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Original Article

Prevalence and Factors Associated with High Blood Pressure Among Out-patients Aged Between 30 and 65 Years at Kabutare District Hospital, Rwanda.

Authors: Benjamin Rugira[1*], Amos Habimana[1]

Corresponding authors and affiliations

[1*]Benjamin Rugira, Department of Public Health, Mount Kenya University, Rwanda, Email: rugirabenjamin@gmail.com, Tel: +250788721068

Co-Authors and Affiliations

[1]Dr. Amos Habimana, Department of Public Health, Mount Kenya University, Rwanda, Email: habis2012@yahoo.com

Abstract

Background: High blood pressure is a major global health issue, particularly in low and middle-income countries, where it contributes 45% of heart-related deaths. The researcher aimed to explore the extent of HBP by assessing the prevalence and contributing factors of high blood pressure among outpatients aged between 30 and 65 years at Kabutare district hospital in Rwanda. **Objectives:** To determine the prevalence of high blood pressure in this age group, identifying its contributing factors, and to examine the relationship between these factors and high blood pressure. High blood pressure often asymptomatic until significant damage occurs, is a key risk factor for various health issues. Despite effective treatments, many remain unaware of their condition, especially in resource-limited settings.

Methods: The study used a cross-sectional design, collecting data through surveys that measured blood pressure and gathered information on socio-economic status, lifestyle habits, and demographic characteristics. Statistical analysis was conducted using SPSS version 20 to identify correlations between high blood pressure and socio-economic, lifestyle, and demographic factors.

Results: The prevalence of high blood pressure was found to be 28.1% among respondents. Bivariate analysis showed significant associations between high blood pressure and variables such as income level ($p < 0.001$), frequency of alcohol consumption ($p < 0.001$), number of cigarettes smoked ($p < 0.001$), physical activity ($p < 0.001$), walking to work ($p < 0.001$), and salt intake ($p = 0.021$). In multivariate analysis, the strongest independent predictors of high blood pressure were high income (AOR = 15.8; 95% CI: 3.66–68.20), alcohol intake more than 3 times per week (AOR = 84.07; 95% CI: 18.04–391.83), smoking ≥5 cigarettes per day (AOR = 2.47×10^{9}), and not walking to work (AOR = 5.33; 95% CI: 2.38–11.94). Age and salt consumption showed weaker and non-

significant associations after adjustment. The model explained 53.4% of the variance in high blood pressure status (Nagelkerke $R^2 = 0.534$) and correctly classified 85% of cases.

Conclusions: Hypertension is highly prevalent among Rwandan adults and is significantly associated with modifiable risk factors such as alcohol consumption, smoking, sedentary behavior, and higher income. These findings highlight the need for integrated community-level interventions focused on health education, behavior modification, and early screening. Strengthening primary healthcare services and promoting active lifestyles should be prioritized in national strategies to curb the growing burden of high blood pressure.

Keywords: Factors associated, High blood pressure, Out-patient

Introduction

Hypertension persistently raised arterial pressure that meets or exceeds 140/90 mmHg on repeated measurement is a key precipitant of cardiovascular morbidity and mortality (WHO, 2023). Globally it is blamed for nearly one in two deaths attributable to heart disease (Pius Al et al., 2021). Evidence from Sri Lanka illustrates the role of heredity: adults reporting hypertension in multiple first- and second-degree relatives showed a markedly higher prevalence themselves than those without such a family background (Ranasinghe et al., 2015). The disorder is unevenly distributed across regions. World Health Organization estimates indicate that 46 % of adults aged ≥ 25 years in Africa are hypertensive the highest proportion worldwide versus 35 % in the Americas and about 40 % elsewhere (Zhou et al., 2021). For 2019 the age-standardized global prevalence among 30- to 79-year-olds stood at 33.1 %, rising to 35.5 % in Africa. Neighboring countries reported similar figures (Burundi 34.2 %, Uganda 32.5 %, Tanzania 33.2 %, Democratic Republic of Congo 34.3 %, and Kenya 33.2 %), while Rwanda was estimated at 29.8 % (WHO, 2018). A Burkinabe study further demonstrated that the likelihood of hypertension climbs steadily with advancing age in both rural and urban settings (Soubeiga et al., 2017).

Within Rwanda, the 2022 national non-communicable disease survey placed current prevalence at 15.9 % and forecast a rise to 17.8 % by 2025 (Rwanda Ministry of Health, 2022). Screening coverage remains limited: only 21.3 % of adults had ever undergone blood-pressure measurement, with higher uptake among women (29.9 %) than men (11.8 %) and among urban and semi-urban residents compared with those in rural areas. Of those who had been screened, 11.2 % carried a hypertension diagnosis, yielding an overall national estimate of roughly 15 %.

Hypertension thus remains the principal modifiable driver of cardiovascular disease in low- and middle-income countries, where untreated cases are common (Ntaganda et al., 2022). In Rwanda, more than half of affected individuals are unaware of their condition, amplifying the non-communicable-disease burden (Rwanda Biomedical Center, 2022). Community screening in Mata Sector revealed an undiagnosed prevalence of 12 %, while a separate investigation among people living with HIV at Kabutare District Hospital documented a 16 %

rate of elevated blood pressure (Parati et al., 2023; Bernard et al., 2023). These observations highlight the need for a focused appraisal of hypertension and its determinants among the hospital's general outpatient population aged 30–65 years, aiming to inform broad, context-appropriate prevention and control strategies.

