Factors Associated with Uncontrolled Blood Pressure Among Adult Hypertensives in Ho Municipality, Ghana: A Cross-Sectional Study

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https://doi.org/10.56893/ajhes2025v04i02.11

Abstract

Background: Uncontrolled blood pressure (UBP) remains a major public health challenge in Ghana and contributes substantially to the burden of non-communicable diseases. This study assessed the prevalence of UBP and its associated factors among hypertensive adults in Ho Municipality, Ghana.

Methods: A cross-sectional study was conducted among 305 hypertensive adults selected through multistage sampling from two major health facilities in Ho Municipality. Data on medication adherence and behavior were collected, and blood pressure measurements were taken. Statistical analyses were performed using STATA version 17.0.

Results: The mean age of participants was 54.5 ± 16.2 years, with females comprising the majority. Overall, 60.7% (185) of participants had UBP. Individuals with UBP consumed significantly fewer fruits and vegetables but higher amounts of table salt (66.92 g vs. 41.58 g. Inadequate physical activity, hazardous alcohol intake, and poor medication adherence were significant predictors of UBP ($p < 0.001$).

Conclusion: The high prevalence of UBP and its association with modifiable lifestyle and behavioral factors underscore the need for targeted interventions to promote healthy behaviors and improve medication adherence among hypertensive adults.

Keywords: Uncontrolled blood pressure, hypertension, Ghana, adults, lifestyle factors

Introduction

Globally, hypertension is estimated to be responsible for approximately 7.1 million deaths each year, accounting for approximately 13% of all global deaths and 3.7% of the total Disability-Adjusted Life Years (DALYs) (Ahmed et al., 2014). It remains the foremost risk factor contributing to the global burden of disease and overall mortality(Ahmed et al., 2014).

The prevalence of hypertension in Africa varies among countries. For instance, hypertension prevalence reaches up to 58% in South Africa (Gomez et al., 2017; Ibrahim & Damasceno, 2012), 38.1% in Nigeria (Odili et al., 2020) and 24.5% in Kenya (Mohammed et al., 2018). Hypertension is one of the main predictors of death, responsible for approximately 1.5 million deaths

annually within the WHO African Region (Ahmed et al., 2014).

In Ghana, hypertension ranks as the third leading cause of death and remains a major contributor to heart failure (GDHS, 2022). It is the principal determinant of stroke in the country, accounting for an estimated 91% of all cases (Owusu & Adu-Boakye, 2013). Moreover, hypertension is a frequent cause of medical emergencies such as heart and kidney failure (Ghana Health Service, 2017). Evidence from a national study indicates that a significant proportion of Ghanaian adults aged 18 years and above are affected by both hypertension and diabetes, with an estimated prevalence of hypertension of 29.5% (Twumasi-Ankrah et al., 2020).

The increasing burden of hypertension is largely attributed to shifting lifestyle and dietary habits. Factors exacerbating this issue include the consumption of excess salt and fatty foods, insufficient incorporation of fruits and vegetables in diets, excessive alcohol consumption, a favorable attitude towards obesity, smoking, insufficient physical activity, excessive alcohol intake, ineffective stress management, and prolonged life expectancy(Atibila et al., 2021; Bosu et al., 2019).

Blood pressure is considered controlled when a person with hypertension maintains systolic and diastolic blood pressure levels under 140 mmHg and 90 mmHg, respectively. For those with comorbid conditions, such as diabetes or chronic kidney disease (CKD), lower targets of 130 mmHg systolic and 80 mmHg diastolic are recommended to attain optimal treatment outcomes (Mancia et al., 2023).

There are significant disparities in hypertension control between urban and rural areas. For instance, the prevalence rate of controlled hypertension is 42% in urban centers and 23% in rural areas (Chobanian et al., 2003). Moreover, lower rates are reported among specific demographics such as women (17%) and men (6%) on treatment (Chobanian et al., 2003).

Despite the availability of effective antihypertensive medications, hypertension remains a persistent challenge (Ibrahim & Damasceno, 2012). Uncontrolled hypertension (UBP) contributes significantly to stroke. There is substantial evidence that lifestyle factors, including decreased salt consumption, adequate intake of fruits and vegetables, adequate physical activity, decreased alcohol consumption, and adherence to antihypertensive medication, are essential for blood pressure control and can help effectively manage hypertension (Chobanian et al., 2003).

In Ghana, despite effective treatment for hypertension, blood pressure (BP) control remains suboptimal. Although several studies have found the burden, detection, and management of hypertension in rural and urban settings in Ghana, limited research has explored the role of dietary and behavioral determinants in achieving hypertension control among patients with hypertension. (Twumasi-Ankrah et al., 2021).

Only 13% of individuals in Ghana have their blood pressure under control(Bosu, 2010), falling short of the worldwide goal of a 25% reduction in elevated blood pressure, as outlined in Target 6 of the nine globally endorsed Non-Communicable Disease (NCD) targets 9 (16). Achieving this goal requires further research to better understand the factors influencing blood pressure control. Factors such as dietary practices, behavioral patterns, and adherence to antihypertensive medications, along with their respective effects on blood pressure regulation, warrant further investigation. Existing studies show low adherence to dietary recommendations, with barriers such as cost and cultural preferences but are insufficient for firm conclusions (Onuh & Qiu, 2020).

