Global Journal of Health Ethics,Volume1,Issue2,June 2025,DOI: https://doi.org/10.63101/gjhe.v1i2.018

Original Article

Prevalence and Factors Associated with High Blood Pressure Among People Aged Between 35 and 74 years in Ruhango District, Rwanda

Authors: Didier NDAYISHIMIYE[1*], Amos HABIMANA[1]

Affiliations: [1]School of Health Sciences, Mount Kenya University, Rwanda

Corresponding Author:

- Didier NDAYISHIMIYE[1*], School of Health Sciences, Mount Kenya University, Rwanda
- Address: Kigali-Rwanda
- Telephone: +250786411539

Email: chrisdidier71@gmail.com

ABSTRACT

Background: Hypertension remains a major global health problem, significantly affecting both individuals and broader populations. It contributes heavily to cardiovascular diseases, which are the leading causes of illness and death worldwide. The burden of high blood pressure is particularly high in low- and middle-income countries, especially among people aged between 35 and 79. Both changeable and unchangeable factors have been linked to the condition. A deeper understanding of its prevalence and contributing elements in this age range is critical for planning effective prevention, early detection, and policy development aimed at reducing hypertension.

Objective: This study aimed to assess how common high blood pressure is and to identify the key contributing factors among individuals aged 35 to 74 years living in Ruhango District, Rwanda.

Methods: A community-based cross-sectional survey was conducted using a multistage sampling approach. A total of 199 individuals were included, with the sample size estimated using accepted statistical formulas. Data were collected through structured interviews and physical measurements, including blood pressure readings taken according to World Health Organization standards. Statistical analysis was performed using SPSS Version 21, with significance determined at a p-value below 0.05.

Results: Of the 199 respondents, 47.7% were diagnosed with hypertension. The rate was slightly higher among males (50.5%) than females (49.4%). Several factors showed significant associations with high blood pressure, including body mass index ($p = 0.001$), area of residence ($p = 0.013$), job status ($p = 0.008$), and income level ($p = 0.001$). Lifestyle-related factors such as tobacco use ($p = 0.008$), alcohol intake ($p = 0.002$), smoking ($p = 0.008$), poor dietary habits, and stress related to work ($p = 0.001$) were also strongly linked to the condition.

Conclusion: The findings indicate that high blood pressure is still a major health issue in Ruhango District, particularly in more rural communities. The proportion of people affected was higher than previously recorded in similar studies. Since many of the risk factors are preventable, local health programs should focus on public awareness campaigns, promoting healthier lifestyles, and improving access to preventive care. Collaborative efforts between local authorities and the Ministry of Health should prioritize physical activity, healthy eating, stress reduction, and quitting smoking to reduce the burden of hypertension.

Key terms: Hypertension. Prevalence, Associated Factors, Cross-Sectional Studies and Rwanda

Introduction:

Globally, raised blood pressure is the foremost modifiable driver of cardiovascular mortality (World Health Organization [WHO], 2023). Despite the availability of safe, inexpensive antihypertensive regimens, progress in screening and control has been sluggish: fewer than half of those affected are aware of their status, and only one in five achieves therapeutic targets (Mills, Stefanescu, & He, 2020; WHO, 2023). Growing life expectancy, rapid urban growth, and widespread adoption of energy-dense diets, sedentary lifestyles, harmful alcohol use, tobacco consumption, and chronic psychosocial stress are fuelling an unabated rise in cases (Amegah, Agyei-Mensah, & Quansah, 2021; Zhou et al., 2021). The epidemiological shift is particularly stark in sub-Saharan Africa (SSA), where average prevalence climbed toward 30 % by 2020 and cardiovascular deaths are projected to double again before 2040 unless prevention is intensified (Guwatudde, Kwarisiima, & Nsubuga, 2022; Tadesse, Kebede, & Ayele, 2021). Country-level data illustrate this heterogeneity: a national survey in Nigeria found hypertension in 29.5 % of adults (Adedoyin et al., 2021), while in Uganda 26.4 % of adults were hypertensive, strongly linked to obesity and inactivity (Mutebi, Kakembo, & Kajumba, 2023).

