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RELATIONSHIP OF PATIENT CHARACTERISTICS AND NUTRITIONAL STATUS TO BLOOD PRESSURE AMONG HYPERTENSIVE PATIENTS AT KITUI LEVEL 5 HOSPITAL, KENYA

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ABSTRACT

Hypertension (HTN) is a cardiovascular disorder that significantly contributes to global morbidity and mortality, increasing risks for stroke, heart disease and kidney dysfunction. Poor blood pressure worsens the condition (hypertension) leading to serious medical complications that are costly to treat and manage. Nutritional status, demographic and socioeconomic factors critically influence blood pressure (BP) control, yet their interrelationship remains understudied, especially in resource-limited settings. This demands for adequate measures to probe the link between blood pressure control with patient characteristics and nutritional status. An analytical cross-sectional study was conducted among one hundred and thirty-six hypertensive adults (≥18 years) attending care at Kitui Level 5 Hospital, Kenya. Data on demographic and socioeconomic characteristics including age, gender, marital status, education level, occupation and monthly income, were collected using structured questionnaires while nutritional status was assessed through anthropometric measures including body mass index (BMI), waist circumference (WC), waist to height ratio (WHtR), waist hip ratio (WHR), body fat (BF) and visceral fat (VF). Blood pressure was recorded, and poor BP control was defined as ≥140/90mmHg. The overall mean age of patients was 60.7 years, with 55.1% exhibiting poor BP control (mean age: 62.8 years). Poor BP control was higher among women (67.7%) compared to men (33.3%). Age emerged as a significant predictor of poor BP control (OR=1.72; 95% CI: 1.00-2.92, P=0.046). Strong positive correlations were observed between BP and anthropometric indices, notably BMI (r=0.458, p<0.01), WC (r=0.246, p<0.01) and WHtR (r=0.460, p<0.01). In conclusion, nutritional status indicators (particularly BMI, WC, WHtR), along with demographic factors such as age, marital status, income and gender significantly correlate with hypertension control. Targeted lifestyle interventions promoting healthy body weight and dietary habits should be emphasized by healthcare providers and other stakeholders for effective hypertension prevention and management. Identification of modifiable risk factors of hypertension should be seriously addressed to support its initial prevention.

Key words: Hypertension, blood pressure control, nutritional status, socio-demographic factors, Kenya

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INTRODUCTION

Hypertension is described as systolic blood pressure, which is greater or equal to 140 mmHg, or diastolic blood pressure being greater or equal to 90 mmHg [1]. Hypertension is grouped into primary (essential) or secondary according to etiology, whereby among the two, primary hypertension is the most common type which affects 90-95% of hypertensive patients and its origin is unknown, whereas, secondary hypertension is caused by diseases such as primary aldosteronism and renal disease [2]. Hypertension is one of the major contributors to mortality and morbidity globally [3]. The global burden has steadily increased, doubling from 650 million to 1.3 billion people from 1990 to 2019 [4]. In a study that included thirty- four unique studies comprising 37 data points with a total of 43,025 subjects in 15 African countries, the prevalence of hypertension ranged from 22.3% to 90% from the individual studies, with an overall prevalence of 57.0% [5]. Additionally, it is estimated that three to five older adults in rural and urban areas in Africa have hypertension [5]. The prevalence of hypertension among men and women in sub-Saharan Africa (SSA) increased to 48.0% and 34.0%, respectively, by the year 2019 [4].

Other studies report that low- and middle-income countries, Kenya included, carry the biggest load of non-communicable diseases (NCDs), HTN being one of them [6]. A recent Kenyan study reported a 30% prevalence of HTN, of which the rich people had the highest prevalence compared to the poor [7]. Hypertension (HTN) is the number one risk of cardiovascular disease and cause of premature death globally, particularly in low and middle-income countries [8]. It is an expensive disease whereby a study in Kenya established that hypertension affected productivity by 30%, social life (job loss, sexual life, separation and divorce) by 42%, cost of medication was high accounting for 75.2% of the total out-of-pocket payments. Additionally, most of the patients were unable to cover for medical and other hospital visit- related costs through their existing incomes and had to seek for alternative resources for hypertension care and treatment [9].

