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Prevalence of suboptimal blood pressure, glycemic control, and associated factors among patients with diabetes and hypertension in primary health care facilities in Ghana: a multicenter retrospective cross-sectional study

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Abstract

Background Hypertension and type 2 diabetes mellitus are major risk factors for cardiovascular disease and are common indications for adult in-patient admissions in Ghana. Primary health facility data on blood pressure (BP) and glycemic control are needed to model the impact of strategies to reduce the high burden of cardiovascular disease risk in Africa.

Methods This retrospective cross-sectional study was conducted at four primary healthcare facilities in Ghana, from January 2023 to December 2023. Glycemic control was defined as fasting blood glucose < 7.0 mm/L, and BP control as < 140/90 mmHg for patients with only hypertension and < 130/80 mm/Hg for those with diabetes or both, per the Ministry of Health standard treatment guideline. Multivariate logistic regression analyses were conducted to assess associations between patient or facility-level factors and BP and glycemic control.

Results Among the 1,503 adults, the mean age was 63 years (± 13.1). Participants were mostly females (1194; 79.4%) and had at least primary-level education (324; 32.7%). Most participants (866; 57.6%) had hypertension, less than half (506; 33.6%) had both hypertension and type 2 diabetes mellitus, and (131; 8.8%) had only type 2 diabetes mellitus. Median systolic blood pressure was 136.7 mmHg (IQR; 126.7 -149.7), and median diastolic blood pressure was 79.7 mmHg (IQR: (73.2–86.4), both higher in patients with hypertension and type 2 diabetes. Suboptimal BP and glycemic control were found in 58.3% (95% CI: 55.6–60.7%) and 72.6% (95% CI: 68.4–75.6%) of patients respectively. Complications affected 14.5% ($n = 218$) of patients, with peripheral neuropathy in 9.0%($n = 135$) and 4.3% ($n = 65$) for retinopathy. In an adjusted multivariate analysis, education (AOR = 1.5, 95% CI: 1.1–2.0, $p = 0.02$), glycemic control

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status (AOR = 2.6, 95% CI: 2.0-3.5, $P < 0.001$) and facility ownership (AOR = 2.45, 95% CI: 1.91–3.101, $p < 0.01$) were associated with suboptimal BP control. For suboptimal glycemic control, associated factors included the presence of complications (AOR = 1.7, 95% CI: 1.0–2.9, $p = 0.004$), educational status (AOR = 1.9, 95% CI: 1.1–3.3, $p = 0.01$), and advanced age (> 60 years) (AOR = 1.5, 95% CI: 1.0–2.1, $p = 0.04$).

Conclusions The prevalence of suboptimal blood pressure and glycemic control was high for patients accessing primary level healthcare. Age, education, and complications were associated with suboptimal blood pressure and glycemic control. Strategies to reduce the high burden of suboptimal blood pressure and glycemic control should address patient- and facility-level factors to improve treatment outcomes.

Clinical trial number Not applicable.

Keywords Suboptimal blood pressure control, Glycemic control, Diabetes, Hypertension, Primary health care, Ghana

Introduction

There are global disparities in the prevalence of hypertension with notable financial and health system implications [1]. Estimates of hypertension in Africa range from 55.2% to 57.0% among adults in Africa, while the prevalence of diabetes mellitus in the region is estimated to be around 13.7% [2, 3].

Like other African countries, the burden of hypertension in Ghana has increased significantly in the last decade [4]. Before 1990, hypertension was uncommon in rural communities in Ghana and was seen as a disease of affluence [4–6]. However, systematic reviews have shown an increase in the prevalence of hypertension from less than 5% before 1990 to 34% in 2020 [6–8]. Despite this increasing trend, control rates remain low. The WHO global hypertension reports show that only 19% of the 34% of people with hypertension are treated to target [9]. Other studies have also reported a control rate below 10% [10]. From tertiary to primary level care, hypertension is the leading cause of admissions and mortality in health facilities in Ghana [11].

Although the burden of type 2 diabetes mellitus is relatively lower (6.9%) compared to hypertension in Ghana, both conditions can hinder BP control and increase cardiovascular disease risk [12–14]. Like BP control, some studies have reported suboptimal glycemic control between 59% and 79% of people with type 2 diabetes in Ghana [15, 16]. Despite these trends, health facility-level arrangements for screening, diagnosis, and management of hypertension and type 2 diabetes mellitus are not commensurate with the increasing incidence of these chronic conditions in Ghana [17, 18].

The existing management guidelines emphasize the importance of a comprehensive approach for hypertension and type 2 diabetes mellitus which includes screening at various service points [19, 20]. Persistent inequities in health care delivery and multifaceted health system-specific barriers such as shortage of physicians, limited resources, and clinical space threaten the attainment of optimal BP and glycemic control in Ghana [18, 21]. For instance, mandatory screening for type 2 diabetes mellitus is only offered for special groups such as pregnant women and as part of routine laboratory requests where resources permit [22]. In theory, regular monitoring and follow-up care are also recognized as crucial components of the care pathway, to ensure that patients maintain therapeutic goals [23, 24]. Patient-level factors such as level of education, age, sex, and place of care may also influence BP and glycemic control [15, 16].

