Control of Hypertension at the Diabetic Outpatient Clinic of a National Referral Hospital, Uganda: A Cross Sectional Study

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Abstract

Background: Non-Communicable Diseases (NCD's) are globally becoming an epidemiological crisis because their burden continues to rise although they disproportionately affect the developing world especially the sub-Sahara African region. NCD's are the leading cause of deaths and disability worldwide where about 46% of deaths in sub-Saharan Africa may be attributed to NCD's by 2030. Hypertension (HT) and Diabetes Mellitus (DM) are the NCD's of particular concern whose coexistence is a major contributor to the development and progression of macrovascular and microvascular complications.

HT is prevalent in 20%-60% of diabetics but conversely about 15% of hypertensive patients have concomitant diabetes and have an increased risk of developing diabetes than non-hypertensives, independent of any specific treatment. Hypertension is a major risk factor for mortality and CVD with 75% of cardiovascular disease in diabetic patients attributed to hypertension. Cardiovascular Disease (CVD) especially stroke accounts for almost 80% of deaths in diabetics but three-quarters of these occur in sub-Saharan Africa. Hypertension is among the most prevalent, modifiable cardiac risk factors for macrovascular disease in diabetic adults and therefore represents the most preventable cause of morbidity and premature mortality. Blood pressure control improves patient outcomes and reduces health care costs but is difficult within diabetics.

We aimed to estimate the prevalence of hypertension, explore hypertension control and investigate factors associated with poor hypertension control among patients attending the diabetic outpatient clinic at the national referral hospital in Uganda.

Methods: A cross-sectional study was conducted among 319 adult consenting patients attending the diabetic clinic of Mulago National Referral Hospital in Uganda between august and october 2018. Data was collected through interviewer administered questions using a standard pre tested questionnaire by trained staff.

Bivariate and multivariate logistic regression was performed to explore the association between factors and control of hypertension. The level of statistical significance was set at 95% confidence interval.

Results: Prevalence of hypertension noted was 88.09%, 25.27% were newly diagnosed with hypertension at the time of study data collection. Among those previously diagnosed/aware of their hypertension status, 130/210 (61.90%) were on hypertension treatment, 82% had their HT well controlled; 127 (60.48%) were on ACE and/or ARB. TG was independently associated with hypertension control in the multivariate analysis model (P=0.048).

Keywords: Hypertension prevalence; Hypertension control; Diabetes mellitus; Cross-sectional study

Abbreviations

ABI: Ankle Brachial Index; ACE inhibitors: Angiotensin Converting Enzyme inhibitors; BMI: Body Mass Index; BP: Blood Pressure; CAD: Coronary artery disease; CHD: Coronary heart disease; DBP: Diastolic Blood Pressure; HBAIC: Glycosylated Haemoglobin/haemoglobinA1c; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; PAD: Peripheral Artery Disease; SBP: Systolic Blood Pressure; WHC: Waist Hip Circumference Ratio

Introduction

Non-Communicable Diseases (NCD's) have become a global epidemiological crisis due to their escalating burden and they disproportionately affect the developing world especially the sub-Sahara African region. NCD's are worldwide the leading cause of deaths and disability with an estimate of 46% of deaths in sub-Saharan Africa attributed to them by 2030 compared to

about 28% in 2008. Demographic shifts such as increasing urbanization with associated lifestyle changes, changes in case ascertainment and diagnostic criteria, as well as improvements in life expectancy have contributed to a surge in NCD's. Hypertension (HT) and Diabetes Mellitus (DM) are the NCD's of particular concern in this epidemiological transition however, their precise epidemiological data are rare. In 2011, 366 million people were estimated with DM but projected to increase to 552 million by 2030 and there were about 422 million Diabetic adults world-wide in 2014. There is a global projection that diabetic adults will rise from 135 million in 1995 to 300 million in the year 2025 although most of this numerical increase will occur in developing countries. There will be more than 125 million Hypertensive adults in sub-Saharan Africa alone by 2025 which is the most experienced and reported NCD globally; in Uganda it is the most reported [1].