Methods

Study Design

This study employed a cross-sectional design to assess the prevalence and associated factors of high blood pressure among outpatients aged 30 to 65 years attending Kabutare District Hospital. The cross-sectional approach was appropriate for providing a snapshot of the condition at a specific time and for estimating the prevalence of hypertension within the target population. Moreover, this design facilitated the simultaneous analysis of various risk factors, including age, income, tobacco and alcohol use, and physical activity. This allowed for the identification of potential associations between hypertension and multiple demographic, socioeconomic, and behavioral determinants, in line with the study's objective.

Study Population and Eligibility

The study population comprised outpatients aged between 30 and 65 years who visited Kabutare District Hospital during the data collection period. This age group was selected because the prevalence of hypertension tends to rise significantly from the age of 30, with a peak observed between 50 and 65 years. Individuals below 30 years were excluded due to the typically lower prevalence of high blood pressure in that age group, which could reduce statistical power. Similarly, participants over the age of 65 were excluded to minimize confounding due to age-related comorbidities and physiological changes. This age range was also chosen because few previous studies had focused on this group in the Kabutare setting, despite the increasing risk of hypertension with age.

Inclusion criteria consisted of all consenting outpatients aged 30 to 65 years who were present during the study period. Exclusion criteria included pregnant and breastfeeding women due to physiological changes in blood pressure during and after pregnancy, as well as hospital-admitted patients, whose routine physical activity may be restricted. Additionally, individuals with mental health disorders were excluded due to potential challenges with providing informed consent and adhering to data collection protocols.

Sample Size Determination and Sampling Technique

The required sample size was calculated using a single population proportion formula for cross-sectional studies, assuming a 95% confidence level, a 5% margin of error, and a conservative prevalence estimate ($p = 0.5$), yielding a sample size of 384.16. This figure was rounded to 385, and a 10% contingency for non-responses brought the final sample size to 424 participants. Systematic random sampling was employed. Based on hospital records

indicating an average of 320 outpatients per day across eight departments, the expected outpatient volume over five days was estimated at 1,600 individuals. The sampling interval (k) was calculated as 1600/424 ≈ 4. To ensure randomness, the first participant was selected using a random starting point, after which every fourth eligible outpatient was included until the sample size was reached.

Data Collection Procedures

Data were collected through face-to-face interviews and direct measurements, using a structured questionnaire adapted from the WHO STEPwise approach. The instrument covered various domains, including socio-demographic characteristics (age, sex, education, marital status, occupation, and income), behavioral risk factors (tobacco and alcohol use, physical activity, and occupational stress), and dietary patterns. Dietary assessment was performed using a 24-hour dietary recall and a 7-day Food Frequency Questionnaire (FFQ), both validated by WHO and FAO. Physical activity was evaluated using the WHO Global Physical Activity Questionnaire (GPAQ), which accounts for activity across work, transport, and recreational domains and calculates metabolic equivalents (METs). Occupational stress was assessed using a nine-item scale rated from 1 (no stress) to 5 (extremely high stress).

Blood pressure measurements were taken using an OMRON automated digital monitor in accordance with WHO guidelines. Participants were seated quietly for at least 10 minutes before measurement. Three readings were recorded at one-minute intervals, and the average of the last two was used for analysis. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, or current use of antihypertensive medication. Anthropometric assessments included height, weight, and waist-hip ratio, using standard equipment (Seca® 213 stadiometer and Seca® 813 scale). BMI was computed as weight in kilograms divided by the square of height in meters.

Quality Assurance: Reliability and Validity of Instruments

To ensure data reliability and instrument consistency, a pilot study involving 20 participants was conducted. The internal consistency of the FFQ and GPAQ was confirmed with Cronbach's alpha scores of 0.82 and 0.79, respectively. Inter-rater reliability for blood pressure measurement was high (Cohen's Kappa = 0.87), and the intraclass correlation coefficient (ICC) for repeated BP measures was 0.91, confirming measurement stability. Digital scales were calibrated before each session to maintain accuracy. Content validity of the questionnaires was established through expert review by public health professionals and nutritionists. Construct and criterion validity were assessed through comparison with established tools and correlation with known health outcomes such as blood pressure and BMI. The blood pressure categorization followed the European Society of Hypertension (ESH) guidelines, which classify blood pressure into normal, stage 1, stage 2, and stage 3 categories. A fast resting heart rate was defined as greater than 80 beats per minute.

Data Management and Statistical Analysis

Data from the questionnaires were checked, coded, and entered into SPSS version 20 for analysis. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to characterize the sample and determine the prevalence of hypertension. To identify potential factors associated with high blood pressure, chi-square tests were conducted for bivariate analysis. Variables with p-values less than 0.05 were included in the multivariate logistic regression model to identify independent predictors of hypertension. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated to evaluate the strength and direction of associations. All statistical tests were two-tailed and considered significant at the 0.05 level. The findings were presented using tables, graphs, and descriptive summaries.

Ethical Considerations

The study received ethical approval from the Mount Kenya University Ethical Review Committee, and permission was obtained from Kabutare District Hospital management. Informed consent was obtained from each participant, both verbally and in writing. Confidentiality was maintained by anonymizing all data, using coded identifiers instead of names. Electronic files were stored in password-protected computers, and physical documents were kept in locked cabinets. All data will be securely retained for five years' post-study and subsequently destroyed in compliance with institutional data protection guidelines.

