INTRODUCTION

Antihypertensive treatment is a more effective and cheaper strategy than reliance on tight blood sugar control in reducing premature diabetic-related deaths and suffering as emerging data strongly suggest.\(^1^-^3\) In Nigeria, practical difficulties are often associated with an individual's efforts to maintain glucose control. The consideration of these obstacles prompted us to determine the extent to which blood pressure (BP) control could be enhanced by modifying factors related to the provision of health care, which may influence this therapeutic endpoint in our patient population where diabetes and hypertension often coexist.\(^6^-^7\)

METHOD

Location and Patients

As described elsewhere,\(^8^-^9\) the site for this study was an outpatient specialist facility which serves as a tertiary referral center for 6 adjoining states. The facility is affiliated with the medical school at the University of Ilorin Teaching Hospital. The federal government provides health-care services to the public at a subsidy; however, consumers pay directly for consultation, laboratory tests, prescriptions, and other incidentals.

Individuals with established diabetes mellitus, who were regularly attending the clinic for at least 6 months, were asked to volunteer to participate in our study. The survey was carried out between April and December 1999 in accordance with the methods of Kumwanda et al.\(^10\) Trained research assistants completed a questionnaire for each patient. Participants were questioned about date of diagnosis of diabetes, utilization of anti-diabetic therapy, presence or absence of hypertension, date of diagnosis of high blood pressure (HBP), and prescribed treatment. The regularity of patient’s attendance at the clinic and other such information were corroborated using patient’s appointment hand-card entries and their medical records. In subjects who did not know the exact date of their birth, age estimation was approximated by utilizing an event calendar.\(^11^-^12\) Some individuals could not recall the names and doses of their prescribed medications, the appropriate information was extracted for these individuals from the patient’s hospital record. Participants who could not be helped using this method were encouraged to bring along their medications at the next clinic visit for identification. Patient’s weight and height were measured as described previously.\(^11^-^12\) Blood pressure (BP) was measured in triplicate using mercury sphygmomanometer after a 5-minute rest in the sitting position as detailed elsewhere.\(^9^-^13\) The mean of the 3 readings was taken as the BP of the subject, provided the variations between consecutive readings were no more than 6 mm Hg. For the purpose of this study, Korotkoff phase V was taken as diastolic BP. The definition of hypertension adopted for this study included treated hypertensive individuals, those individuals with a history of HBP, who were currently on prescribed antihypertensive medication. Individuals with a clinic sitting systolic blood pressure (SBP) of \(\geq 140\) mm Hg and/or a diastolic blood pressure (DBP) of \(\geq 90\) mm Hg who were not aware of their hypertensive status, were also included in the study.

Data were analyzed using table of frequency and differences were examined using \(t\) statistics. The distribution of FBG as a measure of diabetic control was evaluated using chi-square test for homogeneity. Test of association be-
In Nigeria, practical difficulties are often associated with an individual’s efforts to maintain glucose control.

between FBG and the presence (or absence) of hypertension was assessed using chi-square analysis. Differences were considered significant when \( P < .05 \), except as otherwise indicated. For each variable considered, missing values were excluded from analysis. This accounts for the variation in the sample size represented as indicated in the Results section.

RESULTS

The study involved 244 adults (85 males) aged 17–84 years with a mean duration of diabetes of 7.9 years and a body mass index (BMI) of 25.6 kg/m².

One hundred fifty-two participants were hypertensive and 75.6% (115) were on prescribed medications, while the remaining 37 were unaware of their elevated blood pressure status. In this latter category, 23 had mild elevation of SBP (mm Hg) and DBP (mm Hg), while 9 fell into the category of moderate, while 5 had severe blood pressure elevations according to WHO/ISH criteria adopted by the Nigerian Hypertension Society.

The hypertensive subjects with diabetes were older and heavier (Table 1); but, the duration of diabetes in the 2 groups were similar. Among the treated hypertensives (\( N = 115 \)), the mean durations of diabetes and hypertension were similar \( (P = .69) \), equating to 8.7 and 8.4 years respectively. Despite a similar duration of diabetes (Table 1), the mean FBG was significantly lower in the hypertensive sub-population. However, BP status had no significant effect \( (\chi^2 = 4.4, df = 2, P = .10) \) on the degree of glycemic control observed. Thirteen of the 115 treated hypertensives (ie, 11.3%) had BP readings below 140/90 mm Hg. The mean duration of HBP in this subgroup \( (13) \) was 6.1 years. This number was not statistically different \( (P = .30) \) from a mean of 8.3 years for the subset of those subjects with diabetes and HBP who were on prescribed antihypertensive drugs, but whose BP was higher than 140/90 mm Hg.