Neighbouring East African nations show similarly high burdens. A community survey conducted in urban Ethiopia identified hypertension in 31.5 % of adults aged 35–70 years largely attributed to excess body weight and high dietary sodium (Asfaw, Kassie, & Moges, 2021). A broader narrative review concluded that modifiable cardiometabolic and behavioural risks dominate the region's hypertension landscape (Guwatudde et al., 2022).

Rwanda typifies SSA's non-communicable disease transition. The 2021 national STEPwise survey estimated adult hypertension prevalence at 17.2 %, but reported low levels of awareness (54 %), treatment (31 %), and control (16 %) (Rwanda Biomedical Centre [RBC], 2022). Contributing factors include salt-rich diets, physical inactivity, and rising alcohol and tobacco use (WHO, 2023). Facility-based studies corroborate a large diagnostic gap: nearly half of hypertensive adults are unaware of their condition (Ntaganda, Ruhumuriza, Mukanu, & Mutabazi, 2022), and more than 70 % have never received a professional diagnosis (Habimana, Umutoni, & Niyigena, 2021).

Data for Ruhango District are sparse. Nevertheless, routine records from Gitwe Hospital's Health Management Information System indicate a steady rise in hypertension cases from 898 in December 2021 to 1 158 by December 2023 (HMIS, Gitwe Hospital, unpublished). Agricultural livelihoods, evolving urban pressures, and workplace stressors may further compound risk in this setting. Against this background, the present study aims to quantify hypertension prevalence and identify its demographic, behavioral, and metabolic determinants among residents aged 35–74 years in Ruhango District. Findings will inform locally tailored prevention and management strategies and support Rwanda's broader cardiovascular health agenda.

Methods

Research Design

A cross-sectional research design was employed for this study, as its purpose was to collect data at a single point in time. This design was used to assess the prevalence of high blood pressure (BP) and its associated factors among residents of Ruhango District, specifically individuals aged 35-74 years.

Study Area

The study was conducted in Ruhango District, located in the Southern Province of Rwanda, north of Nyanza, the provincial capital. The district is situated at an elevation of 1782 meters, with geographic coordinates of Latitude 2° 13' 24" S and Longitude 29° 46' 41" E, or specifically, Latitude -2.223333 and Longitude 29.778056 (GeoNames, 2023; NISR, 2023).

Study Population

The study population comprised adults aged 35 to 74 years residing in Ruhango District. The estimated population of Ruhango is 359,121, with 52.1% women and 47.9% men, spread across 94,508 households. The district is predominantly rural, with 89.1% of the population living in rural areas (NISR, 2023).

Sample Size and Sampling Technique

The expected prevalence of hypertension in Rwanda is 15.3% (Rwanda Ministry of Health [MoH], 2021), with a margin of error set at 5%. The sample size for this study was determined using a 95% confidence level. The required minimum sample size, calculated using the formula below, was 199:

Sample size (n) = $((Z_{1-\infty/2})^2 * P * (1-P)) / D^2$

Where: $Z_{1-\infty/2}$ = standard normal variate (1.96 for 5% type 1 error),P = expected proportion in the population

(0.153),D = margin of error (0.05). Sample size (n) = ((1.96) ² * 0.153 * (1-0.153)) / (0.05) ² = 199. A multistage sampling method was used to select participants for this study. The process involved three steps: First, sectors were randomly selected. Then, households within each sector were chosen using a systematic random sampling method, considering proportionality and probability. Lastly, one eligible adult from each selected household was chosen for participation. If multiple eligible individuals were present in a household, a lottery system was used to select one. If the household lacked an eligible member, the next household was selected. The study included adults aged 35-74 years who consented to participate. Exclusion criteria included individuals under 35 years, those living outside Ruhango District, and those unable to provide responses due to physical or mental illness or those with whom anthropometric measures could not be taken.