Results

Demographic Characteristics of Study Respondents

The study involved a total of 424 outpatients aged between 30 and 65 years. Regarding gender distribution, males represented the majority at 59.0% (n = 250), while females constituted 41.0% (n = 174). This suggests a slightly higher male participation among those seeking outpatient care within the specified age group. Age-wise, the largest proportion of participants (40.3%, n = 171) fell within the 57–65 years' bracket, followed by those aged 39–47 years at 22.4% (n = 95), and 30–38 years at 22.2% (n = 94). The smallest proportion (15.1%, n = 64) were aged 48–56 years. This age distribution indicates that a significant portion of patients attending outpatient services are older adults nearing retirement age, a group more prone to chronic conditions such as hypertension. Body Mass Index (BMI), a known risk factor for high blood pressure, was assessed among all respondents. More than half of the participants (52.8%, n = 224) had a normal BMI. However, 24.5% (n = 104) were overweight, and 6.8% (n = 29) were obese, indicating that nearly a third of the study population is at increased risk for hypertension due to excess weight. Additionally, 15.8% (n = 67) of the participants were underweight, which may point to underlying nutritional deficiencies or other chronic health issues. These findings suggest that while the majority maintain a healthy weight, a notable proportion are exposed to BMI-related risks for elevated blood pressure.

Marital status is another social determinant that may influence health behaviors and access to care. The majority of participants (65.1%, n = 276) were married, while 20.0% (n = 85) were single. Smaller percentages were divorced (9.9%, n = 42) and widowed (5.0%, n = 21). The predominance of married individuals may imply more stable social support systems, which could influence health-seeking behavior. In terms of education, a large proportion of participants (55.7%, n = 236) had no formal education, followed by those with primary education (22.4%, n = 95). Only 10.8% (n = 46) and 11.1% (n = 47) had secondary and tertiary education respectively. Limited educational attainment may be linked to lower health literacy, which can affect the understanding and management of conditions like hypertension. Regarding income, the majority of participants (41.5%, n = 176) earned less than 30,000 Rwandan Francs per month, reflecting low socioeconomic status. Another 38.0% (n = 161) earned between 70,001 and 100,000 Rwf, while only 10.8% (n = 46) earned above 100,000 Rwf. The minority (9.7%, n = 41) earned between 30,001 and 70,000 Rwf. These figures suggest that financial limitations may impact the ability to afford regular medical check-ups, medication, and a healthy lifestyle, all of which are crucial in preventing and managing high blood pressure. Most participants (80.2%, n = 340) reported agriculture as their main source of income, while others depended on salaries (5.2%, n = 22), business (5.0%, n = 21), donations (5.0%, n = 21), and other sources (4.7%, n = 20). This reliance on subsistence farming may imply irregular income flows, further complicating access to consistent health care. In terms of occupation, 60.6% (n = 257) of participants were employed, 26.2% (n = 111) were self-employed, and 13.2% (n = 56) were non-employed. The prevalence of informal and subsistence work reflects potential occupational stressors and reduced access to workplace health benefits, possibly contributing to the development or poor management of hypertension. Family size also plays a role in resource allocation and stress levels. About 35.6% (n = 151) of respondents lived in households with 4–6 members, 34.7% (n = 147) had families larger than six, while 29.7% (n = 126) lived in smaller families of 1–3 members. Larger household sizes may impose financial and emotional burdens that influence hypertension risk. Finally, the majority (70.0%, n = 297) of participants lived in rural areas, while 30.0% (n = 127) resided in peri-rural settings. This rural predominance may limit access to quality health services and hypertension education. In few words, the sample population comprises a predominantly older, rural-based, low-income population with limited formal education. These demographic and socioeconomic factors, when combined with BMI distributions and occupational realities, present a complex web of risks and determinants that must be considered in addressing the high burden of hypertension among outpatients at Kabutare District Hospital.

Table 1 Demographic characteristics of study respondents

Variable	Category	Frequency	Percent (%)
Gender	Male	250	59.0
	Female	174	41.0
Age	30–38 years	94	22.2
	39–47 years	95	22.4
	48–56 years	64	15.1
	57–65 years	171	40.3
Body Mass Index	Underweight	67	15.8
	Normal	224	52.8
	Overweight	104	24.5
	Obese	29	6.8
Marital Status	Single	85	20.0
	Married	276	65.1
	Divorced	42	9.9
	Widowed	21	5.0
Education Level	No formal education	236	55.7
	Primary education	95	22.4
	Secondary education	46	10.8
	Tertiary education	47	11.1
Income Status	< 30,000 Rwf	176	41.5
	30,001–70,000 Rwf	41	9.7
	70,001–100,000 Rwf	161	38.0
	> 100,000 Rwf	46	10.8
Income Source	Agriculture activities	340	80.2
	Business	21	5.0
	Salaries	22	5.2
	Donations from friends	21	5.0
	Others	20	4.7

Variable	Category	Frequency	Percent (%)
Occupation	Employed	257	60.6
	Self-employed	111	26.2
	Non-employed	56	13.2
Family Size	1–3 family members	126	29.7
	4–6 family members	151	35.6
	Above 6 family members	147	34.7
Residence	Rural	297	70.0
	Peri-Rural	127	30.0

Prevalence of High Blood Pressure Among Study Respondents

The table presents the prevalence of high blood pressure (HBP) among the 424 study participants aged between 30 and 65 years attending outpatient services at Kabutare District Hospital. According to the findings, 119 individuals (28.1%) were identified as having high blood pressure at the time of assessment. This indicates that more than one in four outpatients in the studied age group were hypertensive, highlighting a significant public health concern within this population. Conversely, the majority of participants, 305 individuals (71.9%), did not exhibit high blood pressure during the evaluation. The data demonstrate that while the larger proportion of the outpatient population remains normotensive, the 28.1% prevalence rate is relatively high and warrants targeted interventions, particularly considering the long-term health implications of unmanaged hypertension. Overall, the results underscore the importance of routine screening and early detection efforts for high blood pressure, especially among adults in this age group who may not yet show symptoms but are at increased risk for cardiovascular complications.