Research suggests that a strong association between hypertension and diabetes with the two often coexisting. HT is prevalent in 20%-60% of diabetics which is almost twice the frequency of hypertension in diabetic population as compared to age and gender-matched non-diabetic general population, but may range between 32% and 82% [2]. Hypertensives are more at risk of developing diabetes than non-hypertensives, independent of any specific treatment, about 15% of hypertensive patients have concomitant diabetes. Hypertension and diabetes mellitus have a complex cause-effect relationship, which is hypothesized [3].

The coexistence of hypertension and type 2 diabetes has supplementary effects and is a major contributor to the development and progression of macrovascular and microvascular complications which are often premature ones in diabetics compared to the general population [4]. The high burden of comorbid HT in diabetics together with an improvement in life expectancy in sub-Saharan Africa in the past 50 years results into complications and to experiencing the clinical syndromes of CVD since patients are exposed to hypertension risks for long periods. The presence of hypertension causes a 7.2-fold increase and a 37-fold increase in mortality in diabetic patients and indeed hypertension is the leading risk factor for mortality worldwide. Type 2 Diabetes Mellitus (DM) is a major cause of morbidity and death, primarily through its micro-vascular and macro-vascular complications [5].

Hypertension is a major risk factor for cardiac abnormalities, Cardiovascular Disease (CVD), stroke, myocardial infarction and ischaemic heart disease. Furthermore, up to 75% of cardiovascular disease in diabetics can be attributed to hypertension which further contributes to the overall morbidity and mortality of an already high risk population. CVD, especially stroke, accounts for up to 80% of all deaths in the diabetics and three-quarters of these deaths occur in sub-Saharan Africa [6]. Additionally, hypertension is a major causal factor of end-stage kidney failure, blindness and non-traumatic amputation in people with diabetes, where attributable risks are 50, 35 and 35% respectively. Diabetic Hypertensives are more likely to die when they develop complications. adequate hypertension control in diabetic hypertensives reduces the complication risks and is achieved through accurate, prompt and proper treatment

although control of hypertension is difficult within diabetic patients [7].

Hypertension is among the most prevalent and modifiable cardiac risk factors for macro-vascular disease in adults with diabetes mellitus and therefore represents one of the most preventable causes of morbidity and premature mortality in developed as well as developing countries. Aggressive control of Blood Pressure (BP) improves patient outcomes and reduces health care costs but management of diabetic hypertensives also involves a multifactorial approach including lifestyle changes like dietary modifications, weight reduction, glycemic control, lipid management, increased physical activity, reduction in salt intake, tobacco cessation, appropriate sleep hygiene that are also known to improve metabolic health and reduce blood pressure however pharmacological interventions are frequently required to achieve optimal blood pressure goals in order to reduce mortality and cardiovascular events. All available treatment guidelines for these comorbidities from several professional societies also recommend achievement of similar goals in diabetics [8]. The National Kidney Foundation (NKF) hypertension and diabetes executive committees working group recommend lower blood pressure goals for Diabetics than for the general population. The most recent guidelines from the ADA and NKF recommend that blood pressure be decreased to less than 130/80 mm Hg, with an optimal target of below 120/80 mm Hg, especially in patients with proteinuria or renal insufficiency. The incidence of clinical complications among diabetics except for cataract extraction is significantly associated with systolic blood pressure and the lower the systolic blood pressure, the lower the risk of complications; each 10 mmHg decrease in mean systolic blood pressure is associated with risk reductions of 12% for any complication related to diabetes, 15% for deaths related to diabetes, 11% for myocardial infarction and 13% for microvascular complications [9].