Data Collection Instruments

Data were gathered using a structured questionnaire to collect basic demographic information, lifestyle factors such as exercise, smoking, alcohol consumption, and knowledge about hypertension diagnosis. BP, weight, and height were measured using standard tools by trained research assistants. Hypertension was defined as having a diastolic BP ≥ 90 mmHg or a systolic BP ≥ 140 mmHg. Interviews and examinations were conducted in Kinyarwanda, the local language. All data were entered into forms initially created in English and translated into Kinyarwanda, ensuring the participants' confidentiality. A pretested assisted questionnaire was used in this study. It was based on the WHO STEP-Wise approach for monitoring risk factors for non-communicable diseases. The questionnaire was validated through peer review and supervisor feedback, followed by translation into Kinyarwanda. Additionally, BP monitors, weighing scales, and measuring tapes were used for data collection.

Data Collection Procedures

Participants were first interviewed using a structured and pretested questionnaire to gather sociodemographic and lifestyle information. BP was measured twice on the right arm using an automatic electronic device (Alveen type), with the average of the two readings taken and the respondent was allowed to rest for 15 minutes for accurate results. Anthropometric measurements were made using standard techniques: height was measured with a steel anthropometry rod (SECA Stadiometer) accurate to 0.1 cm, and weight was measured with a Libra weighing scale accurate to 0.1 kg. BMI was calculated using the formula: BMI = Weight (kg) / Height (m)². Participants were categorized based on BMI following the WHO classification.

Reliability and Validity of Instruments

To ensure the reliability and validity of the instruments, a pilot test was conducted. Content validity was used to ensure the questionnaire covered all relevant aspects of hypertension. Criterion validity was assessed by comparing the questionnaire's results to those from established measures, while construct validity evaluated whether the instruments measured the intended constructs. For reliability, test-retest reliability was assessed by administering the instruments to a sample from Byimana and Mwendo Sectors on two separate occasions and comparing the consistency of responses.

Data Analysis

Descriptive statistics, including percentages and frequencies, were used to summarize the data, which were then presented in tables. To assess the relationships between variables and hypertension, chi-square tests were employed. Data analysis was performed using SPSS version 21, with a significance level set at 0.05. Multivariate Logistic Regression Analysis was used to analyse factors associated with high blood pressure among study participants.

Ethical Considerations

Ethical approval for the study was obtained from the Ethical Review Board of Mount Kenya University and Ruhango District prior to data collection. Informed consent was obtained from each participant after explaining the purpose, procedures, risks, and benefits of the study. Participants were assured of voluntary participation and the right to withdraw at any time without consequences. The confidentiality of participants' data was maintained, and personal information was securely stored. Anonymity was ensured by using codes to protect participants' identities. The study aimed to minimize risks and maximize benefits for both participants and the community. Data were securely stored in compliance with data protection regulations.

Results

This study, conducted in Ruhango District, Rwanda, investigated the demographic and socio-economic characteristics of 199 individuals aged 35 to 74 years to better understand the context of hypertension prevalence. The gender distribution was nearly equal, with 52.8% male and 47.2% female respondents. Most participants (87.9%) were aged 36–50 years, a group particularly susceptible to lifestyle-related hypertension risk factors. A smaller proportion fell into the older age bracket of 51–65 years (9.0%), while only 3.0% were under 35. Marital status analysis showed that 58.3% were married and 23.6% were cohabitating. Widowed and separated participants accounted for 14.1% and 4.0%, respectively, with relationship status recognized as an influential

factor in health outcomes. In terms of income, 41.7% earned 30,000 RWF or less per month, limiting access to healthcare and healthy lifestyles. Only 13.1% reported incomes exceeding 90,000 RWF. Educational attainment was generally low, with 60.3% having no formal education, 10.1% with primary, and only 9.5% holding tertiary-level qualifications factors that likely influence health literacy and hypertension management. Employment data revealed that nearly half (49.2%) were self-employed, while 33.2% worked for others and 17.6% were civil servants. The vast majority (91.5%) of respondents lived in rural areas, which may reduce access to health services. Regarding BMI, 64.3% had normal weight, 25.6% were overweight, and 10.1% were underweight. These findings underscore the critical role of socio-demographic variables in shaping hypertension risk, pointing to the need for targeted public health interventions in Ruhango District.