To forge ahead in efforts to achieve the proposed 80-80-80 hypertension control target (*80% of individuals with hypertension are screened and aware of their diagnosis; 80% of those who are aware are prescribed treatment; and 80% of those on treatment have achieved guideline-specified blood pressure targets*) by 2050, there is need to comprehensively understand the burden of suboptimal BP and glycemic control and associated factors from the primary healthcare level where majority of patients access care in Ghana [25]. Additionally, the limited data on patient and facility-level factors hinder the implementation of interventions that can improve screening, diagnosis, and treatment [21]. Largely, hypertension-related research in Ghana has focused on prevalence estimation and is conducted in tertiary and secondary-level healthcare facilities [11, 26, 27]. The study examined the burden of suboptimal BP and glycemic control and associated patient- and facility-level factors among patients with hypertension, type 2 diabetes mellitus, or both in primary healthcare facilities in Ghana.

Methods

Study design and setting

We conducted a retrospective review of electronic medical records of patients with hypertension and type 2 diabetes mellitus from January 2023 to December 2023, at the hypertension clinics of four district hospitals (two government and two mission hospitals) in the Bono Region, Ghana (Fig. 1). These healthcare facilities were selected as potential sites for a cardiovascular disease risk management program based on location and case burden.

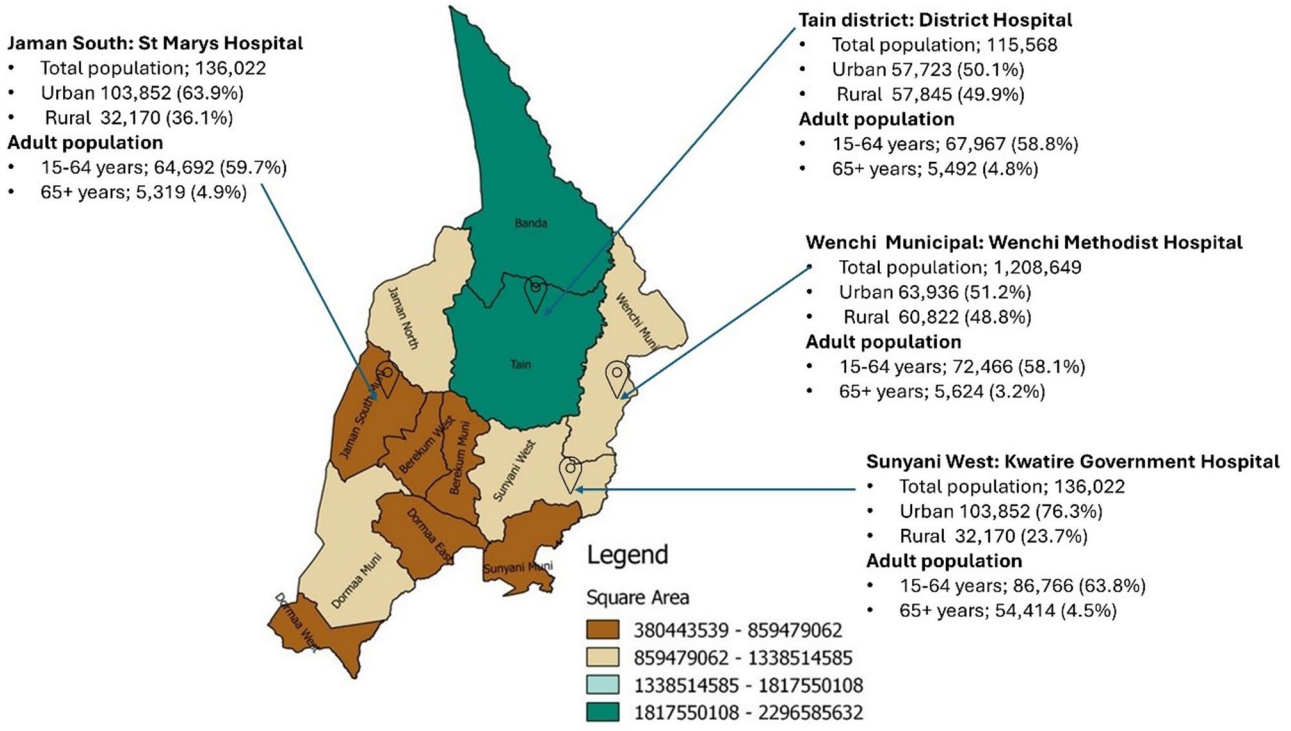

Fig. 1 Map of the Bono Region showing the districts where studies were conducted. ∗The percentage of the urban population in Bono Region was 58.6%. The four facilities are district hospital status selected across four district capitals: Source GSS 2021

The Bono Region was carved out of the erstwhile Brong Ahafo Region in the middle belt of Ghana and is home to an estimated population of 1,082,520 [28]. Healthcare services in the region are organized around one teaching hospital, thirteen government-sponsored district hospitals, and five mission-sponsored hospitals. Particularly, hypertension and type 2 diabetes mellitus treatment is provided at designated district hospitals, secondary and tertiary levels of healthcare services. This retrospective multicenter cross-sectional study was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies [29]. (Appendix A).