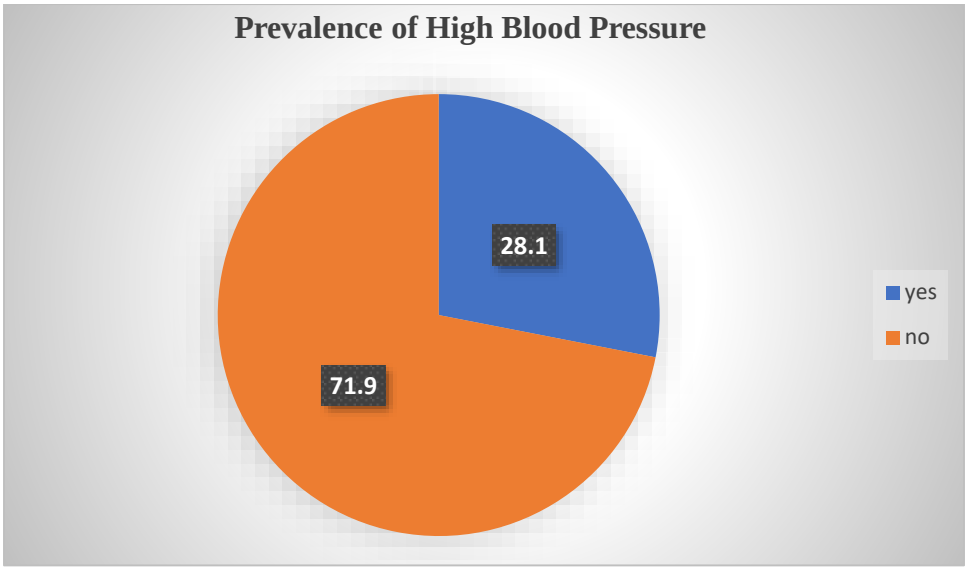

Figure 1 **Prevalence of High Blood Pressure Among Study Respondents**

Association between demographic, socioeconomic factors and prevalence of high blood pressure

The data presented in the table examines the relationship between various demographic and socioeconomic factors and the prevalence of high blood pressure (HBP) among outpatients aged 30-65 years at Kabutare District Hospital. The chi-square test results provide insights into whether these factors are significantly associated with the presence of HBP in this population. The first factor considered is gender. Of the 424 participants, 59% (250 individuals) were male, and 41% (174 individuals) were female. Among the males, 65 individuals (26% of males) had high blood pressure, while 185 males (74% of males) did not. For females, 54 individuals (31% of females) had high blood pressure, while 120 females (69% of females) did not. The chi-square test for gender and HBP prevalence yielded a Pearson chi-square value of 1.288 with a p-value of 0.256, indicating no significant association between gender and the likelihood of having high blood pressure. Age was the next variable analyzed. Participants were categorized into four age groups: 30-38 years, 39-47 years, 48-56 years, and 57-65 years. The highest prevalence of high blood pressure was observed in the 57-65 years' age group, with 56 individuals (33% of the group) reporting HBP, while 115 individuals (67% of the group) did not. The chi-square test showed a Pearson chi-square value of 8.816 with a p-value of 0.032, suggesting a significant relationship between age and the prevalence of high blood pressure. The likelihood ratio and linear-by-linear association tests further confirmed this association, with p-values of 0.025 and 0.028, respectively.

Body mass index (BMI) was also examined to assess its impact on HBP prevalence. The majority of participants were classified as having a normal BMI (52.8%), followed by overweight individuals (24.5%), underweight individuals (15.8%), and obese individuals (6.8%). Among individuals with a normal BMI, 63 (28% of the group)

had HBP, while 161 (72%) did not. In the overweight group, 29 individuals (28%) had HBP, and 75 individuals (72%) did not. The chi-square test for BMI and HBP prevalence resulted in a Pearson chi-square value of 0.834 with a p-value of 0.841, suggesting no significant association between BMI and high blood pressure in this sample. The relationship between marital status and HBP was also assessed. Among the 424 participants, 276 were married, 85 were single, 42 were divorced, and 21 were widowed. The results showed that 81 married individuals (29.3%) had high blood pressure, while 195 (70.7%) did not. Similarly, 20 single individuals (23.5%) had HBP, while 65 (76.5%) did not. The chi-square test yielded a Pearson chi-square value of 1.453 with a p-value of 0.693, indicating no significant association between marital status and the prevalence of high blood pressure. The participants' education level was also examined for its relationship with HBP. A majority of participants (55.7%) had no formal education, followed by those with primary education (22.4%), secondary education (10.8%), and tertiary education (11.1%). Among those with no formal education, 61 individuals (25.8%) had high blood pressure, while 175 (74.2%) did not. For those with primary education, 34 individuals (35.8%) had HBP, while 61 (64.2%) did not. The chi-square test resulted in a Pearson chi-square value of 4.363 with a p-value of 0.225, suggesting that education level does not significantly affect the prevalence of HBP in this population. Income status is another factor that was considered. Participants were categorized into four income groups: less than 30,000 Rwf, 30,001–70,000 Rwf, 70,001–100,000 Rwf, and greater than 100,000 Rwf. The results revealed that the income group with the lowest income (less than 30,000 Rwf) had the highest number of individuals with high blood pressure (30 out of 176 individuals, or 17%), while the group with higher income levels had a lower prevalence. The chi-square test for income status and HBP prevalence showed a Pearson chi-square value of 42.758 with a p-value of 0.000, indicating a significant association between income status and the prevalence of high blood pressure. The likelihood ratio and linear-by-linear association tests further confirmed this significant relationship with p-values of 0.001 and 0.001, respectively.