Thus, this study sought to determine the relationship between dietary, behavioral, and pharmacological factors in the management and control of high blood pressure among adult hypertensive patients in the Ho municipality, guided by the following research questions:

1. What is the controlled and uncontrolled blood pressure status among adults with hypertension in the Ho Municipality?
2. Is there a relationship between salty food consumption, fruit and vegetable intake and blood pressure control among hypertensive adults?
3. What is the association between behavioral factors, adherence to antihypertensive medication and uncontrolled blood pressure among hypertensive adults?

Literature Review

To ensure a comprehensive review of the topic, an extensive search of English-language literature across databases and websites, including PubMed, Google Scholar, and ResearchGate, was conducted, encompassing reports, citations, abstracts, and other scholarly resources. Additionally, the reference lists of the identified publications were meticulously examined to identify supplementary references not captured in the initial database searches. A filter for publication year (1990-2024) was applied to refine the search scope. The search strategy incorporated text words, MeSH Terms, and research inquiries pertaining to the adult population, dietary choices, hypertension, blood pressure control, non-communicable diseases, cardiovascular diseases, trends, epidemics, determinants, interventions, and a listing of countries categorized by income levels, with particular emphasis on Ghana.

Global and Regional Burden of Hypertension and Blood Pressure Control.

Hypertension remains a leading, globally modifiable risk factor for cardiovascular disease, stroke, and premature mortality. Recent estimates indicate that over 1.28 billion adults worldwide live with hypertension, yet fewer than one-quarter have adequately controlled blood pressure (WHO, 2021). The burden is disproportionately higher in low- and middle-income countries,

particularly in sub-Saharan Africa, where rapid urbanization, dietary transitions, sedentary lifestyles, and weak health systems exacerbate poor hypertension outcomes (Ibrahim & Damasceno, 2012; Atibila et al., 2021).

In Africa, the prevalence of hypertension ranges from 24% to over 50% in some urban populations, with control rates consistently below 30% (Gomez-Olive et al., 2017; Odili et al., 2020). Despite increased detection, treatment, and availability of antihypertensive medications, uncontrolled blood pressure (UBP) remains widespread, reflecting persistent gaps in lifestyle modification, medication adherence, and health system support.

Hypertension and Blood Pressure Control in Ghana

In Ghana, hypertension represents a major public health challenge and ranks among the leading causes of outpatient visits, hospital admissions, and cardiovascular-related deaths (Owusu & Adu-Boakye, 2013). National and facility-based studies indicate that approximately 30% of Ghanaian adults are hypertensive; however, only 13–20% achieve adequate blood pressure control (Bosu, 2010; Sarfo et al., 2018). Evidence from the May Measurement Month initiatives further highlights the high prevalence of uncontrolled hypertension among adults receiving care in both urban and peri-urban settings (Twumasi-Ankrah et al., 2020).

Although pharmacological treatment is widely prescribed, sustained BP control remains challenging to achieve. This suggests that hypertension management in Ghana is influenced by factors beyond medication availability, including dietary practices, behavioral patterns, health literacy, and adherence challenges.

Dietary Factors and Blood Pressure Control

Diet plays a central role in regulating blood pressure. A high sodium intake is one of the most consistently documented dietary risk factors for hypertension and UBP. Excess sodium increases plasma volume and vascular resistance, thereby elevating the blood pressure (Jung et al., 2012). The World Health Organization recommends limiting salt intake to less than 5 g/day; however, the average consumption in many African settings far exceeds this threshold due to reliance on processed foods, salted meats, and bouillon cubes (WHO, 2018).

Conversely, diets rich in fruits and vegetables are associated with lower blood pressure and reduced risks of cardiovascular diseases. Fruits and vegetables provide potassium, magnesium, nitrates, and bioactive compounds that promote vasodilation, improve endothelial function, and enhance sodium excretion (Madsen et al., 2023). Systematic reviews and meta-analyses have demonstrated that higher fruit and vegetable intake significantly reduces both systolic and diastolic blood pressure across diverse populations (Wan et al., 2024).

In Ghana, however, adherence to dietary recommendations remains low

due to economic constraints, cultural food preferences, and limited nutrition counseling within routine clinical care (Onuh & Qiu, 2020). Empirical studies assessing the combined effect of salt intake and fruit and vegetable consumption on BP control among hypertensive patients remain limited, highlighting an important research gap.

Behavioral Factors and Hypertension Control

Lifestyle behaviors strongly influence blood pressure outcomes. Physical inactivity is associated with increased sympathetic activity, endothelial dysfunction, and weight gain, all of which contribute to poor BP control. Regular moderate-to-vigorous physical activity is associated with clinically meaningful reductions in blood pressure in hypertensive individuals (Hayes et al., 2022). However, sedentary behavior is increasingly prevalent in urban African populations.

Alcohol consumption is another critical behavioral determinant. Although low levels of alcohol intake may have neutral effects, hazardous and dependent drinking significantly increases blood pressure and undermines treatment effectiveness (Tasnim et al., 2020). Tobacco use, including current and former smoking, has also been associated with arterial stiffness and impaired BP regulation, although the findings vary after multivariable adjustment (Diana et al., 2018).