Hypertension (HTN) undermines the individual quality of life and raises the cost of health care at the national level as well as causing negative economic effects in society since the productive laborers become chronically ill or die leaving their families [10]. Overweight and obesity are key anthropometric risk factors to HTN [11]. Overweight and obesity contribute to impairment of renal pressure natriuresis resulting from physical compression of kidneys and activation of the renin-angiotensin-aldosterone system and sympathetic nervous system which causes obesity-induced hypertension [12]. Marital status, age, gender, employment and education level are socio-demographic characteristics that are significantly associated with hypertension prevalence and control rate among hypertensive patients [13, 14]. Whereby, persons with higher education level tend to have more knowledge on health issues concerning hypertension, thereby adopting a healthier lifestyle like going for medical checkups, eating a balanced nutritious diet and engaging more in physical activity [15]. Further, high income index may lead to high level of luxury like owning and driving private cars, which results to less physical activity, exposing them to the risk of hypertension [16]. Hypertension is a public health problem because of low effective lifestyle awareness, management, control and financial burden [8]. Therefore, the present research aimed at exploring the relationship between nutritional status indicators (BMI, WC, WHR, WHtR, BF and VF) and patient characteristics (age, gender, marital status, income index, education level and occupation) in hypertensive patients attending level 5 hospital. The findings will assist in developing strategies and policies aimed at preventing and improving management and control of hypertension and its complications.

MATERIALS AND METHODS

A cross-sectional analytical study design was used to determine the relationship between patient characteristics and nutritional status to blood pressure levels. The study was conducted in a hospital setting on hypertensive patients aged ≥18 years who were attending Kitui Level 5 Hospital, Hypertensive Care Clinic. The study included hypertensive patients who visited the outpatient clinic for consultations, general check-ups and those on follow up at the hypertensive care clinic at Kitui level 5 hospital, who were given informed consent forms and were willing to participate in the study. Those excluded from the study were the ones attending care at the hypertensive clinic for the first time, expectant women, critically ill patients, inpatient clients and those who declined to consent to the study due to health or personal reasons.

The demographic and socio-economic data that included marital status, age, education level, occupation, gender and income index was collected using structured questionnaires. Anthropometric measurements that included weight, height, waist, hip circumference, visceral fat and body fat were collected using standard procedure [17, 18]. All anthropometric equipment's were calibrated daily prior to data collection to ensure accuracy and reliability. Weight and height were measured with participants wearing light clothes and no shoes, hats, scarves, head wraps and anything in their pockets. The weight was determined to the nearest 0.1kg using a calibrated electronic weighing scale (Seca 874 Digital Flat Scale for mobile use with push buttons and double display) and height to the nearest 0.1 cm using a stadiometer attached to the weighing scale. Body Mass Index (BMI) was calculated using weight (kilograms)/height (meters)^2 and classified as per WHO classification

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[19]. Waist circumference (WC) and hip circumference (HC) were measured using standard protocols [17]. Waist circumference was measured around the midpoint between the top of the iliac crest and the lower margin of the last palpable rib in the mid auxiliary line using a stretch-resistant tape to the nearest 0.5cm. Hip circumference was measured as the maximal circumference around the buttock's posterity and pubic symphysis anteriorly with participants standing upright, arms relaxed at the sides, feet positioned close together and body weight evenly distributed while wearing light clothing. Body fat and visceral fat were measured using a single-frequency four-electrode bioelectric impedance analyzer (BIA), (Tanita BC-420MA, body composition analyzer, Tanita Corporation, Tokyo, Japan) as per standard protocol [18]. The participants were requested not to do the following before the test: consume alcohol for 24 hours, engage in exercise for 12 hours, take meals for 3 to 4 hours. They were also advised to relieve their bladder 30 minutes before the test. The weight, height, age and gender of the participants were considered and the tests were administered at the same time [20]. During measurement, participants were requested to remove their shoes and socks and stand erect on the bioelectric impedance analyzer machine, holding both sides of the machine at shoulder level and at 90-degree angles [21]. The measurements were read and recorded as percentage (%). Blood pressure readings from medical records (previous visit) were included to provide a comparative baseline for assessing variability or consistency in patient blood pressure control. Additionally, Systolic and diastolic blood pressure was measured on data collection (clinic) day by trained research personnel on the left arm with a Spengler digital sphygmomanometer (model: Autortensio® noSPG440). The participants were requested to put both feet flat on the ground and their legs uncrossed while in a seated position with the arm supported at the heart level, for at least 5 minutes and the arm with the cuff rested on a table at chest height while the cuff was snug correctly against bare skin. The reading was taken and recorded in mmHg as per standard protocol AAMI/ESH/ISO 81060-2:2018 (Association for the Advancement of Medical Instrumentation/ International Organization for Standardization).