Description of health facilities and distribution of cases

All four hospitals were in the Bono Region of Ghana. Two of the hospitals were government-operated facilities and the remaining two were mission/faith-based hospitals. Three of the facilities were in semi-urban areas, and the other facility was in a rural setting. A greater proportion of patients were seen at mission health facilities (63.7%, 928) than at government health facilities during the last 12 months. Only 91 (6.0%) patients were not covered by the National Health Insurance Scheme (NHIS) and had no private health insurance. Figure 2 shows the distribution of cases by district where the health facilities are located.

Population and participant selection

We sought to include records of all adults diagnosed with hypertension, diabetes mellitus, or both by healthcare providers following the standard diagnostic and treatment guidelines of the Ministry of Health [30]. Overall, the clinical records of 1682 patients were retrieved across the four health facilities. One hundred and seven records were excluded based on the exclusion criteria. An additional seventy two was excluded due missingness of BP readings. A total of 1503 records were included in the final analytic sample See Fig. 3.

Inclusion/exclusion criteria

Medical records of adults aged 18 years and above, with a diagnosis of hypertension, type 2 diabetes mellitus, or both, and who had at least three previous BP readings were included. In-patients' medical records and those missing at least three BP readings in the past 12 months were excluded to minimize errors in the BP and glycemic control rates. Patients included in this study had received care at the facilities within the past 12 months and were therefore on long-term treatment.

Data collection tool, procedure, and quality assurance

Patient files were retrieved from electronic medical databases across the facilities. Data on facility ownership, patient demographic characteristics, the last three consecutive BP and blood glucose readings, complications,

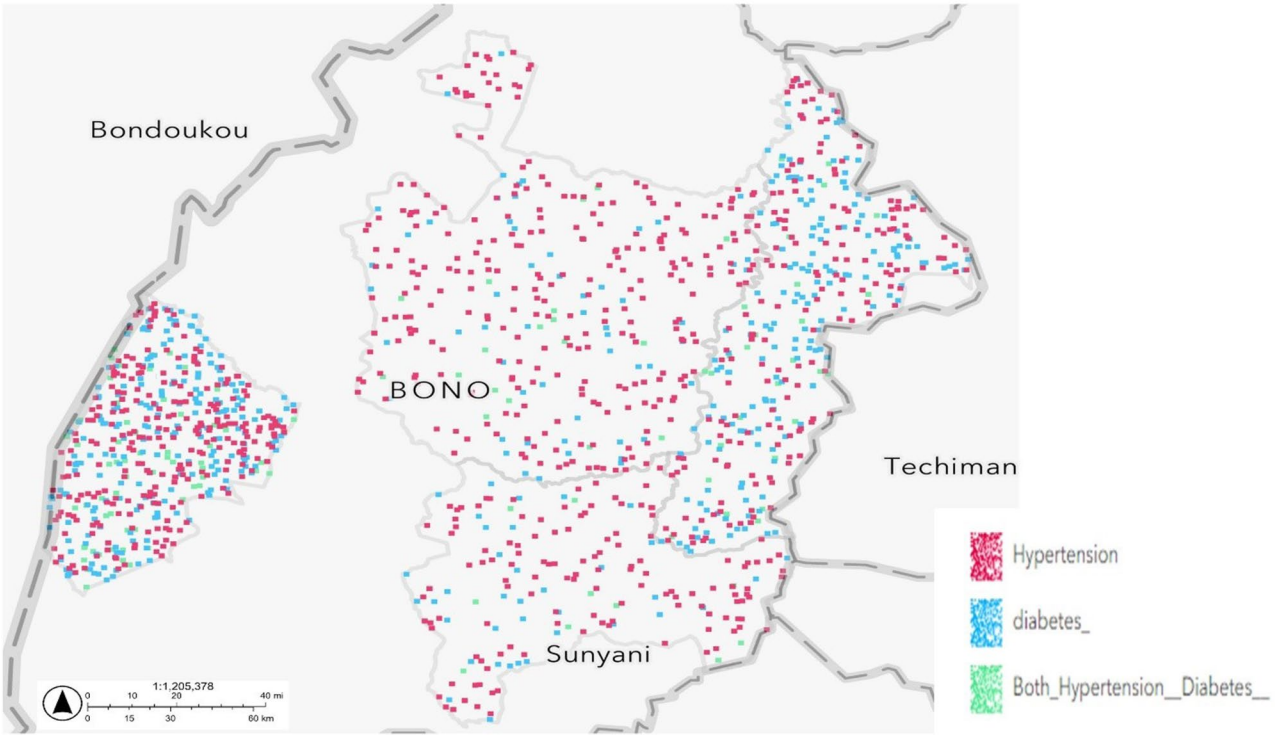

Fig. 2 Visualization of case distribution by health facility. Red-Hypertension, Blue-Diabetes and Green-Both hypertension and diabetes