Achieving the target BP of <130/85 mm Hg is the priority rather than the drug combination used in order to arrest and prevent the progression of complications in diabetic hypertensives. Regardless of the agents selected, a reduction in blood pressure helps to prevent and reduce diabetic complications with the lowest risk being in those with systolic blood pressure less than 120 mmHg [10]. In diabetic hypertensives, Angiotensin Converting Enzyme Inhibitors (ACEI's) are the first line in management of hypertension but can be replaced by Angiotensin II Receptor Blockers (ARB's) if patients are intolerant of them. There is an additional risk reduction with angiotensin converting enzyme inhibitors and β-blockers over and above that associated with lowering of blood pressure and adding both these agents may have beneficial effects on proteinuria. ACEI's may provide additional benefits in patients with diabetes because they have also been shown to increase insulin sensitivity, β-blockers have been shown to reduce cardiovascular risk. In addition to lowering BP, it has been suggested that ARB's reduce albuminuria which is a risk factor for progression to kidney disease and a surrogate marker for renal damage [11].

Unfortunately in sub-Saharan Africa awareness about the growing problem of NCD's is low. In this study group, there is

undiagnosed hypertension evidenced by the newly diagnosed who didn't know that they had hypertension. Blood pressure control is poor among those on antihypertensive treatment and there is untreated disease among those with hypertension knowledge showing that the level of knowledge of the dangers of untreated hypertension in this population is low [12]. Undiagnosed, untreated and inadequate hypertension controls are significant risks of morbidity, complications and mortality for diabetic hypertensive patients. In addition to these issues the current guidelines for prevention and management of diabetes with hypertension in Uganda needs to be updated. There is therefore still need to explore hypertension control and associated factors among diabetics in Uganda [13].

Objectives

To estimate the prevalence of hypertension, explore the control of hypertension and investigate factors associated with poor control of hypertension among patients attending the diabetic outpatient clinic at Mulago national referral hospital in Uganda.

The findings will contribute to the guidelines on management of Diabetes Mellitus (DM) and hypertension in sub-Saharan Africa.

Methodology

This was a cross-sectional study that involved diabetic patients seeking care at the diabetic outpatient clinic of Mulago National Referral Hospital in Kampala, Uganda.

The duration of the study was 3 months between August and October 2018. Patients that presented to this clinic during the study period were enrolled after consenting in writing for study participation according to the inclusion criteria, but critically ill patients, newly diagnosed diabetes, those living more than 20 km from the clinic were excluded from the study. Enrolment was totally free and voluntary; participants were free to withdraw from the study at any time without any consequences to their future care at the clinic [14-17]. Approval to carry out the study was obtained from the ethics committee of the Uganda National Council of science and Technology, the School of Medicine research ethics committee of Makerere University College of Health Sciences.

Using a systematic sampling technique 319 study participants were recruited on the day that they came for their routine visits [18].

A predesigned, pre-tested structured questionnaire was used to collect information of study patients by trained health personnel on socio-demographic characteristics (age, gender, educational status, monthly income) physical activity which was involvement in physical exercises and the weekly exercises in hours, history about the duration of diabetes, family history of diabetes and Hypertension, drug history was taken. Body weight was measured using a weighing scale and was recorded to the nearest kilogram, height was measured in metres using a tape. All study subjects had their Blood Pressure (BP) measured using a sphygmomanometer in the right arm of the patient in sitting position [19,20].

The waist and hip circumference was recorded; BMI and the ABI were calculated; Body Mass Index (BMI) was obtained by dividing the weight in kilograms by the square of the height in meters. Blood Samples were taken for measurement of Random Blood sugar, HBAIC, HIV status, LDL, HDL, total glycerides and cholesterol. HbA 1c was measured using the mindray BS120 chemistry analyzer 2013-2006 by shenzhen mindray bio medical electronics Co [21].

Age was categorized as below and above 45 years, and educational status which was the highest level of education that the patient attained and reported during the interview was categorized as informal, formal, physical activity was a patients' involvement in exercise and weekly exercises in hours was categorized as less or more than 4 hours per week while income was categorized as less or greater than 80 USD. BMI was classified into two categories (<25 and ≥ 25) with the normal as <25 kg/m^2 and abnormal if >25 kg/m^2. ABI was categorized into two categories as normal <1, abnormal if >1 [22].