Sample size determination

The calculated sample size was initially 129 based on Cochran's formula of 1963. This number was inflated by10% to account for potential attrition, resulting in 142 participants. Due to incomplete or missing data among recruited participants, the final analyzed sample was 136, which maintains statistical power for study objectives.

Classification of anthropometric parameters

Body Mass Index (BMI) given by weight in kg/ height in m^2 was categorized according to WHO classification (WHO, 2004): underweight (BMI ≤18.4kg/m^2),

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normal (BMI 18.5-24.9kg/m^2), overweight (BMI 25-29.9kg/m^2) and obesity (BMI ≥30kg/m^2). The waist-hip-ratio (WHR) given by WC in cm/HC in cm was classified according to WHO classification (WHO 2008b), based on health risk into: low (men 0.94 or lower, women 0.80 or lower), moderate (men 0.90-1.0, women 0.80-0.85) and high (men 1.0 or higher, women 0.86 or higher). Waist circumference (WC in cm), according to WHO (2008b). It was classified based on health risk, into: low (men- below 94 cm, women below 80 cm), high (men 94-102 cm, women 80-88 cm), very high (men>102 cm, women >88cm). Waist-height ratio (WHtR) given by WC in cm/Height in cm was classified according to WHO (WHO 2008b) based on health risk into: low (men <0.5, women <0.55), high risk (men >0.5, women >0.55).

Data analysis

Data analysis was done using Microsoft Windows Statistical Package for Social Science (SPSS)) version 20:0. Data were expressed as mean standard deviation for continuous variables and percentages for categorical variables. Logistic regression analyses were conducted to determine the predictive value of socio-demographic variables on poor BP control (BP ≥140/90mmHg). Chi-square test were performed to determine the relationship between demographic, socio-economic characteristics (gender, age, marital status, education level, occupation as well as income index) and blood pressure. Pearson correlation analyses were performed to explore relationship between continuous anthropometric indices (BMI, WC, WHR, WHtR, BF and VF) and systolic/diastolic blood pressure values. An odds ratio with a *p*-value of <0.05 and a correlation coefficient with a *p*-value of <0.05 or <0.01 was considered statistically significant.

RESULTS AND DISCUSSION

Hypertension is the number one risk of cardiovascular disease and cause of premature death globally, particularly in low and middle-income countries [8]. In the current study, hypertension was described as systolic blood pressure greater or equal to 140 mmHg and diastolic blood pressure greater or equal to 90 mmHg as described by Benjamin *et al.* [1]. In the current study, a total of 136 hypertensive patients participated, giving a response rate of 95.8%, that is, data collection was successfully carried out on 136 participants. The prevalence of high blood pressure was reported at 54% in the current study, with 57.6% having elevated systolic blood pressure while 18.7% having elevated diastolic blood pressure as shown in Table 1. The prevalence was similar to the result of other scholars that reported similar prevalence of 37.3% [22]. Increased blood pressure may result from arterial hypertension that occurs due to deregulation of vasodilators and vasoconstrictors, increased renal retention of sodium and water and arterial stiffness [23]. The prevalence of systolic blood pressure was higher as compared to diastolic blood pressure and was comparable to that reported by Mirzaei *et al.* [22].

This study reported that 68% of the participants were females while 32% were males as shown in Table 2. Results of the study on gender were similar to a study by Sainju *et al.* [24], who reported that 72% of the HTN partcipants were females while 27% males. In addition, majority of the participants with uncontrolled HTN were female (67.7%) as shown in Table 3. Gender is a non-modifiable risk factor of hypertension, where high anti-inflammatory immune profile in hypertensive females may have compensatory mechanism to lower blood pressure compared to males who exhibit a higher pro-inflammatory immune profile [25]. Generally, hypertension is more prevalent in males than females [2, 26] but, previous literature has indicated contrasting results, which are in agreement with the current study that reported higher prevalence of uncontrolled BP in females (67.7%) compared to males (33.3%) [13, 27].