Income source was categorized into agriculture activities, business, salaries, donations from friends, and others. The largest group, engaged in agriculture activities (80.2%), had 95 individuals (27.9%) with high blood pressure, while 245 individuals (72.1%) did not. The chi-square test yielded a Pearson chi-square value of 9.192 with a p-value of 0.056, indicating a marginally significant association between income source and the prevalence of high blood pressure. However, the p-value is just above the commonly accepted threshold of 0.05, suggesting that income source may have a weak relationship with HBP in this sample. Occupation was another factor analyzed, with participants classified as employed, self-employed, and non-employed. Among the employed individuals (60.6% of the total sample), 72 individuals (28%) had high blood pressure, while 185 (72%) did not. The chi-square test produced a Pearson chi-square value of 0.078 with a p-value of 0.962, indicating no significant association between occupation and the prevalence of high blood pressure. The size of family members was

categorized into three groups: 1-3 family members, 4-6 family members, and above 6 family members. The results revealed that family size did not significantly affect the prevalence of high blood pressure, with similar proportions of individuals with HBP across all family sizes. The chi-square test resulted in a Pearson chi-square value of 2.064 with a p-value of 0.356, suggesting no significant relationship between family size and the prevalence of high blood pressure.

Finally, the relationship between residence (rural vs. peri-rural) and the prevalence of high blood pressure was examined. A higher number of individuals living in rural areas (70%) had high blood pressure compared to those in peri-rural areas. However, the chi-square test showed a Pearson chi-square value of 0.007 with a p-value of 0.933, indicating no significant association between residence and the prevalence of high blood pressure. In few words, the study found significant associations between age, income status, and the prevalence of high blood pressure, with age and lower income being particularly important factors. However, no significant relationships were observed between gender, BMI, marital status, education level, income source, occupation, family size, or residence and the prevalence of high blood pressure.

Table 4. 2 Association between demographic, socioeconomic factors, and prevalence of high blood pressure: chi-square analysis

Variable	HBP: Yes	HBP: No	Total	χ^2 Value	p-value
Gender					
Male	65	185	250	1.288	0.256
Female	54	120	174		
Age Group				8.816	**0.032**
30–38 years	16	78	94		
39–47 years	31	64	95		
48–56 years	16	48	64		
57–65 years	56	115	171		
BMI				0.834	0.841
Underweight	17	50	67		
Normal	63	161	224		
Overweight	29	75	104		
Obese	10	19	29		
Marital Status				1.453	0.693
Single	20	65	85		

Married	81	195	276		
Divorced	11	31	42		
Widowed	7	14	21		
Education Level				4.363	0.225
No formal education	61	175	236		
Primary education	34	61	95		
Secondary education	10	36	46		
Tertiary education	14	33	47		
Income Status				42.758	0.001
< 30,000 Rwf	30	146	176		
30,001–70,000 Rwf	10	31	41		
70,001–100,000 Rwf	49	112	161		
> 100,000 Rwf	30	16	46		
Income Source				9.192	0.056
Agriculture	95	245	340		
Business	4	17	21		
Salaries	5	17	22		
Donations	4	17	21		
Others	11	9	20		
Occupation				0.078	0.962
Employed	72	185	257		
Self-employed	32	79	111		
Non-employed	15	41	56		
Family Size				2.064	0.356
1–3 members	39	87	126		
4–6 members	45	106	151		
> 6 members	35	112	147		
Residence				0.007	0.933
Rural	83	214	297		
Peri-rural	36	91	127		

Association between behavioral and lifestyle factors and prevalence of high blood pressure (N = 424)