Hypertension was defined as present if subjects had either a history of hypertension and/or evidence of hypertension (blood pressure ≥ 130/85 mmHg) [23,24].

Hypertension control was defined at a cut-off of Systolic Blood Pressure (SBP) 130 and/or Diastolic Blood Pressure (DBP) 85 mm of Hg among the patients that were aware of their hypertension status. Diabetic patients with previously diagnosed hypertension were considered to have uncontrolled hypertension if patients were on antihypertensive medications and the Systolic Blood Pressure (SBP) greater than or equal to 130 mm Hg and/or Diastolic Blood Pressure (DBP) greater than or equal to 85 mm Hg [25-28].

Data analysis

The data generated was entered, cleaned using epidata and analyzed using Stata statistical package: The patients' records/ information was anonymised and de-identified prior to analysis.

Quantitative and qualitative statistical variables were cross-tabulated; Bivariate and multivariate logistic regression was performed to explore the independent effect of factors and control of hypertension. All factors with p-value less than 0.2 in the bivariate model were entered into the multivariate model. Multivariate Logistic regression was performed where variables with a p-value less than 0.05 were considered as statistically significant predictors of hypertension. The level of statistical significance was set at 95% confidence interval [29,30].

Sample size estimation

The minimum required sample size was calculated to be 319 for this study using a sample size formula by Kish Leslie for cross-sectional studies.

N=Z2 PQ/e2, Z=1.96

Where N=sample size estimate of adults with diabetes mellitus.

P=assumed true population disease prevalence, P=29.4%.

Q=the probability of not having DM=1-P=70.6%.

Z=Standard normal deviate at 95% confidence interval corresponding to 1.96.

e=precision=Absolute error between the estimated and true population disease prevalence of 5%.

The calculated sample size N=1.96 × 1.96 (0.294 × 0.706)/0.05²=319.

Results

The study involved 319 participating patients who were predominantly female, 212 (66.46%) with their age range of 20 to 77 years with a mean age of 51.1 years [31-35].

99 (31.03%) patients were below 45 years old, 181 (56.74%) had informal education, 138 (43.26) had formal education up to tertiary level (**Table 1**).

Variable	N (%)
Age	
below 45	99 (31.03)
above 45	220 (68.97)
Education	
Informal education	181 (56.74)
Formal education	138 (43.26
Gender	
Male	107 (33.54)
Female	212 (66.46)
Income (dollars)	
Below $ 80	200 (62.70)
above $ 80	119 (37.30)
HIV	
Negative	291 (91.22)
Positive	28 (8.78)
History of HT	
Non-Hypertensive	109 (34.17)
Hypertensive	210 (65.85)
HBAIC	
Poor control	195 (61.13)

Good control	124 (38.87)
Duration of DM	
Below 10 yrs	189 (59.25)
Above 10 yrs	130 (40.75)
WHC ratio	
Abnormal	50 (15.67)
Normal	269 (84.33)
SBP	
Below 130	91 (28.53)
Above 130	228 (71.47)
DBP	
Below 85	146 (45.77)
Above 85	173 (54.23)
BMI	
Abnormal	186 (58.31)
Normal	133 (41.69)
ABI	
Abnormal	29 (9.09)
Normal	290 (90.91)
Family history of DM	
No	127 (39.81)
Yes	192 (60.19)
Family history of HT	
No	116 (36.36)
Yes	203 (63.64)
HDL	
Below 1.1	23 (7.21)
Above 1.1	296 (92.79)
LDL	
Below 2.6 (51.72)	165
Above 2.6	154

| (48.28)	
TCHOL	
Below 5.2	134 (42.01)
Above 5.2	185 (57.99)
TG	
Below 2.3	215 (67.40)
Above 2.3	104 (32.60)
Weekly exercises	
Less than 4hrs	127 (40.58)
More than 4hrs	186 (59.42)
History of exercising	
No	63 (19.75)
Yes	256 (80.25)
History of smoking	
No	295 (92.48)
Yes	24 (7.52)