Medication Adherence and Clinical Determinants of BP Control

Medication adherence is a cornerstone of effective hypertension management. Poor adherence to antihypertensive therapy is consistently associated with uncontrolled blood pressure, increased complications, and high healthcare costs. Factors influencing adherence include pill burden, side effects, forgetfulness, cost, and limited patient-provider communication (Tan et al., 2014).

Studies in sub-Saharan Africa have shown that non-adherence rates range from 30% to 60%, substantially contributing to poor BP control, even among patients on long-term treatment (Sarfo et al., 2018). Patients with comorbidities, such as diabetes or chronic kidney disease, may demonstrate better BP control due to more frequent clinical monitoring and intensified care. However, the findings remain inconsistent across settings.

Synthesis and Knowledge Gap

The reviewed literature demonstrates that uncontrolled blood pressure is a multifactorial condition influenced by dietary practices, behavioral factors, and medication adherence. While these determinants have been studied independently, there is limited empirical evidence from Ghana that simultaneously examines dietary intake (salt, fruits, and vegetables), lifestyle behaviors, and pharmacological adherence within a single analytical framework.

Moreover, facility-based studies in the Volta Region, particularly in the Ho Municipality, remain scarce.

Understanding how these factors interact in this specific context is essential for designing targeted and culturally appropriate interventions to improve hypertension control.

Guided by the existing evidence and identified gaps, the present study investigated the prevalence of uncontrolled blood pressure. This study examined the combined influence of dietary, behavioral, and medication adherence factors among adult hypertensive patients in Ho Municipality. By adopting validated measurement tools and an analytical approach, this study contributes context-specific evidence to inform clinical practice, public health programming, and policy formulation aimed at improving hypertension outcomes in Ghana.

Materials and Methods

Research Design and Setting

A cross-sectional design was employed. The Volta Region is one of the 16 administrative regions of Ghana, with Ho serving as its capital. It lies west of the Republic of Togo and east of Lake Volta. The region covers 9,504 km2. The Volta region has an estimated population of 1,659,040(Ghana Statistical Service, 2021). Ho is in the middle of the Volta region. It covers an area of 573.2 km^2 (Wikipedia; Volta Region, 2023). The Ho Municipal Population is estimated at 180,420 (Ghana Statistical Service, 2021).

Population and Sample Design

This study was conducted in the teaching and municipal hospitals. This is because they are the main referral health facilities in the municipality. The participants in this study comprised adult patients with hypertension receiving treatment at the Ho Teaching Hospital (HTH) and the Ho Municipal Hospital (HMH).

The total number of hypertensives across the two facilities was known: HTH (1000) and HMH (500), representing an overall hypertensive population of 1500.

The sample size was computed using Cochran's (Snedecor & Cochran, 1956) and Krejcie and Morgan's (1970) formula, yielding 290 sample size. Adjusting for a non-response rate of 5% increased the sample size to 305 participants.

A probability-proportional-to-size (PPS) approach was used to decide the number of participants from each study site, ensuring the sample reflected patient volume. Using this method, the total hypertensive patients per facility were calculated as follows: HTH (1000/1500) × 305 = 203 and HMH (500/1500) × 305 = 102. After determining the sample sizes, systematic sampling was used to select individual participants. The sampling frame consisted of clinic attendance lists, with a sampling interval (k) of 5 applied after a random start. The first participant was randomly selected from the list, and subsequent participants were chosen every fifth interval.

Inclusion and Exclusion Criteria

Adults (≥18 years) must have been diagnosed with high blood pressure. In addition, co-occurring conditions such as diabetes, chronic kidney failure, and hypertension were included in the study (Mancia et al., 2023). They also needed to have been on antihypertensive medication for a minimum of 6 months. Patients with psychiatric conditions, pregnant women, and patients on medications that could elevate their blood pressure were excluded.

Data Collection Procedures

Participants' Blood Pressure (BP) and anthropometric indices (height, weight, waist circumference, and BMI) were measured according to WHO standards. Questionnaires were used to conduct interviews by two research assistants. Participants' information was entered electronically using the research assistants' phones via the Kobo Collection app. The participants were contacted at the cardiothoracic centers of the two health facilities. Each questionnaire administration and measurement lasted for about 45 minutes.

A standard digital automatic OMRON blood pressure monitor was used for measurements. BP was measured three times, with 5 minutes between measurements. Participants were seated quietly and relaxed for 15 minutes, with their legs uncrossed. Measurements were performed using the participants' left arm, with the palm facing upward. The appropriate cuff size for each participant was determined based on their arm circumference (WHO STEPS Surveillance Manual, 2017). The mean of the two concordant readings was calculated and recorded. BP <140/90 mmHg was defined as controlled, and BP > 140/90 mmHg as uncontrolled(Mancia et al., 2023).

A stadiometer (Health O meter) was used to measure the height and weight simultaneously. Participants removed their footwear and mobile phones before standing on the instrument. Participants were instructed to stand with their legs and knees closed while facing the measurer. Height and weight were recorded to the nearest 0.1cm and 0.1kg, respectively. The mean of two concordant readings was calculated and recorded.

A calibrated standard tape measure was used to measure the waist circumference. The participants were asked to remove any tick clothes they had on to ensure accuracy. The landmark of the waist was located and marked by finding half of the distance between the xiphisternum and the umbilicus. Tape was wrapped around the marked site to measure the waist.