Table 2 shows that nifedipine was the most frequently prescribed medication, followed distantly by \( \alpha \)-methyl dopa and the ACEIs of captopril and lisinopril, which constitute about 11% of all prescriptions. Ten percent of treated hypertensives received a prescription for moduretic or bendrofluzide; and another 15.6% were given fixed-drug combination tablets that contain a thiazide as one of its constituents (Table 2). Most of the medications were prescribed at doses much lower than the maximum daily dose recommended. Twenty-one patients were on more than one individual antihypertensive medication, with nifedipine and captopril combination being the most frequently \( (N = 7) \) prescribed. The 13 hypertensive subjects described above with BP readings below 140/90 mm Hg were on the following antihypertensive prescription: Moduretic (1), Brinerdin (2), Bendrofluzide (1), Nifedipine (2), Aldomet (1), Regroton (2), Brinerdin + Aldomet (1), Minizide (1) and traditional herb (extract of Nuclea latifolia tree) (1).

Thiazide or thiazide-containing fixed-drug combinations constituted the largest category in the group (ie, 8 out of 13). The data in Table 2 also show that the unit cost of purchase was lowest for the diuretic category of moduretic, bendrofluzide and furosemide compared to the other class of drugs.

The pattern of anti-diabetic therapy observed was: diet (28), glibenclamide (81), chlorpropamide (36), glibenclamide + metformin (38), chlorpropamide + metformin (17), insulin (39), metformin (6), insulin + metformin (8) and traditional herb (1).

Therefore, diet alone was the sole anti-diabetic therapy prescribed for 11.5% of the patients. Forty-seven individuals were on insulin in the form of Lente. Subjects receiving Lente were significantly younger, were of smaller mean body mass index and had overall poorer diabetic control, compared to their

### Table 1. Distribution of selected variables by blood pressure classification

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Hypertensives</th>
<th>Normotensives</th>
<th>t value</th>
<th>SED</th>
<th>DOM</th>
<th>95% Confidence Interval for Difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50.2 (92)</td>
<td>58.2 (150)</td>
<td>8.0</td>
<td>2.0</td>
<td>4.1</td>
<td></td>
<td>-11.9 to -4.1</td>
<td>( P &lt; .001 )*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.7 (90)</td>
<td>26.1 (151)</td>
<td>1.4</td>
<td>0.7</td>
<td>2.1</td>
<td></td>
<td>-2.8 to -0.1</td>
<td>( P = .04 )*</td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td>117.4 (92)</td>
<td>166.9 (152)</td>
<td>49.5</td>
<td>8.4</td>
<td>5.9</td>
<td></td>
<td>-66.1 to -32.9</td>
<td>( P &lt; .001 )*</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>75.5 (92)</td>
<td>92.2 (152)</td>
<td>16.7</td>
<td>1.7</td>
<td>9.6</td>
<td></td>
<td>-20.2 to -13.3</td>
<td>( P &lt; .001 )*</td>
</tr>
<tr>
<td>FBG at diagnosis</td>
<td>13.8 (60)</td>
<td>12.2 (60)</td>
<td>1.6</td>
<td>0.8</td>
<td>2.0</td>
<td></td>
<td>-0.2 to -3.1</td>
<td>( P = .05 )</td>
</tr>
<tr>
<td>FBG at assessment</td>
<td>9.3 (92)</td>
<td>8.0 (152)</td>
<td>1.2</td>
<td>0.6</td>
<td>2.1</td>
<td></td>
<td>-0.1 to -2.4</td>
<td>( P = .03 )*</td>
</tr>
</tbody>
</table>

Number in parentheses indicates sample size.

DOM = difference of means; SED = standard error of difference of means.

* Statistical significance at P value of means.
Table 2. Frequency of individual antihypertensive medications prescribed as at the time of evaluation