Table 1: Study population characteristics. Note: ABI: Ankle Brachial Index; BMI: Body Mass Index; DBP: Diastolic Blood Pressure; HBAIC: Glycosylated Haemoglobin/haemoglobinA1c; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; SBP: Systolic Blood Pressure; WHC: Waist Hip Circumference Ratio; TCHOL: Total cholesterol; TG: Triglyceride; DM: Diabetes mellitus; HT: Hypertension.

130 (40.75) had been suffering from diabetes for a period greater than 10 years. 195 (61.13%), had poor glycemic control, more than 50%, 186 (58.31%) of study participants had an abnormal BMI and 203 (63.64%) had a family history of hypertension (**Table 1**).

The prevalence of hypertension noted was 281/319 (88.09%)(**Figure 1**).

Figure 1: Distribution of hypertension among the study group. ■ Non-Hypertensive 12% Hypertensive 88% ■
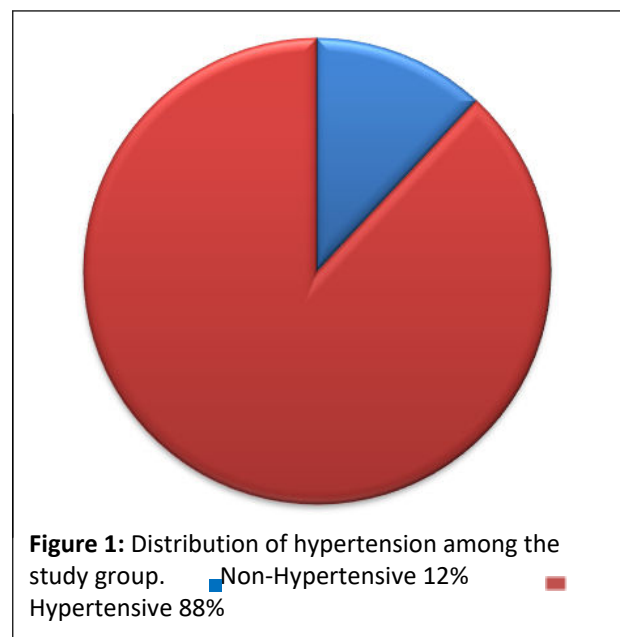
There were 186 (66.19%) females and 95 (33.81) males among those with Hypertension (**Figure 2**).

Figure 2: Hypertension status by gender.

■ Male 66% ■ Female 34%.
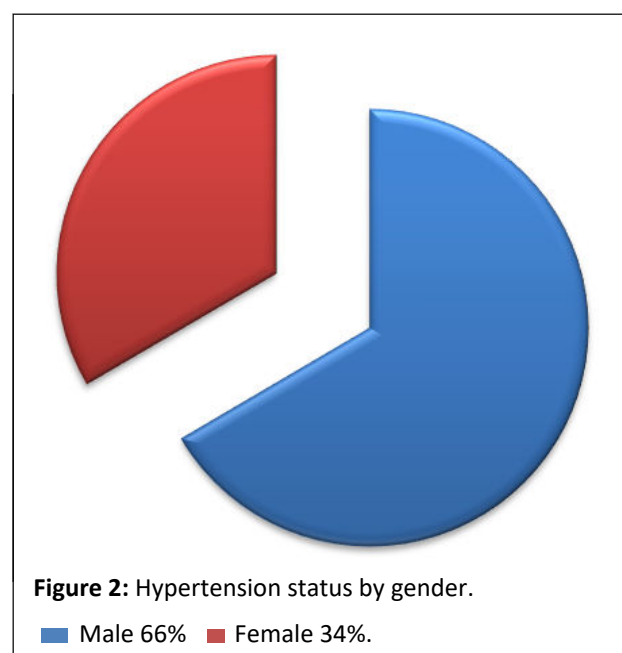
Among those who were Hypertensive, 71/281 (25.27%) were not aware of having hypertension at the time of the study from the history but were newly diagnosed with hypertension during study data collection. Among the patients that were aware of their hypertension status, 130/210 (61.90%) were on hypertension treatment [36].

