±3.25
Hypertensive status (Awareness)		
Yes	82.1	100
No	-	16.1
Uncertain	-	1.8
Blood pressure measurement (Last 12 months) cigarette smoking	85.96	14.04
Yes	5.4	-
No	92.9	100
Exposed to indoor smoke		
Yes	17.9	10.8
No	82.1	89.2
Non-steroidal anti-inflammatory drugs (NSAIDS)		
Yes	61.9	84.6
No	33.3	7.7
Physical activities		
Yes	43.2	57.9
No	56.8	42.1

All results above were expressed as percentages (%), except BMI, expressed as kg m⁻² of Mean±SEM

(Addo *et al.*, 2007; Ulasi *et al.*, 2011). Report by Cooper *et al.* (1997), put the prevalence of hypertension in Nigeria and Cameroun at 16%. The prevalence of hypertension in people with diabetes mellitus is known to be variable worldwide, with data from several epidemiologic studies suggesting that the prevalence of hypertension in patients with diabetes mellitus is approximately 1.5-2.0 times greater than in an appropriately matched non-diabetic population (Simonson, 1988). A study by Bugaje *et al.* (2005), demonstrated a rapid increase in prevalence rate of hypertension in adolescents in Zaria. It has also been reported that about 60% of Nigerian diabetics are hypertensive, as found in many other areas of the world, with females having a slightly higher incidence than males (Wingard and Barret-Connor, 1998). The prevalence of hypertension in diabetic patients attending Ahmadu Bello University Teaching Hospital, Zaria was 78.33%, a result which agrees with reports by Vukovich *et al.* (1992) and Tiptaradol and Aekplakorn (2012) that hypertension affects 75% of diabetic patients. It is thus possible that the high prevalence of hypertension in this study represents the increasing prevalence across the globe. Several factors acting together, such as metabolic abnormalities, elevated plasma levels of lipoprotein, oxidation of low-density lipoprotein cholesterol and formation of glycated low-density lipoprotein, as well as abnormalities in the structure and function of the vascular endothelium are known to be responsible for the damage of the vasculature resulting in cardiovascular diseases, including hypertension, in diabetic individuals (Grossman and Messerli, 2008). In addition, the high prevalence of hypertension among diabetic patients has been attributed to high concentration of factor VIII in

hyperglycemic conditions, known to accelerate the rate of thrombin formation and contribute to occlusive vascular diseases in diabetic patients (Carmassi *et al.*, 1992).

The high percentage (63.33%) of type II compared to type I diabetic patients attending ABUTH agrees with reports by Unadike *et al.* (2011) that type II diabetic population is usually higher than type I. Also, type II diabetes has been shown to occur in over 90% of diabetic patients; and affects older adults, particularly those over 50 years of age (Carl and Edward, 2001). The prevalence as observed in the present study may be attributed to high BMI and sedentary lifestyle of the patients (Table 2). This finding is in agreement with that of Grossman and Messerli (2008) who showed that as the prevalence of type II diabetes increases with obesity, higher fat diets and decreased physical activity. With BMI, the risk of obesity, a strong risk factor for the coexistence of diabetes and hypertension is determined (Balogun and Salako, 2011).

It has been suggested that hyperinsulinemia and insulin resistance may also contribute to the maintenance of an elevated blood pressure because insulin promotes sodium retention and enhances sympathetic nervous system activity (Simonson, 1988). Therefore, the abnormally high levels of sodium ion in most (88.1%) of the diabetic patients as observed in this study may cause accumulation of extracellular fluid and expansion of plasma volume as a result of renal insufficiency, resulting in increased blood pressure (Simonson, 1988). Also, the abnormal level of creatinine, urea and other electrolytes in the diabetic patients (Fig. 3) agrees with studies by Sweileh *et al.* (2009) that 63.5% of diabetic patients have renal dysfunctions, which may be caused by hyperglycemia and hemodynamic abnormalities of the renal micro circulation that results in progressive structural and functional glomerular abnormalities.

The high prevalence in both male and female diabetic patients between the ages of 50-59 years agrees with studies by American Diabetes Association, 1997 that there is high prevalence of hypertension among females. Also, studies have demonstrated that women have a lower prevalence of hypertension than men before age 50, but after age 55, the prevalence increases. The reasons for these differences are not clear, but hypertensive women have been shown to have somewhat different hemodynamic findings from men (Pemu and Offili, 2008). In another study, Didem *et al.* (2008) attributed the high prevalence of hypertension in women to their age being within the menopausal period and the protective effect of estrogen.

The large percentage of hypertensives among the unemployed diabetic patients (30%) conforms with

studies by Lucini *et al.* (2005) stressing the significant role of psychosocial stressors in the development of cardiovascular diseases, including hypertension. Studies have shown that low occupational status and the threat or reality of unemployment increases the risk of hypertension (Gallo *et al.*, 2004).

From our results (Fig. 6), about 40% of diabetic patients had only primary school certificates, while only 2.5% have post graduate degree. This is compatible with the decreased prevalence associated with an increase in education as reported by Sadeghi *et al.* (2004). It is thus obvious that education, coupled with enlightenment could be related to the protection of hypertension.

Hammoudeh *et al.* (2006) and Lorenzo *et al.* (2005) reported that the risk of hypertension is higher in smokers than non-smokers. From our present study, although, the population of patients smoking and those exposed to indoor smoke (Table 2) was very low, it is possible that they could also be exposed to other risk factors as data from the Nurses Health Study, suggests that maintaining a desirable body weight, eating healthy diet, regular exercises, non-smoking and moderate consumption of alcohol reduces the risk of hypertension by 84% (Lawrence *et al.*, 1996).

The high percentage of diabetic patients taking Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) may account for the high prevalence of hypertension within the study population as NSAIDs has been shown to induce dose-related fluid retention and raise blood pressure in some patients (Morgan *et al.*, 2000). It can also reduce renal blood flow and cause a dose-dependent form of blood pressure salt sensitivity. Clinical trials have demonstrated that NSAIDs may diminish the overall efficacy of certain antihypertensive medications such as diuretics, β -blockers and angiotensin converting enzyme inhibitors (Morgan *et al.*, 2000).

CONCLUSION

In conclusion, this study has shown that the prevalence of hypertension among diabetic patients attending ABUTH is 78.33%, with most patients presenting with impaired renal function; and most are unaware of their hypertensive status. This high prevalence is a public health challenge; hence, educational programs need to be established with the aim of monitoring blood sugar, screening of risk factors for hypertension, early diagnosis and treatment of hypertension. At the same time, routine blood pressure measurement for the elderly people should be encouraged. Public health awareness of simple measures,

such as a low salt diet, physical exercises and avoiding obesity to maintain normal arterial blood pressure should also be encouraged.

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