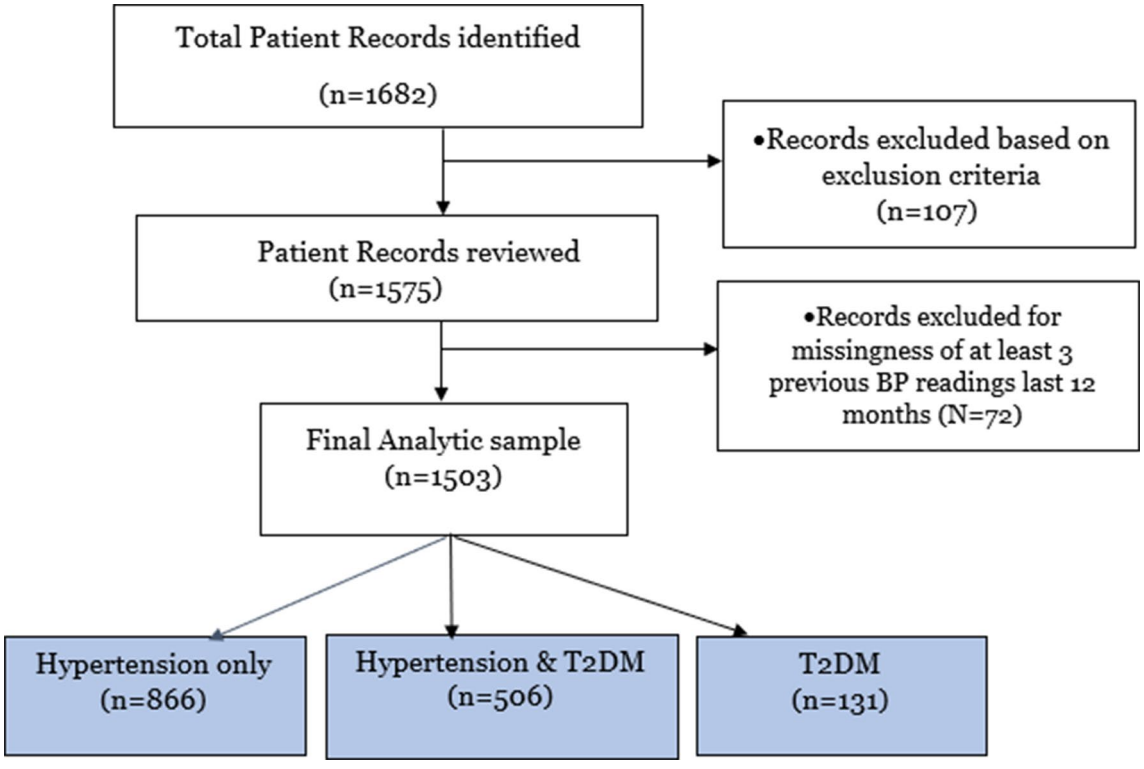

Fig. 3 Flow chart of data selection of participants records at primary health care facilities in Ghana, DM-Diabetes mellitus

and standard laboratory investigations were retrieved. Sociodemographic attributes like age, gender, education, marital status, and comorbidities were also exported.

Potential confounding variables such as smoking status, lifestyle behaviors, physical activity, dietary patterns, and family history of conditions were not collected as these measures are not routinely collected during clinical care. Additional quality measures included pilot-testing of the data extraction template before the commencement of the study as well as weekly data reconciliation with the study team to ensure data completeness.

Operational definitions

- **Suboptimal blood pressure control**: SBP ≥ 140 mmHg and DBP ≥ 90 mmHg for patients with only hypertension.
- **Suboptimal blood pressure control**: SBP ≥ 130 mmHg and DBP ≥ 80 mmHg for patients with only type 2 diabetes mellitus or both.
- **Suboptimal glycemic level**: Fasting blood glucose ≥ 7.0 mmol/L; average measurements on three consecutive visits. Our definitions follow the WHO guidelines for the diagnosis of hypertension and type 2 diabetes [31, 32].
- **Comorbidity**: Diagnosed of having both hypertension and type 2 diabetes mellitus by a healthcare worker.

Clinical measures and practices

In all facilities, in line with the standard diagnostic and treatment guidelines of the Ministry of Health, trained healthcare providers, mostly nurses, routinely capture data on cardiovascular risk to inform clinical decision-making [19]. Anthropometric measurements and other physical measures including BP, weight, and height are monitored by trained healthcare workers using validated devices during routine clinic visit. In practice, BP is measured using calibrated sphygmomanometers or automated, validated devices according to standard protocols. BP outcomes are then determined from the average of three BP readings taken within an interval of 5 min between readings with confirmation at a second visit. [19]. The diagnosis of hypertension and type 2 diabetes mellitus is usually established by the attending physician based on medical history, physical examination, and laboratory results.

Statistical analyses

Descriptive statistics were used to summarize patient and facility-level characteristics. The mean BP and fasting blood glucose (FBG) from the three most recent readings were calculated and used to estimate control rates based on the Standard Treatment Guidelines for hypertension and diabetes mellitus. Data on BP and glycemic control were stratified according to diagnosis. Glycemic control analysis was restricted to patients diagnosed with type 2 diabetes mellitus and hypertension/ diabetes mellitus given that FBG is not routinely monitored for patients with only hypertension. The association between BP and glycemic control and patient and facility characteristics (independent variables) were analyzed using Pearson's Chi-square test and t-test where necessary. Multivariate logistic regression was used to identify factors associated with suboptimal BP and glycemic control. Preliminary exploratory bivariate analysis was conducted and variables returning p-value < 0.2 were included in multivariable logistic regression. Significant associations were determined by p-value < 0.05 and 95% confidence intervals. Data analysis was performed using Stata©, /IC 16.1 (Stata Corp©, College Station, Texas) [33].

Ethical considerations

The study was conducted in line with the provisions of the Helsinki declaration and later amendments. Ethical approval for the conduct of the study was obtained from the Kintampo Health Research Centre (KHRC) (KHRCIEC/2022-16). Furthermore, as facility-level data mining was planned, express written permission was also secured from the Bono Regional Health Directorate.