Table 1: Demographic characteristics of respondents

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	105	52.8
	Female	94	47.2
Age Group (years)	<35	6	3.0
	36–50	175	87.9
	51–65	18	9.0
Marital Status	Married	116	58.3
	Cohabiting	47	23.6
	Widowed	28	14.1
	Separated	8	4.0
Monthly Income (RWF)	≤30,000	83	41.7
	30,001–50,000	50	25.1
	>90,000	26	13.1
Education Level	No formal education	120	60.3
	Primary education	20	10.1
	High school education	40	20.1
	College/University	19	9.5
Occupation	Self-employed	98	49.2
	Employed (non-civil service)	66	33.2
	Civil servant	35	17.6
Residence	Rural	182	91.5
	Urban	17	8.5
Body Mass Index (BMI)	Underweight	20	10.1
	Normal weight	128	64.3
	Overweight	51	25.6

Overall prevalence of Hypertension among study participants

Hypertension, or High Blood Pressure (HTA)**,** is increasing public health concern, especially in sub-Saharan Africa, where the prevalence of non-communicable diseases is rising. Understanding the distribution and associated factors of hypertension within specific populations is essential for targeted public health interventions. In Ruhango District**,** hypertension poses a significant health challenge among adults aged 35 to 74 years. In Table 1, study participants were classified based on their hypertensive status (HTA)**,** revealing that 47.7% (95 individuals) were diagnosed with hypertension, while 52.3% (104 individuals) did not have the condition. The nearly even split between hypertensive and non-hypertensive individuals highlights the need for ongoing screening and effective management strategies. These findings will guide the exploration of demographic, socio-economic, and health-related factors influencing the prevalence of hypertension in this population, ultimately informing prevention and treatment efforts.

Table 2. Overall prevalence of Hypertension among study participants

Category	Frequency	Percent
With Hypertension	95	47.7
No Hypertension	104	52.3
Total	199	100.0

This study investigated the relationship between hypertension and various demographic, socioeconomic, and health-related factors among individuals aged 35–74 years in Ruhango District, Rwanda. Binary analysis was used to assess the association between hypertension and variables including gender, age, body mass index (BMI), marital status, education, residence, occupation, and income. Although age did not show a statistically significant association ($p = 0.623$), the highest prevalence of hypertension was observed among individuals aged 36–50 years. Gender was similarly not associated with hypertension ($p = 0.546$), with nearly equal numbers of hypertensive men and women. However, BMI demonstrated a significant association ($p = 0.001$), with overweight individuals having a notably higher prevalence of hypertension compared to those with normal or underweight BMI. Marital status did not significantly correlate with hypertension ($p = 0.821$), though most hypertensive individuals were married. A significant association was found between residence and hypertension ($p = 0.013$), with rural residents experiencing higher prevalence. This may be due to limited healthcare access or dietary practices in rural areas. While education level was not statistically significant ($p = 0.097$), hypertension was more common among those with no formal education, suggesting a possible link between health literacy and hypertension risk. Occupation was significantly associated with hypertension ($p = 0.008$); self-employed individuals had the highest prevalence, possibly due to irregular income and job-related stress. Income level

showed a strong association (p = 0.001), with lower-income individuals more likely to be hypertensive, reflecting socioeconomic barriers to healthcare and healthy living. Overall, key risk factors for hypertension included elevated BMI, rural residence, self-employment, and low income. These findings highlight the need for targeted public health strategies, especially in rural and economically disadvantaged populations, to reduce the burden of hypertension through improved healthcare access, lifestyle education, and social support.

Table 2. Distribution of Hypertension status in study respondents based on fundamental factors

Variable	Categories	HTA	No HTA	P-Value
Age Category	Less than 35	2	4	0.623
	36-50	83	92	
	51-65	10	8	
Total		95	104	
Gender	Male	48	57	0.546
	Female	47	47	
Total		95	104	
BMI	Underweight	3	17	0.001
	Normal	49	79	
	Overweight	43	8	
Total		95	104	
Marital Status	Married	56	60	0.821
	Widowed	15	13	
	Separated	4	4	
	Cohabitating	20	27	
Total		95	104	
Residence	Rural	82	100	0.013
	Urban	13	4	
Total		95	104	
Level of Education	No formal education	60	60	0.097
	Primary level	5	15	
	High school level	18	22	
	College/university level	12	7	
Total		95	104	