Additionally, age is also strongly related to HTN progression and management [27]. Age has been reported as the most common predictor and non-modifiable risk factor of hypertension, where older adults (>50years) are more likely to suffer from HTN than younger adults (aged <40 years) [26, 27]. In the current study majority of the participants were aged between 51-70 years (66.2%). Moreover, there was a positive significant relationship between age and blood pressure control (p=0.046) as shown in Table 3. The current study further demonstrated that older age is a major factor associated with uncontrolled blood pressure where 66.2% of hypertensive patients aged 51-70 years had uncontrolled blood pressure compared to 2.2% of those aged 25-40 years. Aging causes structural changes in large arteries and lower baroreceptor sensitivity, a rise in responsiveness to sympathetic nervous system stimuli, increased renal sodium retention, and altered renin-aldosterone association leading to uncontrolled blood pressure [28]. Moreover, bivariate logistic regression results in Table 3 indicated that there is a likelihood of poor blood pressure control as age advances, with significant Odd ratio (OR=1.176, 95% CI: 1.00-2.918 P=0.046) for the blood pressure control and age. Several studies have shown that there is a link between age and blood pressure control [26], the findings of this study are in agreement with this, where relationship between age and blood pressure was statistically significant (p=0.046).

The current research also looked at the relationship between marital status and HTN. The results in Table 3 show that the married population had the highest prevalence of uncontrolled blood pressure (69.1%), compared to other marital statuses, with those who were single reporting good control. Studies done elsewhere revealed that there is no direct impact of marital status on blood pressure for men but, it has an indirect impact in women through dietary habits and economic status and it is an independent risk factor for HTN in women [29]. In agreement with other studies conducted in Africa [13] and Asia [29], the current study revealed that married participants (72.1%) were significantly associated with high prevalence of hypertension as shown in Table 2. In other studies, the findings indicated that never married men and widowed women had a significantly higher prevalence of hypertension [30]. The dynamics surrounding the influence of marital status and HTN have not yet been fully identified.

Furthermore, level of education was also a crucial indicator that was found to have a relationship with the prevalence and control of blood pressure in the current study, which is in line with previous scholars [13, 27]. The prevalence of uncontrolled blood pressure was high among those who had attained primary school education (37.3%) compared to college level (11.1%) as indicated in Table 3. This finding was similar to prior research which reported that higher education attainment was related to decreased levels of uncontrolled blood pressure [14]. Further, low education level affects the management and control of hypertension directly or indirectly due to insufficient information on disease prevention, discrimination in healthcare service and positive healthy behaviors [31].

Moreover, the income or occupation status of an HTN patient has been shown to have an influence on blood pressure control [6, 16]. In the current study, uncontrolled blood pressure prevalence was high among farmers (46.9%), compared to salaried individuals (9.9%). Interestingly, participants with higher monthly income (4.9%) showed better blood pressure control compared to those with lower monthly income (46.9%). This finding is in line with results from previous studies [14, 16] that reported that low income earners and unemployed were more likely to suffer from hypertension and less likely to have controlled hypertension.

Overweight and obesity is related to uncontrolled hypertension [32]. The current study reported that 46.8% of the participants were overweight while 23.7% were obese of which 25.9% had uncontrolled hypertension. A study by Mbijiwe *et al*. [33] conducted on HTN patients, revealed that most (59.0%) of the participants were overweight and 23.9% were obese and, agreeing with the current study. Being overweight leads to impaired renal-pressure natriuresis due to physical compression of kidneys and activation of the renin-angiotensin-aldosterone system and sympathetic nervous system which result to obesity-induced hypertension [12]. This is also supported by a study by Xiao *et al.* [34] which reported 42.5% subjects were overweight while obesity rate was 14.6%. Experts of the American Heart Association (AHA), highlighted obesity as an independent threat for cardiovascular health conditions as well as hypertension because of its relationship with a surge in the

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concentration of Low-Density Lipoproteins, glucose, tri-acylglycerols plus a reduction of High-Density Lipoprotein level.