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Number</th>
<th>Most Frequent Dose Prescribed</th>
<th>Recommended Maximum Daily Dose</th>
<th>*Unit Price of Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nifedipine (N)</td>
<td>51</td>
<td>20 mg</td>
<td>80 mg</td>
<td>N10 per 20 mg tab</td>
</tr>
<tr>
<td>2. Methyldopa (A)</td>
<td>18</td>
<td>500 mg</td>
<td>3000 mg</td>
<td>N25 per 250 mg tablet</td>
</tr>
<tr>
<td>3. Captopril (C)</td>
<td>10</td>
<td>37.5 mg</td>
<td>150 mg</td>
<td>N10 per 25 mg tablet</td>
</tr>
<tr>
<td>4. Lisinopril (L)</td>
<td>3</td>
<td>5 mg</td>
<td>80 mg</td>
<td>N35 per 5 mg tablet</td>
</tr>
<tr>
<td>5. Regroton (R)</td>
<td>6</td>
<td>one tablet</td>
<td>1 tablet</td>
<td>N20 per tablet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(50 mg chlorthalidone + 0.25 mg reserpine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Brinerdin (Br)</td>
<td>9</td>
<td>one tablet</td>
<td>3 tablets</td>
<td>N20 per tablet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5 mg clopamide + 0.1 mg reserpine + 0.5 mg dihydroergo cristine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Minizide (Mn)</td>
<td>3</td>
<td>one tablet</td>
<td>16 tablets</td>
<td>N16 per tablet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.5 mg prazosin HCl + 0.25 mg polythiazide)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Moduretic (M)</td>
<td>8</td>
<td>one tablet</td>
<td>4 tablets</td>
<td>N5 per tablet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5 mg amiloride HCl + 50 mg hydrochlorothiazide)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Bendrofluazide (B)</td>
<td>3</td>
<td>2.5 mg</td>
<td>5 mg</td>
<td>N2 per 5 mg tablet</td>
</tr>
<tr>
<td>10. Amlodipine (AM)</td>
<td>1</td>
<td>5 mg</td>
<td>10 mg</td>
<td>N90 per 5 mg tablet</td>
</tr>
<tr>
<td>11. Furosemide (Fr)</td>
<td>1</td>
<td>80 mg</td>
<td>40 mg</td>
<td>N2 per 40 mg tablet</td>
</tr>
<tr>
<td>12. Bromazepam (Bro)</td>
<td>1</td>
<td>3 mg</td>
<td>18 mg</td>
<td>N15 per 3 mg tablet</td>
</tr>
<tr>
<td>13. Traditional herb</td>
<td>1</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(extract of Nuclea lati folia tree)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Quoted prices as at April 4, 2000 at the Teaching Hospital Pharmacy.
† Upper limit of dose in hypertension.
Average family size=6.
Cost of taxi ride=N10–N20 per drop.

control counters on other forms of anti-diabetic therapy. The mean levels of BP in the 2 subsets were similar.

**DISCUSSION**

This study shows that 63% of individuals with diabetes also had elevated BP. These findings are similar to a recent report showing that 66% of Cameroonian persons with diabetes also had elevated BP.14 The current study and those of the Cameroonian study are different from 2 earlier studies,6,7 which reported a hypertension prevalence rate of 38.2% and 30% in persons with diabetes. However, both of these earlier studies conducted nearly a decade ago, either used higher cut-off points or did not define the BP criteria for hypertension; thus, they are not comparable.

Incidentally, 24% of the hypertensive subjects with diabetes were unaware of their BP status. Specifically, 21 of these 37 individuals had HBP rates that were either moderate or severe in intensity. This finding cannot be explained solely on the basis of lack of access to care and suggests an area for improvement.

Significantly, only 11% of treated hypertensive individuals with diabetes had BP controlled to below 140/90 mm Hg. The pattern of prescription summarized in Table 2 appears to contribute in a major way to these observations for a number of reasons. Thiazides were prescribed less often when compared to the other classes of antihypertensives, which are newer and often more expensive (Table 2). This prescription pattern probably reflects existing concern that thiazides could adversely affect diabetic control in Nigerians.15,16 However, the data in Table 1 showed a similar control of diabetes in both hypertensives and normotensives, as previously reported by Okesina et al from this center.6 This finding is reassuring and reinforces data from controlled studies in Nigeria8,17 and elsewhere4,5,18 which are affirmative about the efficacy and safety of low-dose thiazides in the treatment of hypertension in diabetes, as well as in non-diabetics. Furthermore, these findings clearly demonstrate that thiazides are neither precluded or contraindicated in diabetes. Since thiazides are the least expensive (Table 2) therapy and Nigerians are relatively resistant to the antihyper-
tensive effects of ACEIs, α-blockers and β-blockers,19–23 it follows that thiazides should be the preferred initial antihypertensives given that cost of drugs is the single major obstacle to effective control of diabetes and hypertension in Nigeria.7,8,24–25 Unfortunately, the prescription pattern of antihypertensive therapy evident in Table 2 does not appear sensitive to affordability concerns experienced by those persons needing medication therapy. Available local data on comparative efficacy was also recently observed in another region of the country.26 This observation is of some importance as our healthcare system requires that 98% of cost of care is directly borne by patients in out-of-pocket expenses without reimbursement. Inability to afford prescribed drugs is the major reason cited by individuals for not taking their antihypertensive medicines as prescribed.27,28 Due to these concerns, it is not uncommon for such individuals in our care to seek and use traditional herbs that are cheaper even if they are of dubious efficacy (Table 2).29

In summary, this study shows that control of BP to below 140/90 was not common and the use of thiazides in the management of hypertension in this cohort study focusing on subjects with diabetes occurred even less frequently. The results also strongly suggest that the problem of sub-optimal control of blood pressure involved inappropriate prescription and misplaced emphasis. Fortunately, the data also show that thiazides were associated with better control of BP at a cost that was affordable without jeopardizing diabetic control.

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**AUTHOR CONTRIBUTIONS**

*Design and concept of study*: Okoro, Oyejola

*Data analysis and interpretation*: Okoro, Oyejola

*Manuscript draft*: Okoro

*Statistical expertise*: Oyejola

*Administrative, technical, or material assistance*: Okoro