Results

Sociodemographic and clinical characteristics of participants

The mean age of study participants was 63 (SD + 13.1) years; the majority being 60 years or older (864; 57.5%) (Table 1). Participants were mostly females (1194; 79.4%) and had at least primary level education (324;32.7%). One in two participants (748; 50.1%) resided in urban areas. With respect to facility ownership, (958; 63.7%) accessed care in mission-owned health facilities and (545; 36.3%) in government-owned facilities within the last year.

Clinical and laboratory characteristics of participants

The majority of participants (866; 57.6%) had hypertension, relative to the prevalence of type 2 diabetes mellitus (131; 8.8%). Approximately (506; 33.6%) had been diagnosed with both hypertension and type 2 diabetes mellitus (Table 1).

Frequently reported complications were peripheral neuropathy (135; 9.0%), retinopathy (65; 4.3%), and stroke (21; 1.4%) (Fig. 2). Diabetes mellitus ulcers (6; 0.4%), and heart diseases (5; 0.3%) were relatively uncommon. However, peripheral neuropathy was more common among people with type 2 diabetes mellitus only (35; 26.7%) (Fig. 4).

Table 1 Sociodemographic and clinical characteristics of participants

Variable	Total *N* (%) (1503)	Case status			χ^2	*P* -value
		HTN *N* (%) 866(57.6)	DM *N* (%) 131(8.7)	HTN/ DM *N* (%) 506(33.7)		
Age group						
<60	639 (42.5)	345 (39.8)	81(61.8)	213(42.1)	22.6	< 0.001*
≥60	864 (57.5)	521(60.2)	50(38.2)	293(57.9)		
Mean age (SD)	63(13)	64(13.5)	57.0 (13.0)	62.2 (11.7)	35.1	< 0.001*
Male	309 (20.6)	157 (18.10.)	30 (22.9)	122 (24.1)	7.5	0.024*
Female	1194 (79.4)	709 (581.9)	101 (77.1)	384(75.9)		
Marital Status						
Single Divorced/Widowed	394 (25.7)	220(42.9)	33 (39.8)	141 (45.5)	15.4	0.58
Married/Cohabiting	514 (74.3)	295(57.3)	50(60.2)	169 (54.5)		
Occupation						
Farmer	937 (62.3)	558(64.4)	78(59.5)	301(59.5)	30.9	< 0.001*
Trader	178 (11.8)	92(10.6)	20(15.3)	66(13.1)		
Government employee	55 (3.7)	20(2.3)	13(9.9)	22(4.4)		
Unemployed	193 (12.8)	122(14.1)	12(9.2)	59(11.7)		
Others	140 (9.3)	74 (8.6)	8 (6.1)	58(11.5)		
Education						
No formal education	283 (28.6)	143 (25.3)	26 (31.0)	114 (33.4)	10.0	0.12
Primary education	324 (32.7)	200 (35.3)	24 (28.6)	100(28.6)		
Secondary/HS	278 (28.1)	160 (28.3)	22(26.2)	96 (28.2)		
Tertiary education	106 (10.7)	63(11.1)	12(14.3)	31(9.1)		
Facility Ownership						
Mission	958 (63.7)	448(51.7)	102(77.9)	408 (80.6)	127.8	< 0.001*
Government	545 (36.3)	418(48.3)	29 (22.1)	98(19.4)		
Setting						
Urban	748 (50.1)	400 (46.1)	50 (38.2)	248 (49.0)	24.5	0.05
Rural	254 (16.9)	150 (17.3)	30 (22.9)	74 (14.6)		
Semi-Urban	494 (33.0)	316 (36.4)	51 (38.9)	184 (36.4		
Complications						
*Yes	218 (14.5)	106(12.2)	40 (30.5)	72(14.2)	30.7	< 0.001*
Stroke	21 (1.4)	14 (1.6)	1(0.8)	6(1.2)	0.8	0.65
Peripheral Neuropathy	135 (9.0)	52(6.0)	35 (26.7)	48(9.5)	59.95	< 0.001*
Retinopathy	65 (4.3)	39(4.5)	4(3.1)	22(4)	0.58	0.75
Diabetes mellitus Ulcers	6 (0.4)	0	3(2.3)	1(0.2)	12.9	0.002
Heart disease	5 (0.3)	1(0.2)	2(2.0)	2(0.2)	6.18	0.045
Health Insurance						
Yes	1412(93.9)	814(94.0)	123(93.7)	475(93.9)		0.97

*Statistically significant at $p \leq 0.05$,

*Complications coded "Yes" and "No" for each and Yes response, reported

Prevalence of suboptimal glycemic and blood pressure control

The median systolic blood pressure among participants was 136.7 mmHg (IQR: 126.7 to 149.7 mmHg), and diastolic blood pressure was 79.7 mmHg (IQR: 73.0 to 86.5 mmHg), and were higher in patients with both hypertension and type 2 diabetes mellitus. For fasting blood glucose levels, the median was 8. 8 mmol/L (IQR: 6.8 to 11.8). See Fig. 5.

Overall, suboptimal BP control was observed in 58.3% (95% CI: 55.6%, 60.7%) of patients and higher in patients with both hypertension and diabetes 83.1% (95 CI; 79.9-86.7%) (Table 2).