In a study analyzing the association between various behavioral and lifestyle factors and the prevalence of high blood pressure (HBP) among 424 respondents, several significant and non-significant relationships were observed across different variables. The analysis employed Chi-square tests to evaluate the statistical significance of each factor's relationship with HBP prevalence. The presence of a family history of high blood pressure was assessed in relation to HBP prevalence. Among the respondents, 14 individuals with a family history of HBP also had high blood pressure, compared to 49 without high blood pressure. For those without a family history, 105 individuals had high blood pressure while 256 did not. The Chi-square test revealed a Pearson Chi-square value of 1.252 with a p-value of 0.263, indicating no statistically significant association between family history of HBP and the prevalence of HBP in this population. Smoking status was another factor considered in relation to HBP prevalence. Among smokers (54 with HBP and 139 without), the data showed no significant difference in HBP prevalence compared to non-smokers (65 with HBP and 166 without). The Pearson Chi-square value for smoking status was 0.001, with a p-value of 0.971, suggesting that smoking status was not associated with a higher or lower prevalence of HBP. The number of cigarettes smoked per day was strongly associated with HBP prevalence. For respondents who smoked five or fewer cigarettes per day, 91 had HBP and 305 did not, while among those smoking more than five cigarettes per day, 28 individuals had HBP, and no one in this group was without HBP. The Chi-square test revealed a significant association, with a Pearson Chi-square value of 76.839 and a p-value of 0.001, indicating a clear relationship between the number of cigarettes smoked daily and HBP prevalence. The study also examined the relationship between alcohol consumption and HBP. A total of 56 individuals who consumed alcohol had high blood pressure, while 158 did not, and among non-drinkers, 63 had high blood pressure, and 147 did not. However, the Chi-square test returned a Pearson Chi-square value of 0.771 and a p-value of 0.380, suggesting no significant association between alcohol consumption and HBP prevalence in the study population.

A more detailed analysis was conducted on the frequency of alcohol consumption, focusing on how often respondents consumed alcohol per week. Those who consumed alcohol three or fewer times per week had 77 with HBP and 303 without, whereas those who consumed alcohol more than three times per week had 42 with HBP and 2 without. The Pearson Chi-square value of 110.431 and a p-value of 0.000 revealed a significant association, indicating that higher frequency of alcohol consumption was strongly linked to a higher prevalence of HBP. Physical activity levels were classified into three categories: low, moderate, and high physical activity. Among individuals with low physical activity, 41 had HBP and 95 did not; with moderate activity, 56 had HBP and 149 did not; and with high activity, 22 had HBP and 61 did not. The Pearson Chi-square test for this variable returned a value of 0.449 and a p-value of 0.799, suggesting that physical activity level did not have a significant

association with HBP prevalence. Walking regularly to work was another behavioral factor analyzed. Among those who walked to work, 90 individuals had HBP and 283 did not, while among non-walkers, 29 had HBP and 22 did not. The Pearson Chi-square value of 23.812 and a p-value of 0.001 indicated a significant relationship, suggesting that walking to work regularly may help reduce the prevalence of HBP in this sample. Diet quality was assessed in relation to HBP prevalence, with respondents categorized into three groups: poor diet, average diet, and good diet. Among those with poor diets, 34 had HBP and 113 did not; with average diets, 39 had HBP and 110 did not; and with good diets, 46 had HBP and 82 did not. The Chi-square test returned a Pearson Chi-square value of 5.967 and a p-value of 0.051, indicating a borderline association between diet quality and HBP prevalence, with those reporting a better diet potentially having lower rates of HBP.

Finally, the frequency of adding salt to food was examined. Those who added salt three or fewer times per week had 51 with HBP and 94 without, while those who added salt more than three times per week had 66 with HBP and 204 without. The Chi-square value of 5.363 and a p-value of 0.021 indicated that higher salt consumption was statistically significantly associated with a higher prevalence of HBP in this population. The study highlighted several important factors related to the prevalence of high blood pressure. Family history of HBP, smoking status, physical activity, and alcohol consumption frequency were found to have varying levels of statistical significance in relation to HBP prevalence. Particularly strong associations were observed between the number of cigarettes smoked daily, frequency of alcohol consumption, and salt intake, underscoring the role of modifiable behaviors in HBP risk. These findings provide valuable insights for public health interventions aimed at reducing the burden of hypertension, especially through behavioral modifications such as smoking cessation, reduced alcohol intake, and improved dietary habits.

Table 3 Association between behavioral and lifestyle factors and prevalence of high blood pressure (N = 424)

Variable	Category	HBP: Yes	HBP: No	Total	Pearson χ^2	p-value
HBP Family History	Yes	14	49	63	1.252	0.263
	No	105	256	361		
Smoking Status	Yes	54	139	193	0.001	0.971
	No	65	166	231		
Number of Cigarettes Smoked/Day	≤ 5/day	91	305	396	76.839	**0.001**
	≥ 5/day	28	0	28		

Alcohol Consumption	Yes	56	158	214	0.771	0.380
	No	63	147	210		
Alcohol Frequency/Week	≤ 3 times/week	77	303	380	110.431	**0.001**
	> 3 times/week	42	2	44		
Physical Activity Level	Low	41	95	136	0.449	0.799
	Moderate	56	149	205		
	High	22	61	83		
Walk to Job Regularly	Yes	90	283	373	23.812	**0.001**
	No	29	22	51		
Diet Quality	Poor	34	113	147	5.967	0.051
	Average	39	110	149		
	Good	46	82	128		
Salt Added to Food	≤ 3 times/week	51	94	145	5.363	**0.021**
	> 3 times/week	66	204	270		

Multivariate Logistic Regression Analysis of Factors Associated with High blood pressure