The Body Mass Index (BMI) of participants was classified as obese (BMI > 30kg/m^2), overweight (25.0kg/m^2<BMI< 29.9 kg/m^2), and normal (24.9kg/m^2 >BMI>=18.5 kg/m^2) (Dwyer JT & Melanson KJ, n.d.).

In addition, the Global Physical Activity (GPAC) questionnaire was adopted to assess participants' physical activity. Calculations of participants' total physical activity were based on time spent in transport, recreation, and work.

Vigorous and moderate-intensity physical activity were classified according to the WHO GPAQ standards (Global Physical Activity Questionnaire Analysis Guide, n.d.). The interviewers used pictures as a guide.

Participants were classified as having adequate physical activity if they engaged in at least 150 minutes of moderate-intensity physical activity, at least 75 minutes of vigorous-intensity physical activity, or a combination of physical activity totaling at least 600 MET. Participants who failed to meet the stipulated criteria were classified as having inadequate physical activity.

The study employed the individual-level tobacco use questionnaire from the Global Adult Tobacco Survey (GATS) (Global Adult Tobacco Survey Collaborative Group, 2020). The questionnaire assessed participants' knowledge, attitudes, and perceptions of smoking. Pictures were used to provide detailed clarity of the vaping devices, such as shisha and electronic cigarettes.

The study adopted the Alcohol Use Disorder Identification Test (AUDIT) (Institute on Drug Abuse, n.d.). The structured questionnaire consisted of 10 closed ended questions with multiple-choice answers. Each question is assigned a score on a scale of 0-4 based on the severity and frequency of behaviors. Participants' alcohol consumption was categorized according to their AUDIT overall scores. The total score for each participant ranged from 0-40, with 0 indicating abstainer, 0-7 indicating low risk, 8-15 indicating hazardous drinking, 16-19 indicating harmful drinking, and a score greater than 40 indicating alcohol dependence (Institute on Drug Abuse, n.d.).

The study adapted the Morisky-4-item Medication Adherence Scale (MMAS) (Tan Isha Patel Jongwha Chang et al., 2014). The 4-item MMAS consists of four questions with multiple-choice answers: "Yes" and "No." A score of 1 was assigned to "Yes," and a score of 0 was assigned to "No." An overall score ranging from 0–4 was estimated for each participant. A score of 0, 1-2, and 3-4 represented High adherence, Medium adherence and Low adherence respectively (Tan Isha Patel Jongwha Chang et al., 2014).

A semi-qualitative Food Frequency Questionnaire (FFQ) from the Food and Agriculture Organization (FAO) dietary assessment guidelines (Dietary Assessment, 2018) was used to assess participants' salt, fruit, and vegetable consumption. The study conducted a 24-hour recall among selected adults in the Ho municipality to compile a list of commonly consumed foods. Participants were asked to indicate the number of days they had eaten specific foods in the previous week and to quantify the amounts of each food using household measurement standards, such as cup size, tablespoon, teaspoon, palm size, and fist size. These household measurements were converted manually using the FAO dietary guidelines. For instance, a tablespoon heap full was quantified as 10g, a cup full as 200g, and so on. Estimations and calculations were performed to the nearest 0.1g.

In summary, study employed eight data collection instruments, including the WHO STEPS Questionnaire for sociodemographic, behavioral, and clinical information; Global Physical Activity Questionnaire (GPAQ) to assess physical activity; Global Adult Tobacco Survey (GATS) for tobacco use; Alcohol Used Disorder Identification Test (AUDIT) for alcohol consumption categories; Morisky 4-Item Medication Adherence Scale (MMAS-4) for adherence assessment; Semi-quantitative Food Frequency Questionnaire (FAO) for estimating weekly salt, fruit, and vegetable intake; Omron digital sphygmomanometer for BP measurements following the WHO protocol; and stadiometer and calibrated scale for BMI and anthropometric measurements. All tools used in this study are internationally validated and have been widely applied in non-communicable disease (NCD) research.

Data Analysis

The collected data were exported to Stata version 17 for further analysis. Blood pressure readings were categorized into two groups: controlled (BP < 140/90 mmHg) and uncontrolled (BP > 140/90 mmHg). Descriptive statistics, including frequencies and proportions, are presented in tables.

Binary logistic regression was used to assess the association between uncontrolled blood pressure (dependent variable) and predictor variables, including sex, education level, BMI, physical activity, smoking status, alcohol intake, adherence to antihypertensive medication, comorbidities, and hypertension duration. Model fitness was evaluated using the Pearson goodness-of-fit test (N=305), indicating an adequate fit ($p > 0.05$). Additionally, the Hosmer-Lemeshow test (N=305, groups=10) confirmed a proper model fit ($p > 0.05$), suggesting no significant discrepancy between the observed and predicted values.

Independent-samples t-tests were used to evaluate the relationship between uncontrolled blood pressure (dependent variable) and quantitative dietary variables, including salt intake (grams), salt-rich food consumption, and fruit and vegetable intake. Statistical significance was set at $p < 0.05$.