Additionally, the prevalence of uncontrolled blood pressure was highest (92%) among the participants who had a WHtR above 0.5 for men and 0.55 for women (Table 4), demonstrating that, WHtR (≥0.5/0.55, 92%) is a superior predictor of blood pressure control compared to BMI (≥30kg/m^2, 28%), WC (≥80/94cm, 81.3%), WHR (≥0.80/0.94, 85.3%), BF (≥30/35%, 73.3%) and VF (≥10%, 37.3%). This result is consistent with previous literature [35, 36]. Furthermore, the current study indicates that participants with higher WHR (OR=1.512) and WC (OR=1.180) had significantly increased odds of poor blood pressure control whereas VF (OR=0.402) and BMI (OR=0.619) were associated with lower odds. Similar to prior research [35], this study results (Table 4) showed that WC, WHR, WHtR, BF and VF are superior to BMI (OR=0.619) in relationship to blood pressure control. Moreover, the analyzed results show that WHR (OR=1.512) and WHtR (OR=0.835) (measures of central adiposity) based on OR values, WHR has a higher value than WHtR. This finding is similar to other studies which indicated that WHR and WHtR are better predictors of blood pressure control than BMI [36]. In contrast, some studies like that of Mohamed *et al*. [37] and Qiu *et al*. [38], reported that the subjects with a higher BMI were found to have low control of blood pressure as well as those with high WC and WHR, and the effect of WHR on blood control was greater than WC [35].

Moreover, the current study looked at the correlation of anthropometric indices with HTN. The results of the study indicated that, most of the anthropometric indices had a positive correlation with blood pressure (Table 6). Moderate positive correlations were found between BMI and BF (r=0.613, P<0.01), WHtR and VF (r=0.583, p<0.01) and BMI and WC (r=0.585, P<0.01). Waist circumference showed a modest positive correlation with blood pressure (r=0.246, p<0.01). Researchers have reported findings that indicate anthropometric indicators have a strong relationship with blood pressure [35], whereby, any measure above the optimum of these indices, leads to poor blood pressure control [36, 39].

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

In conclusion, this study found significant associations between anthropometric indices and blood pressure control among hypertensive patients. Obesity-related indicators-particularly visceral fat (VF), waist hip ratio (WHR), waist-height ratio (WHtR) and body fat (BF) emerged as strong predictors of poor hypertension control. Additionally, demographic factors such as older age (OR=1.716, p=0.046), female, marital status, lower education levels and low monthly income were significantly associated with uncontrolled hypertension. Given the cross-sectional study design, these findings should be interpreted as associative rather than causal. Therefore, targeted interventions addressing obesity, enhancing education on hypertension management and encouraging lifestyle modifications should be prioritized by healthcare providers and other stakeholders, for high risk populations. Future longitudinal studies are recommended to establish causal relationships and further inform hypertension prevention and management strategies.

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Competing interests
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Availability of data and materials
All the collection tools and data are in the custody of Janet Kirema and are available on request.

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Authors' contributions
All the authors contributed to the conception and design of the study. Ann Thuita, Beatrice Kiage, and Judith Okoth supervised the study. Janet Kirema collected and analyzed the data as well as drafting of the manuscript. All the authors contributed to the interpretation of the results, revision and approval of the manuscript.

Ethics approval and consent to participate
Ethical approval to conduct the research was granted by Jomo Kenyatta University of Agriculture and Technology, Institutional Scientific and Ethics Review Committee, Approval No. JKU/ISERC/02316/0801, while the administrative approval was granted by the National Commission for Science, Technology and Innovation (NACOSTI) permit No. NACOSTI/P/23/23507; the Ministry of Interior and Co-ordination of National Government, County Commissioner Kitui Permit No. KC603/IV/70; Ministry of Education Kitui permit No. KTIC/ED/RES/VOL1/22/121, County Government of Kitui (Ministry of Health and Sanitation) Permit No. CGTI/MOH/HRM/8/Vol.1(044) and Kitui Level 5 hospital administrators. Written/verbal informed consent was provided by all participants.