The multivariate logistic regression analysis conducted to examine factors associated with hypertension (HBP) revealed several key variables that significantly influence the likelihood of having high blood pressure. These variables included age, monthly income, cigarette smoking habits, alcohol consumption, physical activity (specifically walking to work), and the frequency of salt added to food. The analysis showed that the age groups significantly influenced the prevalence of hypertension. Individuals aged between 36 and 50 years had a slightly higher odd of having hypertension (AOR = 1.348, 95% CI = 0.583–3.118) compared to the reference group (18–35 years), though this difference was not statistically significant (p = 0.486). Similarly, individuals aged 51–65 years (AOR = 0.664, 95% CI = 0.318–1.387) and those over 65 years (AOR = 1.024, 95% CI = 0.425–2.471) did not show a significant difference in hypertension prevalence when compared to the younger reference group (p-values of 0.276 and 0.958, respectively). Monthly income was found to be a significant determinant of hypertension prevalence. Compared to individuals with a monthly income of over 100,000 RWF, those with an

income between 75,001 and 100,000 RWF had a significantly higher odd of having hypertension (AOR = 9.558, 95% CI = 3.866–23.631, p < 0.001). Similarly, individuals earning between 50,001 and 75,000 RWF (AOR = 15.801, 95% CI = 3.661–68.195, p < 0.001) and those earning less than or equal to 50,000 RWF (AOR = 4.265, 95% CI = 1.840–9.887, p = 0.001) were more likely to have hypertension compared to their higher-income counterparts. Regarding smoking habits, individuals who smoked more than five cigarettes per day did not show any significant association with the likelihood of hypertension (AOR = —, p = 0.997), likely due to the very low number of individuals in this group (28 smokers). In contrast, those smoking fewer than five cigarettes per day had a much higher prevalence of hypertension, but the analysis did not show a significant statistical association for this variable. Alcohol consumption also played a significant role in hypertension prevalence. Individuals who consumed alcohol more than three times per week had significantly higher odds of being hypertensive (AOR = 84.066, 95% CI = 18.036–391.827, p < 0.001) compared to those who drank less frequently. This suggests that frequent alcohol consumption may be a strong contributor to hypertension, as evidenced by the large odds ratio and highly significant p-value.

The likelihood of having hypertension was also influenced by whether or not individuals regularly walked to work. Those who did not walk to work were significantly more likely to have hypertension (AOR = 5.334, 95% CI = 2.383–11.938, p < 0.001). This finding underscores the potential health benefits of physical activity, with walking to work possibly serving as a protective factor against developing high blood pressure. Finally, the frequency of salt added to food was another variable of interest. Individuals who added salt to their food more than three times a week had a lower likelihood of having hypertension (AOR = 0.717, 95% CI = 0.391–1.316, p = 0.283), though this association was not statistically significant. This may indicate that other factors, such as overall diet and sodium intake, could play a more significant role in hypertension than just the frequency of adding salt during food preparation. In summary, the multivariate analysis revealed that factors such as monthly income, alcohol consumption, walking to work, and the age group of individuals significantly contributed to the likelihood of having hypertension. These findings suggest that economic and lifestyle factors, including physical activity and alcohol intake, are crucial determinants of hypertension. However, smoking and salt consumption did not show strong associations with hypertension in this study. These insights are vital for public health strategies aiming to reduce hypertension prevalence in Rwanda.

Table 4. Multivariate Logistic Regression Analysis of Factors Associated with High blood pressure

Variable	HBP Yes (n)	HBP No (n)	AOR	95% CI (Lower–Upper)	p-value
Age Group					
30–35 years (Ref)	36	126	1.00	–	–

36–50 years	30	93	1.348	0.583 – 3.118	0.486
51–65 years	29	112	0.664	0.318 – 1.387	0.276
>65 years	24	79	1.024	0.425 – 2.471	0.958
Monthly Income					
>100,000 RWF (Ref)	17	108	1.00	–	–
75,001–100,000 RWF	33	36	9.558	3.866 – 23.631	<0.001
50,001–75,000 RWF	35	25	15.801	3.661 – 68.195	<0.001
≤50,000 RWF	34	36	4.265	1.840 – 9.887	0.001
Cigarettes per Day					
≤5/day (Ref)	91	305	1.00	–	–
>5/day	28	0	—	—	0.997
Alcohol Use per Week					
≤3 times/week (Ref)	77	303	1.00	–	–
>3 times/week	42	2	84.066	18.036 – 391.827	<0.001
Walks to Work					
Yes (Ref)	90	283	1.00	–	–
No	29	22	5.334	2.383 – 11.938	<0.001
Salt Added to Food					
≤3 times/week (Ref)	51	94	1.00	–	–
>3 times/week	66	204	0.717	0.391 – 1.316	0.283

Model Summary

This table presents the model summary from your logistic regression analysis. The -2 Log likelihood value is 300.978, which is a measure of the fit of the model. The Cox & Snell R Square value of 0.371 indicates that the model explains approximately 37.1% of the variation in the outcome variable. The Nagelkerke R Square of 0.534 suggests that the model explains 53.4% of the variation in the dependent variable, which is a higher and more adjusted measure of the model's goodness of fit.

Table 4. 3 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	300.978a	0.371	0.534

Discussion

The present investigation revealed a notably high prevalence of hypertension among adults aged 30–65 years attending the outpatient clinics of Kabutare District Hospital, suggesting that this cohort constitutes a particularly vulnerable sub-population. Several factors may underlie the elevated rate observed. First, the broader age spectrum captured in this study compared with the Rwanda Demographic and Health Survey (RDHS), which concentrated on respondents aged 35 years and above may have unveiled cases that national surveillance tends to overlook (NISR et al., 2021). Second, the study setting is characterized by accelerating urbanization, exposure to sedentary occupations, and wider access to energy-dense processed foods, all of which have been implicated in the rising burden of hypertension across sub-Saharan Africa (Bigna et al., 2017; Sarki et al., 2019). While our prevalence aligns with regional estimates of 25–30 percent, minor discrepancies in absolute figures are probably attributable to differences in study designs, sampling frames, and local environmental contexts. Age emerged as a dominant predictor of elevated blood pressure. Consistent with the RDHS and earlier African studies (Ogah et al., 2012; Owolabi et al., 2015), each advancing decade was associated with a pronounced increase in risk, likely mediated by vascular stiffening, declining renal function and heightened peripheral resistance (van der Linde et al., 2017). These physiological changes may be compounded in Kabutare by intermittent access to preventive services, thereby amplifying the impact of ageing on blood-pressure control.