Ethical Concerns

The study was reviewed by the Research Ethics Committee (REC) of the University of Health and Allied Sciences, Institute of Health Research (IHR), Ho, with protocol identification number UHAS-REC A.9 [167 23-24]. Permission was obtained from both hospitals through a formal letter from the Dean of the Fred Newton Binka School of Public Health. The participants signed consent forms allowing us to collect data from them. Participants' identities and other sensitive details were safeguarded by not using names and instead employing IDs. Noninvasive methods were used to collect the necessary information from the participants.

Results

Characteristics of Participants

Table 1 presents the background characteristics of the 305 hypertensive patients included in the study. Of these, 42.3% were male (n=135) and 55.7% were female (n=170), with an average age of 54.5 (±16.2) years. The majority were Ewes from the Volta Region, representing 77.70% (n=237), and the least represented ethnic group was Kotokoli (7.54% (n=23). Of the total participants, 75.74%(n=231) were married, 13.44%(n=41) were single, and 5.57% (n=17) were cohabiting. Christianity was the most widely practiced religion among the study participants, representing 86.23% (n=263), followed by Islam (8.88%, n=27), and the least practiced religion was Traditionalist (4.93%, n=15).

Table 1

Respondents' Sociodemographic Characteristics

Characteristic	Frequency(n=305)	Percentage (%)
Sex		
Male	135	44.26
Female	170	55.74
Age		
Mean age (54.47±16.24)		
18-26	12	3.93
27-45	78	25.57
46-60	108	35.41
61-94	107	35.08
E**ducation level**		
No formal education	52	17.05
Primary School	48	15.74
Junior High School	94	30.82
Senior High School	48	15.74
Tertiary	63	20.66
Ethnicity		
Ewe	237	77.70
Twi	39	12.79
Kotokoli	23	7.54
**Other	6	1.97
Religion		
Christianity	263	86.23
Islam	27	8.88
Traditional	15	4.93
Marital Status		
Married	231	75.74
Cohabiting	17	5.57
Single	41	13.44
Divorced	16	5.25

Occupation		
Unemployed	136	44.59
Formal Employment	103	33.77
Self-employed	66	21.64
Existence of comorbidities		
Yes	208	68.20
No	97	31.80
Family history		
Yes	225	73.77
No	80	26.23

** Others include Moshie, Dagomba, and Ga people.

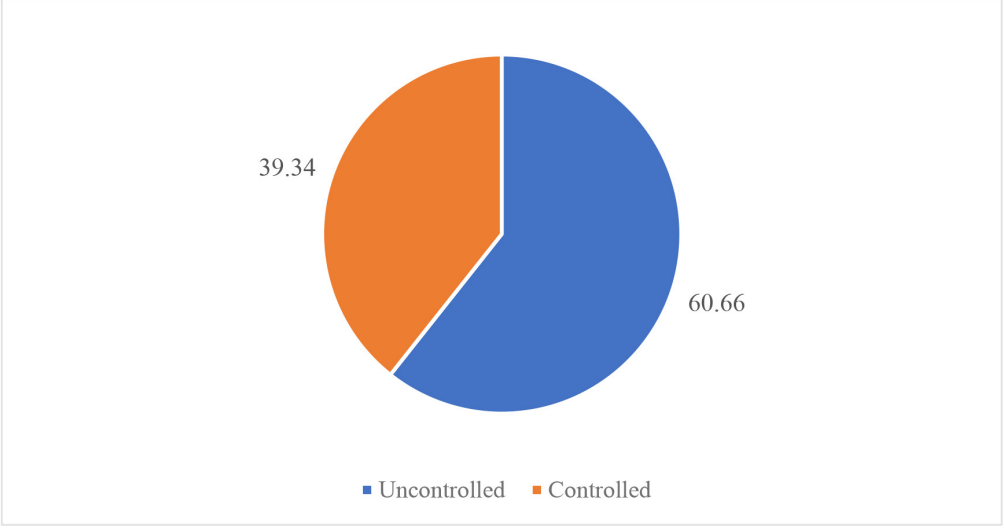
Regarding educational background, 17.1% (n=52) of the participants had no formal education. Additionally, 44.6% (n=136) were unemployed at the time of the study. Comorbidities were common, with 68.2% (n=208) of the participants reporting at least one additional chronic condition, including diabetes, stroke, and chronic kidney disease. A family history of high blood pressure was noted among 73.8% (n=225) of the participants.

Uncontrolled Blood Pressure (UBP) Prevalence Among Adult Hypertension Patients

Figure 1 shows the prevalence of UBP and CBP among hypertensive adults in Ho municipality. UBP (BP>140mmHg/90mmHg), represented 60.66%(n=185). Patients with controlled blood pressure (CBP) (BP < 140/90 mmHg) constituted 39.34% (n = 120).

Figure 1

Prevalence of Uncontrolled and Controlled Blood Pressure Among Hypertensives in Ho Municipality, Volta Region, Ghana



Comparative Analysis of Salty Food and Fruit and Vegetable Intake Among Hypertensive Adults in Ho Municipality

Table 2 presents a comparative analysis of commonly consumed salt-based foods, fruits and vegetables, and blood pressure values among patients with hypertension in Ho.

Among salty foods, table salt consumption was significantly higher among individuals with UBP (66.92 g ± 46.32) than among those with controlled blood pressure (41.58 g ± 34.84) (p = 0.02).