In Table 2, we present the study population characteristics among those with known Hypertension status that were on treatment (**Table 2**).

Variable	Poorly controlled	Well controlled	p-value
Age			
below 45	9 (24.32)	25 (14.45)	0.139
above 45	28 (75.68)	148 (85.55)	
Education			
Informal education	21 (56.76)	111 (64.16)	0.397
Formal education	16 (43.24)	62 (35.84)	
Gender			
Male	19 (51.35)	50 (28.90)	0.008
Female	18 (48.65)	123 (71.10)	
Duration of DM			
Below 10 yrs	18 (48.65)	96 (55.49)	0.448
Above 10 yrs	19 (51.35)	77 (44.51)	
HIV			
Negative	34 (91.89)	157 (90.75)	0.826
Positive	3 (8.11)	16 (9.25)	
HBAIC			
Abnormal	22 (59.46)	99 (57.23)	0.803
Normal	15 (40.54)	74 (42.77)	
WHC ratio			
Abnormal	9 (24.32)	27 (15.61)	0.202
Normal	28 (75.68)	146 (84.39)	
Family history of HT			
No	15 (40.54)	63 (36.42)	0.637
Yes	22 (59.46)	110 (63.58)	
Family history of DM			
No	15 (40.54)	74 (42.77)	0.803
Yes	22 (589.46)	99 (57.23)	
BMI (kg/m²)			
Abnormal	21 (56.76)	113 (64.20)	0.394
Normal	16 (43.24)	63 (3.80)	
ABI			
Abnormal	0 (0.00)	20 (11.56)	0.03
Normal	37 (100)	153 (88.44)	
LDL			
Below 2.6	25 (67.57)	89 (51.45)	0.074
Above 2.6	12 (32.43)	84 (48.55)	
HDL			
Below 1.1	3 (8.11)	10 (5.78)	0.594
Above 1.1	34 (91.89)	163 (94.22)	
TG			
Below 2.3	28 (75.68)	105 (60.69)	0.086
Above 2.3	9 (24.32)	68 (39.31)	
TCHOL			
Below 5.2	19 (51.35)	73 (42.20)	0.308
Above 5.2	18 (48.65)	100 (57.80)	
ACE/ARB use			
No	19 (51.35)	64 (36.99)	0.105
Yes	18 (48.65	109 (63.01)	
History of exercising			
No	3 (8.11)	27 (15.61)	0.237
Yes	34 (91.89)	146 (84.39)	
Weekly exercises in hours			
Less than 4	13 (35.14)	65 (37.57)	0.781
More than 4	24 (64.86)	108 (62.43)	
History of smoking			
No	34 (91.89)	164 (94.80)	0.489
Yes	3 (8.11)	9 (5.20)	

Table 2: Socio-Demographic characteristics by hypertension control among those with known history of status of hypertension. Note: ABI: Ankle Brachial Index; BMI: Body Mass Index; HBAIC: Glycosylated Haemoglobin/haemoglobinA1c; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; WHC: Waist Hip Circumference Ratio; TCHOL: Total cholesterol; TG: Triglyceride; DM: Diabetes mellitus; HT: Hypertension; ACE inhibitors: Angiotensin Converting Enzyme inhibitors; HIV: Human immunodeficiency virus.

Among the patients with knowledge of Hypertension, 173/210 (82.38%) had their hypertension controlled. Good HT control was defined as a SBP less than 130 mm Hg and/or DBP less than 85 mm Hg among those on antihypertensive medication [37-39]. Use of either ARB or ACE was 60.48% among those who were aware of their Hypertension status.