Suboptimal glycemic control was recorded in 72.6% (95 CI: 68.4–75.6%) of the patients and are comparable for patients with only diabetes 72.7% (95 CI: 68.1–76.1%) and both hypertension and type 2 diabetes mellitus 71.6% (95 CI: 66.1–68.3%).

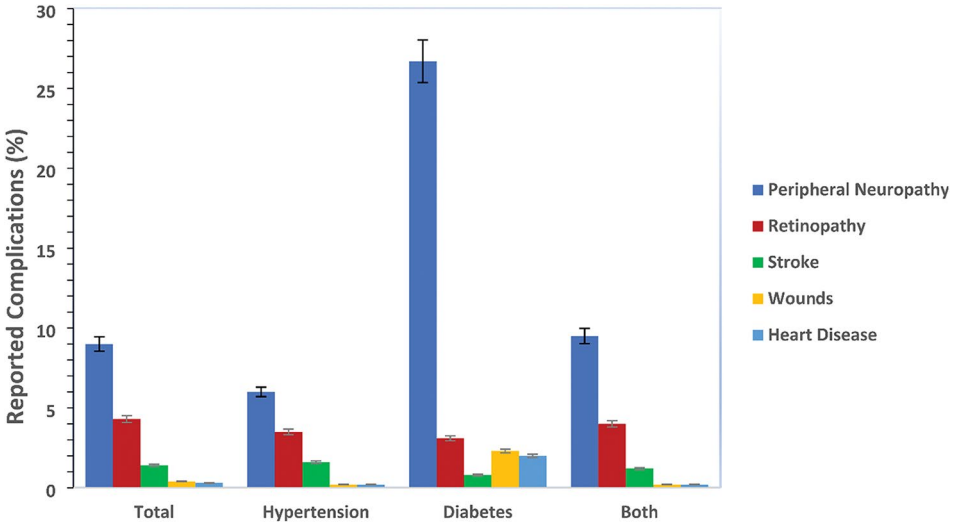

Fig. 4 Frequency of complications among patients with hypertension, diabetes or both in Ghana

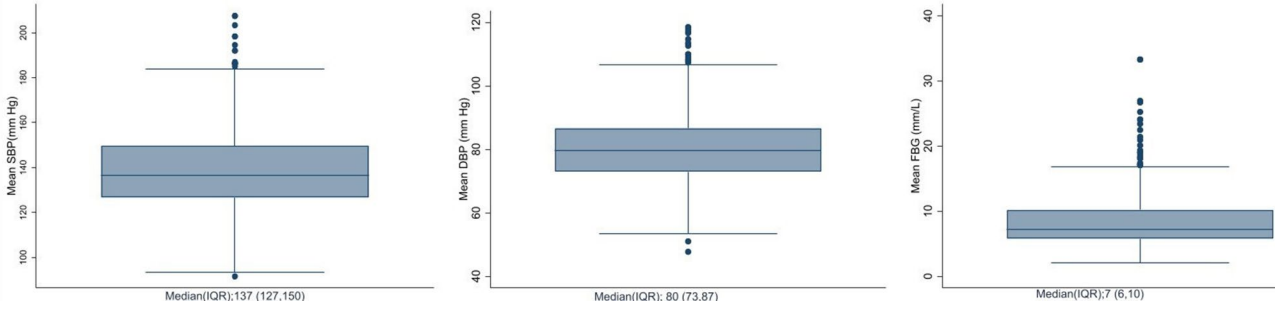

Fig. 5 Systolic blood pressure, diastolic blood pressure, and fasting blood glucose levels of patients

Table 2 Blood pressure and glycemic control among participants

Variable	Average BP, *N* (%)	HTN *N* (%)	DM *N* (%)	HTN/DM *N* (%)
BP level and control				
SBP (mm, Hg) (median ± IQR)	136.7 (126.7 -149.7)	136.3(1253 ± 146.9)	123.3 (114.7 ± 136.1)	141.7(130.0 ± 153.6)
DBP (mm, Hg) (median ± IQR)	79.7 (73.2–86.4)	75.0(69.7 ± 80.7)	75 0.46 ± 9.35	80.7(75.0 ± 88.0)
Suboptimal BP control	58.3% (95% CI: 55.6%, 60.7%)	46.4% (95 CI: 42.7–49.1%)	50.2% (95 CI: 41.8–52.1%)	83.4% (95 CI; 79.9-86.7%)
Glycemic level and control				
Mean FBG mmol/L (median ± IQR)	8. 8 (6.8 to 11.8)	-	8.8 (6.9 to 12.4)	8.8 (6.8 ± 11. 7)
Suboptimal Glycemic control	72.6% (95 CI: 68.4–75.6%)	-	72.7% (95 CI: 68.1–76.1%)	71.6% (95 CI: 66.1–68.3%)

NB: Blood pressure and glycemic control stratified by diagnosis. Blood pressure control as defined for patients with only hypertension (< 140/90 mm Hg) and for those with both hypertension and diabetes mellitus (< 130/80mmHg) or only diabetes mellitus. glycemic control defined as < 7.0 mmol/L average fasting blood glucose

Factors associated with suboptimal blood pressure control among patients with hypertension diabetes mellitus and diabetes mellitus comorbidity

In bivariable analysis, primary education, glycemic control status, gender, age, and facility ownership were significantly associated with suboptimal BP control. In an adjusted multivariable analysis, education, glycemic control status, and facility ownership had significant effects on optimal BP control.