Abbreviations

BMI	Body Mass Index
BF	Body Fat
BP	Blood Pressure
CVD	Cardiovascular Disease
DBP	Diastolic Blood Pressure
HC	Hip Circumference
HDL	High Density lipoproteins
HTN	Hypertension
LDL	Low Density Lipoproteins
NCD	Non-Communicable Disease
SBP	Systolic blood pressure
SPSS	Statistical Package for Social Sciences
WC	Waist Circumference
WHtR	Waist-Height Ratio
WHR	Waist-Hip Ratio
WHO	World Health Organization
VF	Visceral Fat

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Table 1: Blood pressure

Parameters		**Frequency (%)**	**Mean± SD**
Blood pressure	**Controlled BP (<140/90mmHg)**	61(43.9)	125.78±12.34
	Elevated BP (>140/90mmHg)	75(54.0)	153.80±11.59
Systolic blood pressure	**Controlled SBP (<140mmHg)**	56(40.3)	124.22±11.83
	Elevated SBP (≥140mmHg)	80(57.6)	153.14±11.36
Diastolic blood pressure	**Controlled DBP (<90mmHg)**	110(79.1)	77.61±8.35
	Elevated DBP (≥90mmHg)	26(18.7)	99.00±8.16

BP: Blood pressure; SBP: Systolic blood pressure; DBP: Diastolic blood pressure
n represents number of participants; % percentage; SD: Standard deviation

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Table 2: Demographic and socioeconomic characteristics of the participants

Variable		n (%)
Gender	**Male**	43(32.0)
	Female	93(68.0)
Age	**25-40**	7(5.1)
	41-50	16(11.8)
	51-70	90(66.2)
	>71	23(16.9)
Marital status	**Married**	98(72.1)
	Widowed	29(21.3)
	Separated/divorced	3(2.2)
	Single	6(4.4)
Children	**1**	39(30.0)
	2	47(37.0)
	3	27(21.0)
	>3	16(12.0)
Level of education	**None**	15(11.0)
	Primary	54(40.0)
	Secondary	52(38.0)
	College	15(11.0)
Occupation	**Unemployed**	24(18.0)
	Formal employment	11(8.0)
	Business	30(22.0)
	Farmer	68(50.0)
	Casual labor	3(2.0)
Monthly income	**<1000**	68(50.0)
	1001 to 5000	31(22.0)
	5001 to 10000	17(13.0)
	10001 to 15000	1(0.7)
	15001 to 20000	8(6.0)
	20001 to 25000	6(4.3)
	>25001	5(4.0)

n represents the participants while (%) represents the percentage; X^2: Chi-square;
Monthly income is in Kenyan shillings
*Statistical significance at p<0.05; **Statistical significance at p<0.01

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Table 3: Relationship between social demographic characteristics and Blood pressure

Variable		BP<140/90mmHg n (%)	BP>140/90mmHg n (%)	X^2	0dd ratio	P value	95% CI
Gender	**Male**	16(29.1)	27(33.3)	0.273	0.993	0.987	0.450-2.191
	Female	39(70.9)	64(67.7)				
Age	**25-40**	4(2.9)	3(2.2)	3.918	1.716	0.046*	1.00-2.918
	41-50	11(20.0)	9(11.1)				
	51-70	34(61.8)	54(66.7)				
	>70	6(10.9)	15(18.5)				
Marital status	**Married**	42(76.4)	56(69.1)	2.285	1.138	0.610	0.698-1.870
	Widowed	9(16.4)	20(24.7)				
	Separated/divorced	2(3.6)	1(1.2)				
	Single	2(3.6)	4(4.9)				
Education level	**None**	5(9.1)	10(12.3)	0.760	0.929	0.759	0.581-1.486
	Primary	24(43.6)	30(37.3)				
	Secondary	20(36.4)	32(39.5)				
	College	6(10.9)	9(11.1)				
Occupation	**Unemployed**	10(18.2)	14(17.3)	3.228	0.920	0.598	0.674-1.255

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	Formal employment	3(5.5)	8(9.9)				
	Business	12(21.8)	18(22.2)				
	Farmer	30(54.5)	38(46.9)				
	Casual laborer	0(0.0)	3(3.7)				
Monthly income	**<1000**	30(54.5)	38(46.9)	3.914	1.265	0.076	0.976-1.639
	1001 to 5000	14(25.6)	17(21.0)				
	5001 to 10000	6(10.9)	11(13.6)				
	10001 to 15000	1(1.8)	0(0.0)				
	15001to 20000	1(1.8)	7(8.6)				
	20001 to 25000	2(3.6)	4(4.9)				
	>25001	1(1.8)	4(4.9)				

n represents the number of participants while (%) represents the percentage. OR-Odds ratio; 95% CI: 95% Confidence interval; *Statistical significance at p-value<0.05; ** Statistical significance at p-value<0.01; BP: Blood pressure; X^2: Chi-Square: Monthly income is in Kenyan shillings