Contrary to the traditional narrative that chronic diseases disproportionately affect lower-income groups, wealthier participants in this setting exhibited greater odds of hypertension. This finding mirrors RDHS observations (NISR et al., 2021) and reflects the epidemiological transition wherein affluence confers lifestyle patterns prolonged sitting, increased consumption of salty convenience foods, and psychosocial stress that elevate cardiovascular risk (Agbahtor, 2020). Rapid economic development in Huye District may be accelerating these transitions among the middle and upper socioeconomic strata, where health-promoting knowledge and behaviors have not kept pace with purchasing power. The study also affirmed smoking as a significant modifiable determinant, echoing national statistics indicating that roughly one in five Rwandan men smoke (NISR et al., 2021) and corroborating evidence that nicotine-induced vasoconstriction and endothelial dysfunction raise blood pressure (Muna et al., 2019). The higher odds ratio documented here could stem from a concentration of long-term heavy smokers within the outpatient sample, many of whom reported limited success in cessation attempts. Dietary sodium was another salient correlate. Excess salt intake, previously highlighted in both national data and African multicenter investigations (Stolarz-Skrzypek et al., 2017; Semba et al., 2020), was strongly linked to hypertension, suggesting that locally prevalent food-preservation practices and growing reliance on packaged products may be important intervention targets. Similarly, physical inactivity showed a robust association with elevated blood pressure. The RDHS found that 34 percent of women and 41 percent of men nationwide fail to meet physical-activity guidelines (NISR et al., 2021); our findings imply that the built environment in and around

Kabutare characterized by limited recreational infrastructure and walkability may further curtail opportunities for incidental movement (Ma, 2018). Collectively, these patterns confirm that Rwanda is traversing the same epidemiological pathway as many of its neighbors: hypertension is rising in tandem with urbanization, socioeconomic change and shifts in lifestyle. Although the overall prevalence recorded here (28.1 percent) sits modestly above the national mean, the strength of associations with age, income, smoking, sodium intake and sedentariness underscores the need for tailored, context-sensitive interventions in Kabutare District.

Conclusion and Recommendations

This study enriches the evidence base on hypertension in Rwanda by demonstrating that middle-aged outpatients at Kabutare District Hospital face a substantial burden of high blood pressure linked to modifiable behaviors and socioeconomic shifts. The findings reinforce the urgency for the country's non-communicable-disease agenda to prioritize precision public-health strategies particularly community-level screening, dietary-salt reduction campaigns, smoking-cessation support and programmes that integrate physical activity into daily routines. Special attention should be directed toward higher-income groups, whose disease risk may be underestimated, and toward adults over 50 years, who exhibited the steepest rise in hypertension prevalence.

Future research would benefit from longitudinal designs to track incidence, progression and control of hypertension over time, as well as qualitative inquiries into the cultural and psychosocial drivers of behaviors such as high-salt cooking practices, tobacco use and physical inactivity. Comparative studies spanning urban, peri-urban and rural settings could elucidate geographical nuances in risk profiles, while implementation research examining the effectiveness of community-based education, routine outreach screening and policy measures (e.g., sodium reformulation standards) will be critical for crafting evidence-based national guidelines. Addressing these knowledge gaps will accelerate progress toward reducing the cardiovascular disease burden in Kabutare District and Rwanda at large.

List of abbreviations

AHA	American Heart Association
BMI	Body Mass Index
BP	Blood Pressure
CVD	Cardiovascular diseases
DBP	Diastolic Blood Pressure
DDQ	Dietary diversity questionnaire
FAO	Food and Agriculture Organization
FFQ	Food Frequency Questionnaire
GPAQ	Global physical activity questionnaire

HBP High blood pressure

HIV/AIDS Human Immuno-deficiency Virus/Acquired Immuno-Deficiency Syndrome

NCD Non-Communicable Disease

OPD Out-Patient Department

SBP Systolic Blood Pressure

SPSS Statistical Package for Social Science

WHO World Health Organization

Data availability

The data used during the current study are available from the corresponding author upon reasonable request.

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Contributions

BR designed the study, collected and analyzed data and findings interpretation, and wrote the manuscript. AH supervised the study and participated in reviewing and editing the manuscript. All authors have read and approved the final version of the manuscript for submission.

Corresponding author

Correspondence to Benjamin Rugira

Ethics declaration

Ethics approval and consent to participate

This study was conducted in the Kabutare district hospital, Rwanda, and received approval from the Ethical Review Board of Mount Kenya University, Rwanda, under REF: MKU/ETHICS/23/01/2024(1). The study was also approved by the Kabutare district hospital administration N°: 397/09/Hop.Kab/2024 This study adhered to the Declaration of Helsinki. All study participants voluntarily provided a written consent form before enrollment in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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