Occupation	Self-employed	35	62	0.008
	Employed by others	38	28	
	Civil Servant	22	13	
Total		95	104	
Income per Month	<=30000	22	61	0.001
	30001-50000	22	28	
	50001-70000	19	5	
	70001-90000	12	4	
	=>90001	20	6	
Total		95	104	

Distribution of High blood pressure status among study respondents based on underlying factors

This study investigated the relationship between hypertension and a range of behavioral, lifestyle, and socio-economic factors among individuals aged 35–74 years in Ruhango District. Significant associations were identified, shedding light on critical determinants of elevated blood pressure in this population. The primary source of income was strongly linked to hypertension ($p = 0.002$), with agricultural workers and business people reporting higher prevalence, suggesting occupation-related stress and healthcare access disparities may contribute to risk. Tobacco use also showed a significant association ($p = 0.008$), and the number of cigarettes smoked daily correlated with hypertension ($p = 0.041$), reinforcing the cardiovascular risks posed by smoking. Recent alcohol consumption within the past 30 days was significantly associated with hypertension ($p = 0.002$), while general alcohol use was not ($p = 0.081$), indicating acute alcohol exposure may influence blood pressure. Frequent stress (1–4 days per week) and work-related pressure significantly elevated hypertension risk ($p = 0.001$), confirming the detrimental effects of chronic stress. Dietary patterns also played a critical role: consuming fried snacks ($p = 0.001$) and processed foods ($p = 0.044$) was significantly linked to hypertension, as was eating frequency ($p = 0.014$). Irregular meal timing ($p = 0.001$) and higher salt use showed marginal association ($p = 0.066$).

Although fruit and vegetable intake was not significantly linked to hypertension, physical activity emerged as a protective factor. Walking regularly ($p = 0.003$), cycling ($p = 0.045$), and engaging in vigorous exercise ($p = 0.001$) were all associated with reduced hypertension risk. Conversely, sedentary behaviors, such as car commuting, showed a marginally higher risk ($p = 0.058$). In few words, modifiable behaviors such as smoking, stress, diet, and physical inactivity significantly impact hypertension risk. These findings highlight the need for

community-based interventions promoting healthier lifestyles and stress management to reduce hypertension prevalence in Ruhango District.

Table 4 Distribution of high blood pressure status among study respondents based on underlying factors

Question	HTA (Count)	No HTA (Count)	P-Value
What is the main source of income for the household?			**0.002**
- Agriculture activities	41	69	
- Business	31	15	
- Salary	23	20	
Total	95	104	
Do you currently smoke tobacco products daily?			**0.008**
- Yes	17	5	
- No	78	99	
Total	95	104	
On average, how many numbers of cigarettes do you smoke each day?			**0.041**
- 0	78	97	
- 2	5	4	
- 3	11	2	
- 4	1	0	
Total	95	104	
Have you ever consumed alcohol drinks such as beer, wine, spirits?			0.081
- Yes	67	61	
- No	28	43	
Total	95	104	
Have you consumed an alcoholic drink within the past 12 months?			0.081
- Yes	67	61	
- No	28	43	
Total	95	104	

During the past 12 months, how frequently have you had at least...?			**0.001**
- No stress	21	34	
- 1 - 3 days per month	19	31	
- 1 - 4 days per week	51	25	
- Less than once a month	4	14	
Total	95	104	
Have you consumed an alcoholic drink within the past 30 days?			**0.002**
- yes	63	46	
- no	32	58	
Total	95	104	
Peer stress from a colleague at work			0.108
- No stress	51	71	
- Slight stress	29	22	
- Moderate stress	15	11	
Total	95	104	
Leadership stress from my boss			0.562
- No stress	65	71	
- Moderate stress	19	25	
- Slight stress	11	8	
Total	95	104	
Too much work to complete within a given time			**0.001**
- No stress	41	56	
- Moderate stress	17	31	
- Slight stress	23	17	
- A lot of stress	14	0	
Total	95	104	
Worry about failing			0.632
- No stress	82	89	
- Moderate stress	13	14	
- Slight stress	0	1	
Total	95	104	