(Table 3). For patient-level factors; having lower education (AOR = 1.5; 95% CI: 1.1-2.0; $P = 0.02$), and having suboptimal glycemic control (AOR; 2.6, 95% CI: 2.0-3.5, $P < 0.001$) were associated with suboptimal BP control. Accessing hypertension care in mission-owned facilities was associated with suboptimal BP control (AOR 2.5; 95% CI: 1.9-3.0, $P < 0.001$).

Factors associated with suboptimal glycemic control among patients with DM only and hypertension/diabetes mellitus

In an adjusted multivariable analysis, lower education (AOR = 1.9, 95% CI: 1.1–3.3, $P = 0.01$), presence

Table 3 Factors associated with suboptimal blood pressure control among patients with hypertension, diabetes mellitus and hypertension/ diabetes mellitus

Variable	Crude estimates OR (95% CI)	*P*-values	Adjusted estimates OR (95% CI)	*P* -values
Age group				
<60	1.00		1.00	
≥60	0.9 (0.7–1.1)	0.22	1.0 (0.7–1.1)	0.24
Sex				
Females	1.00		1.00	
Males	0.8 (0.6–1.2)	0.18	0.8 (0.6–1.3)	0.25
Education				
No Education	1.00		1.00	
Primary education	1.4 (1.0–2.0)	0.04	1.5 (1.1-2.0)	0.02*
Secondary/high school	1.1 (0.7–1.4)	0.90	1.0 (0.7–1.3)	0.66
Tertiary education	1.0(0.6–1.5)	0.91	0.9 (0.6–1.4)	0.75
Marital Status				
Married/cohabitating	1.00		1.00	
Single/ divorced	1.0 (0.7–1.2)	0.72	1.0 (0.7–1.3)	0.77
Glycemic Control				
Uncontrolled	1.0			
Controlled	2.6 (2.4–3.4)	< 0.001*	2.6 (2.0-3.5) *	< 0.001*
Complications				
No	1.00		1.00	
Yes	0.8 (0.6–1.1)	0.73	1.2 (0.9–1.6)	0.70
Occupation				
Farmer	1.00		1.00	
Trader	1.2 (0.9–1.7)	0.28	1.2 (0.9–1.7)	0.27
Government Employee	0.9 (0.5–1.5)	0.61	0.9 (0.5–1.5)	0.63
Unemployed	1.2 (0.9 – 0.1.6)	0.33	1.2 (0.9–1.6)	0.34
Others	0.6 (0.4–0.9)	0.014	0.6 (0.4–0.9)	0.013
Facility Ownership				
Government hospital	1.00			
Mission hospital	2.7 (2.2–3.4)	< 0.001	2.5 (1.9–3.1)	<0.001*

Adjusted for: age, gender, education, health insurance, patient volume CI confidence interval, HTN-hypertension, DM, diabetes

of complication status (AOR = 1.7, 95% CI: 1.0-2.9, $P = 0.004$), being advanced in age (≥ 60) (AOR = 1.5, 95% CI: 1.0-2.1, $P = 0.04$) and accessing hypertension care in mission-owned facilities (AOR = 1.9, 95% CI: 1.2–2.8, $P = 0.003$) were associated with suboptimal glycemic control (Table 4).

Table 4 Factors associated with suboptimal glycemic control among patients with diabetes mellitus and hypertension / diabetes mellitus

Variable	Crude estimates OR (95% CI)	*P*-value	Adjusted estimates OR (95% CI)	*P*-value
Age group				
<60	1			
≥60	1.4(1.0–2.0)	0.05	1.5 (1.2–2.08)	0.04*
Sex				
Females	1.00		1.00	
Males	1.1 (0.7–1.6)	0.71	1.0 (0.7–1.6)	0.85
Education				
No education	1.00		1.00	
Primary education	1.9 (1.1–3.2)	0.03	1.9 (1.1–3.3)	0.01*
Secondary/high school	1.7 (0.9–2.9)	0.08	1.7 (0.9 -3.0)	0.06
Tertiary education	1.8(0.8–3.9)	0.14	1.8 (0.8–3.9)	0.16
Marital Status				
Married/ cohabitating	1.00			
Single/ divorced	1.0(0.6–1.6)	0.99	1.0 (0.7–1.6)	0.86
Complications				
No	1.00			
Yes	1.8(1.0–3.0)	0.025	1.7 (1.0–2.9)	0.04*
Occupation				
Farmer	1.00			
Trader	1.3(0.8–2.1)	0.35	1.2 (0.7–2.1)	0.41
Unemployed	1.2 (0.7–2.2)	0.44	1.3(0.7–2.2)	0.42
Others	1.0 (0.6–1.8)	0.98	1.1 (0.6–1.8)	0.96
Facility Ownership				
Government Hospital	1.00			
Mission Hospital	2.0 (1.3–3.0)	0.001	1.9 (1.2–2.9)	0.003*

Adjusted for: age, sex, education, and health insurance, patient volume. CI confidence interval, hypertension, DM, diabetes mellitus

Discussion

This study assessed BP and glycemic control and associated factors at a primary healthcare level in Ghana. Suboptimal BP and glycemic control were observed in 52% and 72% of patients, respectively, consistent with earlier single-site studies in Ghana.