Table 3 shows the relationship between HT control and predictive factors and only includes variables from bivariate analysis that had a significance at $p<0.2$. The following variables, Age, Gender, ACE/ARB use, WHC ratio, ABI, LDL and TG were associated with hypertension control in the bivariate model analysis and were the factors that were taken into the multivariate regression analysis.

Hypertension Control		
Test statistic		
Variables	**P<(Z)**	**95% conf. Interval**
ACE/ARB use	0.207	-1.55
Age	0.159	-1.87
Gender	0.144	(-1.71)-(0.25)
WHC ratio	0.986	-2.28
LDL	0.979	(-0.30)-(0.30)
TG	0.048	(0.01)-(0.97)

Table 3: Multivariate logistic regression analyses of factors associated with poor Hypertensive control in DM patients at the national referral hospital diabetic outpatient clinic, august to october 2018. Note: LDL: Low-Density Lipoprotein; WHC: Waist Hip Circumference Ratio; TG: Triglyceride; ACE inhibitors: Angiotensin Converting Enzyme inhibitors.

However TG was the only independent factor that showed significant association at $p=0.048$ with BP control in the multivariate model.

Discussion

Our study found that hypertension is a prevalent 88.09% co-morbidity among diabetic patients at the specialized outpatient clinic of Mulago National Referral hospital which is in agreement with the statement that hypertension is a common problem for people with diabetes. Hypertension occurs more commonly in diabetics than in comparable non-diabetics [40,41]. This is in keeping with earlier studies, which found that the prevalence of hypertension in patients with diabetes was approximately two-fold higher than in age-matched subjects without the disease and conversely, individuals with hypertension were at increased risk of developing diabetes compared with normotensive persons. This may be because both hypertension and DM patients have similar profiles. Previous observations suggest that demographic transition, urbanization and increasing life

expectancy are major determinants of prevalence of hypertension among diabetics [42].

The rate of hypertension among diabetics in our study is comparable to the reported prevalence of hypertension in other studies in other populations, 74%, 74.4% and 73% rates of hypertension reported in UK Caucasians, Italian, and Spanish populations, respectively [43-47]. It is higher than the 82% prevalence rate reported about Afro-Caribbean individuals living in UK and much higher than the 32% and 39% rates reported among diabetics in the Turkish and Taiwanese populations, respectively. The prevalence of hypertension in a study among newly diagnosed diabetics was (62%) more than six patients out of 10 having hypertension. The rate reported is comparable in Arab populations of 64.5% and 72.4% reported in Qatari diabetics and Jordanian diabetics respectively but is however higher in other Arab populations of 53% in Saudi, 44% in Omani diabetics and 38% in Bahraini diabetics [48-55].

Unfortunately 71/281 (25.27%) of all those who are hypertensive in this study were not aware of having hypertension from the history but were newly diagnosed during the study and 210 (74.73%) knew their status. This is evident from other studies in the region, which found that the majority of patients with hypertension in sub-Saharan Africa did not know they were hypertensive and very few were on treatment, yet hypertension is the leading cause of stroke in Africa [56-60].

In another cross-sectional study in Uganda, awareness of hypertension was low, less than 30%. Furthermore, among those who knew they had hypertension, 130 (61.90%) were on treatment for hypertension [61-63]. This reflects the low level of knowledge of the dangers of untreated hypertension. In this population but carries a great risk for the complications of diabetes, especially CVDs such as stroke, LVH, myocardial infarction, as reported by the United Kingdom Prospective Diabetes Study (UKPDS) [64]. There is an additional risk reduction with Angiotensin Converting Enzyme inhibitors (ACE inhibitors) and β-blockers over and above that associated with lowering of blood pressure [65-70].

The results of this study also show that HT control is not adequate in this diabetic study population, 173/210 (82.38%) had their hypertension controlled. This finding is consistent with what other studies that reported a proportion of hypertensive patients with DM with inadequate control of BP [71].