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Table 4: Relationship between Anthropometric indices and blood pressure

Variable		BP<140/90mmHg n (%)	BP>140/90mmHg n (%)	X2	P Value	Odd ratio	95% CI
BMI	**<30kg/m2**	49(80.3)	54(72.0)	1.270	0.260	0.619	0142-3.232
	>30kg/m2	12(19.7)	21(28.0)				
WC	**<80 cm for W/94cm for M**	13(21.3)	14(18.7)	0.146	0.701	1.180	0.507-2.745
	>80 cm for W/94 cm for M	48(78.7)	61(81.3)				
WHR	**<0.80 for W/0.94 for M**	13(21.3)	11(14.7)	1.022	0.701	1.512	0.599-3.822
	>0.80 for W/0.94 for M	48(78.7)	64(85.3)				
WHtR	**<0.5 for M/0.55 for W**	5(8.2)	6(8.0)	0.002	0.967	0.835	0.230-3.035
	>0.5 for M/0.55 for M	56(91.8)	69(92.0)				
BF	**<30% for M/35% for F**	20(32.8)	20(26.7)	0.607	0.312	1.046	0.462-2.371
	>30% for M/35% for F	41(67.2)	55(73.3)				
VF	**<10%**	46(75.4)	47(62.7)	2.527	0.112	0.402	0.542-10.151
	>10%	15(24.6)	23(37.3)				

n represents the number of participants while (%) represents the percentage, OR-Odds ratio; 95% CI: 95% Confidence interval; *Statistical significance at p-value<0.05; ** Statistical significance at p-value<0.01

X^2: Chi-Square BP: Blood pressure; BMI: Body mass index; WC: Waist circumference; WHR: Waist hip ratio; WHtR: Waist-height ratio; M Men; W: Women

Table 5: Anthropometric indices as predictors of blood pressure control

Parameters		Totals n (%)	Mean± SD
BMI	**<30kg/m²**	103(75.7)	24.75±3.26
	≥30kg/m²	33(24.3)	32.88±1.86
WC	**<80 cm for women/94cm for men**	27(19.9)	84.96±7.34
	>80cm for women/94 cm for men	109(80.1)	112.71±9.70
WHR	**<0.80 for women/0.94 for men**	24(17.7)	0.89±0.04
	>0.80 for women/0.94 for men	112(82.3)	0.95±0.06
WHtR	**<0.5 for men/0.55 for women**	11(8.1)	0.49±0.03
	>0.5 for men/0.55 for women	125(91.9)	0.63±0.07
Body fat	**<30% for men/35% for women**	40(29.4)	26.12±5.95
	>30% for men/35% for women	96(70.6)	42.55±6.76
Visceral fat	**<10%**	93(68.4)	5.78±2.07
	>10%	43(36.6)	14.70±3.27

n represents the number of participants while (%) represents the percentage; SD: Standard deviation
BMI: Body mass index; WC: Waist circumference; WHR: Waist hip ratio; WHtR: Waist-height ratio

Table 6: Pearson Correlations between each of the anthropometric indices (variables) of hypertensive patients

Variable	1	2	3	4	5	6	7	8
1. BP	-							
2. Weight	0.135	-						
3. BMI	-0.037	0.458**	-					
4. WC	0.246**	0.449**	0.585**	-				
5. WHtR	0.130	0.413**	0.460**	0.647**	-			
6. WHR	0.114	-0.030	0.132	0.296**	0.114	-		
7. BF	0.149	0.496**	0.613**	0.572**	0.523**	0.040	-	
8. VF	0.060	0.491**	0.553**	0.484**	0.583**	0.086	0.757**	-

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed)
BP: Blood pressure; BMI: Body mass index; WC: Waist circumference; WHtR: Waist-height ratioWHR: Waist-hip ratio; BF: Body Fat; VF: Visceral fat

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