The observed suboptimal BP control rate is consistent with an earlier study by Sarfo et al., which reported uncontrolled rate of 58% patients diagnosed with hypertension [34]. The high rate of uncontrolled BP in this study reflects the frequency of complications and comorbidity in the sample. However, it is noteworthy that all patients in this present study were on treatment. This highlights the urgent need to adopt more patient-centered management strategies for hypertension and glycemic control in Ghana.

Also, our results point to how health systems are still grappling with a major challenge of suboptimal BP and glycemic control and corroborate previous reports from

other African populations [35–38]. Although high coverage of health insurance has been proposed as the panacea to suboptimal BP and glycemic control in Africa [39, 40], this assertion was not supported by our data. Medication adherence and the quality of drugs provided to patients under health insurance coverage are critical factors, particularly as socioeconomic variables reveal that many patients need continuous support to achieve BP and glycemic control beyond what healthcare providers can offer.

There was an association between patient- and facility-level factors and BP control. Lower-level education and poor glycemic control status were associated with suboptimal BP control similar to what has been reported in earlier studies [41, 42]. Additionally, facility ownership was also associated with BP control. This finding aligns with an ealier study in Ghana that reported differences in BP control by levels of care in Ghana [34]. Contextually, government-owned health facilities and mission health facilities in Ghana are comparable in the availability of human resource allocation, health insurance access, health infrastructure, and guidelines for the management of conditions [43, 44]. Additional research is required to understand differences in health systems framework for delivery of health care across the major health services blocks in Ghana. Bringing the observed BP control rate into perspective in relation with the existing BP target, in Ghana, our study highlights the need to update the guideline to overcome treatment inertia if the goal is to achieve the proposed global target of 80-80-80 [25].]. Also, there is a critical need for remodeling chronic care in Ghana to support team-based approach for hypertension management, which leverages the expertise of a dynamic healthcare team and prioritizes patient-centeredness Ghana [45].

Although sex was not associated with BP and glycemic control in this study, the greater number of female patients (70%) in this study highlights the sex-specific differences in health-seeking behavior among populations in Ghana. This persistent trend requires further interrogation given that men are prone to smoking, alcoholism, and other sedentary lifestyles which are major contributors to the development of hypertension [34, 46].

In a stratified analysis, patients with type 2 diabetes mellitus, being advanced in age, having primary level education, presence of complications, and accessing care in mission facility were associated with suboptimal glycemic control. We also observed an association between glycemic control and BP control for patients with both type 2 diabetes and hypertension which is corroborated by findings from a community-based study where high glucose levels were found to be associated with poor BP control [47]. Patients with both hypertension and diabetes may have a higher medication burden, which may impact medication adherence and affect treatment outcomes [48].

This study's primary strength lies in its setting within public primary care facilities and encompassing both mission and government-owned facilities that deliver most chronic disease care in Ghana. These facilities serve both rural and urban populations, providing valuable insights into real-world management of hypertension and diabetes across Ghana's healthcare infrastructure. However, the study has some limitations. Glycemic control should be interpreted with caution given that FBG was used instead of HbA1c. Additionally, factors such as health behaviors, body mass index, adherence, and medication usage, which could influence BP control, were not assessed, because they are not routinely collected in these facilities. Additionally, a retrospective cross-sectional design has limitations including not supporting causal inference.

Conclusion

This study investigated factors associated with suboptimal blood pressure and glycemic control among adults with hypertension and diabetes mellitus in primary healthcare settings in Ghana. The findings reveal a high prevalence of suboptimal control, with nearly six in ten patients experiencing poor BP control and over seven in ten demonstrating poor glycemic control. Key factors associated with these outcomes include lower education levels and complications such as peripheral neuropathy and retinopathy.

These results underscore the need for targeted interventions in primary care including regular follow-up care to optimize BP and glycemic control. Integrating these strategies into routine care could help reduce the burden of cardiovascular disease risk and related complications, and improve health outcomes in resource-limited settings across Africa.

Abbreviations

BP	Blood pressure
DBP	Diastolic blood pressure
SBP	Systolic blood pressure
CVD	cardiovascular disease
DM	diabetes mellitus type 2
HTN	Hypertension
FBG	Fasting Blood Glucose
GHS	Ghana Health Service
HTN/DM	Both hypertension/diabetes mellitus
WHO	World Health Organization
KHRC	Kintampo Health Research Centre

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Author contributions

TH. and E.T.D. wrote the main manuscript text and Y.C.M reviewed B.M., J.B and O.O supported the analysis. All authors reviewed the manuscript.

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Data availability
The minimal dataset supporting the conclusions reached in this report is provided in this manuscript. Additional data can be obtained from the Ethics Board of the Ghana Health Service and the corresponding author on request. The sharing of the complete datafile is restricted by the jurisdictional Research Ethical Committee owing to concerns regarding the sharing of sensitive patient information.

Declarations

Ethical approval
The study complied with the Declaration of Helsinki (1964) and its later amendments. Informed consent was sought from all participants before data extraction. The consent procedure was approved by the Ethical Review Committee of the Kintampo Health Research Center (approval no KHRCIEC/2022-16).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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