Similarly, the intake of Maggie bouillon cubes was significantly greater in the uncontrolled group (50.37 g ± 19.66) than in the controlled group (42.68 g ± 10.73) (p = 0.01). Salted meat intake also differed significantly between the groups (P < 0.001). In contrast, the intake of salty fish was marginally higher among the UBP group (255 g ± 110.69 g) than among the CBP group (234.28 g ± 127.39), although this difference was not statistically significant (P = 0.64).

Regarding fruit and vegetable intake, participants with CBP consumed significantly greater amounts of banana (1274.51g ± 797.96), orange (1971.43g ± 1077.46), cabbage (2071.43g ± 933.38), carrot (1608g ± 1215.84), spinach (2024.14g ± 833.95), cocoyam leaves (1600g ± 1043.71), and lettuce (171.8g ± 120.68) compared to their counterparts with UBP (p < 0.05 in all cases). However, the differences in pawpaw consumption between the two groups were not statistically significant.

Table 2

Comparison of Weekly Consumption of Salty Foods, Fruits, Vegetables, and their link to Blood Pressure Control in Hypertensive Adults

Amount in grams of intake per week(g)	Controlled BP Mean(±SD)	Uncontrolled BP Mean(±SD)	P Value
Table salt	41.58(±34.84)	66.92(±46.32)	0.02*
Salted fish	234.29 (±127.39)	255(±110.69)	0.64
Salted meat	431 (±311.27)	1200.56(±658.75)	0.00**
Maggie bullion	42.68(±10.73)	50.37 (±19.66)	0.01*
Banana	1274.51 (±797.96)	764.23 (±628.22)	0.00**
Orange	1971.43 (± 1077.46)	1005.88 (±935.31)	0.00**
Pawpaw	113.04 (±48.47))	110.29 (±67.10)	0.87
Cabbage	2071.43(±933.38)	852.70(±819.99)	0.00**
Carrot	1608 (±1215.84)	1072.22 (±815.43)	0.04*
Spinach	2024.14 (±833.95)	996.77 (±765.72)	0.00**
Cocoyam leaves	1600(±1043.71)	674.51(±568.33)	0.00**
Lettuce	171.86 (±120.68)	84(±80)	0.00**

** indicates a statistical significance of p value <0.001, * represents p value <0.05.

Relationship between behavioral factors, medication adherence and UBP among Patients with Hypertension

Table 3 shows the association between behavioral adherence to antihypertensive medications and UBP among adult hypertensive patients in Ho Municipality.

In the adjusted model, several variables emerged as significant predictors of UBP. The results showed that participants with inadequate physical activity were significantly more likely to have UBP (AOR = 4.53; 95% CI: 2.34–8.77; $p < 0.001$), and those with low adherence to antihypertensive medications had over ten times the odds of having UBP compared to those with high adherence (AOR = 10.82; 95% CI: 4.5–25.97; $p < 0.001$). Hazardous alcohol consumption was also strongly associated with UBP (AOR = 8.09; 95% CI: 3.10–21.16; $p < 0.001$) compared to abstainers. Previous smoking was significantly associated with UBP in the crude model (COR = 2.89; 95% CI: 1.54–5.40; $p < 0.001$), though this association was offset after adjustment.

Even though obesity showed a significant crude association with UBP (COR = 2.04; 95% CI: 1.07–3.92; $p = 0.03$), the adjusted odds ratio did not remain statistically significant (AOR = 2.09; 95% CI: 0.87–5.02; $p = 0.09$). In the adjusted models, comorbid conditions were inversely associated with UBP (AOR = 0.32; 95% CI: 0.15–0.65; $p < 0.001$).

Higher educational attainment was associated with a protective effect against CBP. Individuals with primary and tertiary education had significantly lower odds of UBP than those with no formal education (AOR = 0.28; 95% CI: 0.09–0.86; $p = 0.02$), as did those with tertiary education (AOR = 0.36; 95% CI: 0.13–0.99; $p = 0.04$, respectively). However, other variables, such as sex, smoking, age, and duration of hypertension, were not statistically significant with UBP in the adjusted models.

Table 3.

Binary Logistic Regression Model Showing Factors Associated with UBP Among Adult Hypertensive Patients in Ho Municipality, Volta Region, Ghana(N=305).

. Variable	Sub-group	Total N= 305 (%)	Blood Pressure CBP	Blood Pressure UBP	Chi-square (p-value)	COR (95% CI) p-value	AOR (95% CI) p-value
Sex	Male	135(44.26)	54(17.70)	81(26.56)	0.04(0.84)	Ref	Ref
	Female	170(55.74)	66(21.64)	104(34.98)		1.05(0.66-1.66)0.84	0.94(0.49-1.76)0.84
Education Level	No formal	52(17.01)	16(5.25)	36(11.80)	8.76(0.07)	Ref	ref
	Primary	48(15.74)	20(6.56)	28(9.18)		0.62(0.27-1.42)0.26	0.28(0.09-0.86)0.02
	Junior	94(30.82)	30(9.84)	64(20.98)		0.95(0.46-1.97)0.89	0.97(0.37-2.58)0.95
	Senior	48(15.74)	21(6.89)	27(8.85)		0.57(0.25-1.29)0.18	0.77(0.25-2.39)0.64
	Tertiary	63(20.66)	33(10.82)	30(9.84)		0.40(0.18-0.87)0.02	0.36(0.13-0.99)0.04
BMI	Normal	91(29.84)	44 (14.43)	47(15.01)	5.13 (0.08)	Ref	Ref
	Overweight	144 (47.21)	54(17.70)	90(29.51)		1.56(0.92-2.66)0.10*	1.17(0.56-2.43)0.67
	Obese	70 (22.95)	22 (7.21)	48(15.74)		2.04(1.07-3.92)0.03*	2.09(0.87-5.02)0.09
Physical Activity	Adequate	144(47.21)	79 (25.90)	65 (21.31)	27.90 (0.00)	Ref	Ref
	Inadequate	161 (52.79)	41 (13.44)	120 (39.34)	**	3.56(2.19-5.77)0.00**	4.53(2.34-8.77)0.00**
Current Smokers	Yes	14(4.59)	6(1.97)	8(2.62)	0.08 (0.78)	0.86(0.29-2.54)0.78	0.69(0.15-3.12)0.63
	No	291(95.41)	114(37.38)	177(58.03)		Ref	ref