Patient factors contribute to poor blood pressure control through non adherence to medications and follow-up visits. Health care costs may reduce adherence by some patients. Inadequate patient knowledge about hypertension and CVD risk is likely to be an additional contributor [72,73]. In a 2002 survey, nearly two-thirds of people with diabetes did not consider CVD to be a common complication of diabetes, more than half did not consider themselves personally at risk for CVD and only 5% recognized that reducing blood pressure could lower CVD risk. Blood pressure control is the lynchpin of cardiovascular risk reduction, its optimal control may be even more important in diabetic patients, yet, copious research demonstrates that a high proportion of hypertensive patients do not achieve blood pressure control that conforms to current recommendations.

There was suboptimal control in the majority, >70%, of non-diabetic and diabetic patients even in the context of high (91%) adherence to prescribed regimens, less than 10% in a cross-sectional study and in another retrospective study conducted in an urban diabetes clinic in Kampala, 56% of the patients had optimal blood pressure control, defined as ≤ 140/80 mmHg [74,75]. This confirms earlier conclusions in Uganda that blood pressure control among adult diabetic patients is sub-optimal. The possible explanation for the low level of HT control noted in our study could be that the majority of people with hypertension are not aware they have the condition, and even among those who are aware, less than half are receiving treatment. This may be due to the patient's underestimation of the potential complications of hypertension, non-compliance, absence of effective health education programs, low level of education and/or low socioeconomic levels [76]. However, even among those receiving treatment, eighty three in one hundred have optimally controlled blood pressure. The low levels of Hypertension control are a worrying global trend that is widespread in both low- and high-income countries. 56.74% of study participants had informal education (primary level and below). Illiteracy is usually associated with low income, unemployment which may contribute to the high frequency of hypertension because anti-hypertensives are daily medications whose costs may be high and unaffordable to these patients [77].

While new data caution against excessive BP and glucose control in certain subpopulations, studies continue to suggest that appropriate lowering of BP in diabetes is important for improving macrovascular outcomes. Each 10 mmHg decrease in updated mean systolic blood pressure is associated with risk reductions of 12% for any complication related to diabetes, 15% for deaths related to diabetes, 11% for myocardial infarction and 13% for microvascular complications [78].

Age, gender, ACE/ARB use, WHC ratio, ABI, LDL and TG were associated with hypertension control in the bivariate model. Among these factors, Ankle Brachial Index (ABI), LDL and TGL are modifiable, while gender is the non-modifiable factor associated with hypertension control. However in the multivariate model only TG was independently associated with hypertension control in this model. Mounting evidence indicates that elevated triglyceride level is a risk factor for Coronary Heart Disease (CHD) and that high triglyceride levels are associated with several risk factors including suboptimal BP control that substantially increase the risk of CAD [79,80].

The results of this study show that Hypertension (HT) is common among this Diabetic clinic's patients and that HT control in DM is not adequate.

CONCLUSION

The prevalence of Hypertension among diabetic patients at this diabetic clinic in Uganda was high. Quite a number of these patients were not aware of their HT status and even among those aware that they were hypertensive, some were not on HT treatment.

Hypertension control is sub-optimal even among those with known hypertension status and on anti-hypertensive medication. This requires clear national guidelines to be put in place on the management of hypertension in Diabetic patients.

Ethics Statement

Approval to carry out the study was obtained from the Institutional Review Board (IRB) of the Uganda National Council of science and Technology, the School of Medicine research ethics committee of Makerere University College of Health Sciences. Written informed consent was obtained from patients to participate in this study after a comprehensive explanation of the purpose and procedure of the study.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on request.

Disclosure

The authors report no conflicts of interest in this work.

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Authors' Contributions

I contributed in conceiving the idea, study design, drafting, data analysis, interpretation, managing the overall progress of the study and write up of the manuscript. BSE was involved in study design, data analysis, writing up and editing of the manuscript. The others equally contributed in data analysis, drafting and in revising the manuscript. The final manuscript was read and approved by all the authors.

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