. Variable	Sub-group	Total N= 305 (%)	Blood Pressure CBP	Blood Pressure UBP	Chi-square (p-value)	COR (95% CI) p-value	AOR (95% CI) p-value
Past Smokers	Yes	69(22.62)	15(4.92)	54(17.70)	12.31 (0.00)**	2.89(1.54-5.40)0.00*	1.59(0.59-4.27)0.35
	No	236(77.38)	105(34.43)	131(42.95)		Ref	Ref
Alcohol Intake	Abstainer	178(58.36)	94(30.82)	84(27.54)	36.66 (0.00)**	Ref	Ref
	Dependence	8(2.62)	1(0.33)	7(2.30)		7.83(0.944-64.99)0.06	10.12(0.97-128.41)0.05
	Hazardous	68(22.30)	11(3.61)	57(18.69)		5.80(2.8511.79)0.00**	8.09(3.10-21.16)0.00**
	Low risk	35(11.48)	9(2.95)	26(8.52)		3.23(1.43-7.29)0.00**	4.34(1.5-12.96)0.00*
	High Risk	16(5.25)	5(1.64)	11(3.61)		2.46(0.82-7.38)0.11	3.37(0.71-15.24)0.20*
Med. Adherence	High	95(31.15)	52(17.05)	43(14.10)	47.15 (0.00)	Ref	Ref
	Low	99(32.46)	13(4.26)	86(28.20)		8(3.94-16.26)0.00**	10.82(4.5-25.97)0.00**
	Medium	111(36.39)	55(18.03)	56(18.36)		1.23(0.71-2.13)0.45	1.42(0.68-2.83)0.33
Age (Years)	18-26	11(3.69)	6(1.97)	5(1.64)	5.87 (0.12)	Ref	Ref
	27-45	52(17.05)	24(7.87)	28(9.18)		1.4(0.38-5.12)0.61	1.41(0.20-6.50)0.88
	46-60	87(28.52)	39(12.79)	48(15.74)		1.48(0.42-5.21)0.54	0.78(0.14-4.40)0.78
	61-94	155(50.82)	51(16.72)	104(34.09)		2.45(0.72-8.39)0.16	1.78(0.32-9.89)0.51

. Variable	Sub-group	Total N= 305 (%)	Blood Pressure CBP	UBP	Chi-square (p-value)	COR (95% CI) p-value	AOR (95% CI) p-value
Co-morbidities	Yes	208(68.20)	85(27.87)	123(40.33)	0.63(0.42)	1.22(0.74-2.0)0.42	0.32(0.15-0.65)0.00
	No	97(31.80)	35(11.48)	62(20.33)		Ref	Ref
Hypertension	1-2	36(11.80)	17(5.57)	19(6.23)	7.04(0.07)	ref	Ref
Duration (Years)	3-5	105(34.43)	43(14.09)	62(20.33)		1.29(0.60-2.76)0.51	0.89(0.32-2.47)0.82
	6-10	104(34.10)	31(10.16)	73(23.93)		2.10(0.97-4.59)0.06	1.67(0.56-4.98)0.36
	>10	60(19.67)	29(9.51)	31(10.16)		0.95(0.58-2.15)0.07	0.81(0.25-2.64)0.73

Source: Field work. **indicates a statistical significance of p <0.001 and * shows a statistical significance of p<0.05; Pearson Goodness of Fit Test, N=305, Chi-square = 282.47, p= 0.26; Hosmer-Lemeshow Goodness of Fit Test, N=305, number of groups = 10, Chi-square=8.10, p=0.42. COR – Crude Odds Ratio; AOR – Adjusted Odds Ratio; CI – Confidence Interval; Ref – Reference Category

Discussion

This study examined the prevalence and determinants of uncontrolled blood pressure (UBP) among adults with hypertension in Ho Municipality. This study contributes context-specific evidence to the growing literature on hypertension control in sub-Saharan Africa. Overall, the findings align with existing regional and global research and offer nuanced insights relevant to the management of hypertension in Ghana.

Prevalence of Uncontrolled Blood Pressure in Context

The high prevalence of uncontrolled blood pressure observed in this study is consistent with prior facility-based and population-level studies conducted in Ghana and other African countries. Similar proportions of uncontrolled hypertension have been reported in Ghanaian hospital-based studies and in the May Measurement Month initiatives, which documented persistently low control rates despite treatment availability (Sarfo et al., 2018; Twumasi-Ankrah et al., 2020). Comparable findings have also been reported in Ethiopia and Nigeria, where more than half of patients with hypertension fail to achieve the recommended blood pressure targets (Odili et al., 2020; Solomon et al., 2023). Collectively, these findings reinforce the notion that uncontrolled hypertension remains a systemic challenge, rather than an isolated clinical issue.

Dietary Factors and Blood Pressure Control

The observed association between high sodium intake and uncontrolled blood pressure supports substantial evidence linking excessive salt consumption to elevated blood pressure. Previous studies across diverse populations have demonstrated that sodium intake increases intravascular volume and vascular resistance, thereby impairing blood pressure control (Jung et al., 2012; WHO, 2018). The higher consumption of table salt, salted foods, and bouillon cubes among participants with UBP in this study reflects dietary patterns commonly reported in West African settings and underscores the difficulty in achieving sodium reduction in contexts where processed and salt-enhanced foods are culturally entrenched.

Conversely, the lower intake of fruits and vegetables among individuals with UBP is consistent with the findings of systematic reviews and cohort studies demonstrating the protective role of plant-based diets in blood pressure regulation (Madsen et al., 2023; Wan et al., 2024). These foods provide potassium, antioxidants, and bioactive compounds that promote vasodilation and sodium excretion. The present findings therefore corroborate existing evidence and highlight dietary imbalance as a modifiable contributor to poor blood pressure control.

Behavioral Determinants in Relation to Existing Evidence

Physical inactivity emerged as a strong predictor of uncontrolled blood pressure, which aligns with previous research showing that regular physical activity reduces sympathetic nervous system activity, improves endothelial function, and lowers peripheral vascular resistance (Hayes et al., 2022). Similar associations have been documented in both African and high-income settings, reinforcing the universal importance of physical activity in the management of hypertension.

Hazardous alcohol consumption was also significantly associated with uncontrolled blood pressure, consistent with the findings of systematic reviews indicating that heavy alcohol intake raises blood pressure and diminishes the effectiveness of antihypertensive treatment (Tasnim et al., 2020). This relationship may be mediated by increased sympathetic activity, impaired baroreceptor function, and reduced medication adherence. The strength of this association in the current study emphasizes the need to integrate alcohol screening and counseling into routine hypertensive care.

Medication Adherence and Clinical Implications

Poor adherence to antihypertensive medication demonstrated the strongest association with uncontrolled blood pressure, a finding that mirrors extensive evidence identifying nonadherence as a principal barrier to effective hypertension control (Tan et al., 2014; Sarfo et al., 2018). This consistency across settings underscores the fact that pharmacological efficacy alone is insufficient without sustained adherence. The finding highlights the importance of patient education, simplified treatment regimens, and follow-up mechanisms to support long-term adherence.

Interestingly, the inverse association between comorbid conditions and uncontrolled blood pressure contrasts with some studies that reported worse outcomes among patients with multiple chronic conditions. However, similar protective effects have been observed in settings where patients with comorbidities receive close clinical monitoring and intensive management. This suggests that increased healthcare engagement may mitigate the risk of poor blood pressure control and highlights the potential benefits of structured follow-up systems.

Strengths and Limitations

This study makes a unique contribution to the literature by specifically examining uncontrolled blood pressure (UBP) among adults with high blood pressure in Ghana. By employing the World Health Organization's stepwise approach to non-communicable disease surveillance, along with the Food and Agriculture Organization's validated food frequency questionnaire, our methods are both rigorous and easily reproducible in other settings.

However, this study has several limitations. The cross-sectional design allowed us to identify associations but did not permit causal inferences. We did

not capture broader system-level factors such as the quality of health service delivery which may influence blood pressure control. Dietary assessment was self-reported, which may have introduced potential recall bias. Blood pressure readings were taken during routine clinic visits and may have been affected by acute factors such as stress or medication timing. We also did not measure the psychological attributes of the participants, which can affect blood pressure levels. Finally, because we purposively selected two primary health facilities, our sampling strategy may not have fully eliminated selection bias.

Conclusion and Recommendations

The findings of this study have important implications for the management of hypertension in Ghana. First, they underscore the need for integrated care models that combine pharmacological treatment with dietary counseling, physical activity promotion, and behavioral risk reduction. Second, the strong association between lifestyle factors and uncontrolled blood pressure suggests that community-based interventions, such as salt-reduction campaigns and culturally appropriate nutrition education, could substantially improve control rates.

From a policy perspective, incorporating nutritionists, physiotherapists, and health educators into routine hypertension clinics can strengthen multidisciplinary care. Additionally, routine screening for alcohol use and medication adherence should be institutionalized within non-communicable disease (NCD) programs. Addressing these factors may help close the persistent gap between treatment and effective blood pressure control.

Acknowledgements

During the preparation of this manuscript, the authors used ChatGPT and Grammarly to check the grammar and assist with the literature search. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published work.

We are grateful to Almighty God for His continued mercy and grace throughout this project. The authors' heartfelt gratitude goes to the management of Ho Teaching Hospital and Ho Municipal Hospital for their unwavering support during data collection.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

None

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