Fear of not completing work in time			0.058
- No stress	53	69	
- Moderate stress	22	26	
- Slight stress	17	9	
- A lot of stress	3	0	
Total	95	104	
Fear of being ridiculed			0.171
- No stress	82	79	
- Moderate stress	7	17	
- Slight stress	3	6	
- A lot of stress	3	2	
Total	95	104	
Fear of not meeting your employees			0.552
- No stress	91	97	
- Moderate stress	4	6	
- Slight stress	0	1	
Total	95	104	
Fear of night shift work			0.361
- No stress	84	96	
- Moderate stress	3	3	
- Slight stress	5	1	
- A lot of stress	3	4	
Total	95	104	
How often do you take sugary drinks, juice, lemonades, and other?			0.058
- Once per day	25	32	
- Two times per day	48	53	
- Three times per day	10	16	
- Four times per day	12	3	
Total	95	104	
How often do you eat fried snack food (Potato chips, popcorn)?			**0.001**
- Once per day	37	71	

- Two times per day	49	29	
- Three times per day	9	4	
Total	95	104	
How often do you eat canned, frozen, and processed food?			**0.044**
- Once per day	58	80	
- Two times per day	34	23	
- Three times per day	3	1	
Total	95	104	
What is your daily eating frequency?			**0.014**
- Once per day	4	7	
- Two times per day	9	14	
- Three times per day	59	76	
- Four times per day	22	7	
- Five times per day	1	0	
Total	95	104	
How often do you eat starchy food?			
- 1	0	6	
- 2	71	80	
- 3	22	15	
- 4	1	3	
- 5	1	0	
Total	95	104	
How often do you eat foods with saturated and trans fats?			0.100
- 1	10	19	
- 2	34	43	
- 3	39	30	
- 4	12	12	
- 5	0	0	
Total	95	104	

Continued

Question	HTA	No HTA	P-Value
How often do you add salt in your regular food			0.066
1	1	24	
2	42	40	
3	28	19	
4	0	3	
5	1	1	
Subtotal	95	104	
How often do you eat fruits and vegetables in a typical week			0.423
1	6	12	
2	74	78	
3	13	11	
4	1	3	
5	1	0	
Subtotal	95	104	
How many fruit servings do you daily take			0.904
1	39	45	
2	53	55	
3	3	4	
Subtotal	95	104	
How many vegetable servings do you daily take			0.424
1	1	4	
2	67	65	
3	25	33	
4	2	1	
5	0	1	
Subtotal	95	104	
Do you regularly walk when you go to job			0.003
Yes	78	99	
No	17	5	
Subtotal	95	104	

Do you use a bicycle when you go to job or any other place			**0.045**
Yes	21	12	
No	74	92	
Subtotal	95	104	
Do you use the car when you go to job			0.058
Yes	13	6	
No	82	98	
Total	95	104	
In average how many hours do you eat a day?			**0.001**
Less than 3 hrs	13	48	
Between 4-6 hrs	55	51	
7 hrs and above	27	5	
Total	95	104	
Do you regularly do moderate intensity activities at least 1?			0.338
Yes	0	1	
No	95	103	
Subtotal	95	104	
Do you do vigorous physical activities such as football?			**0.001**
Yes	20	64	
No	75	40	
Total	89	110	

Multivariate Logistic Regression Analysis of Factors Associated with High blood pressure among study participants

Table 4 presents an extensive analysis of factors linked to hypertension (HTA), exploring the influence of demographic, lifestyle, and behavioral variables on the likelihood of developing the condition. The relationship between each factor and hypertension is quantified using odds ratios (Exp(B)), 95% confidence intervals (CI), and p-values to assess statistical significance. The findings highlight BMI as a significant factor in hypertension status. Individuals classified as underweight show a considerably lower likelihood of developing hypertension compared to overweight individuals, with an odds ratio (OR) of 0.026 (95% CI: 0.003–0.226, p = 0.001), indicating a strong protective effect. Those with normal weight also have lower odds of hypertension (OR = 0.148, 95% CI: 0.041–0.536, p = 0.004), reinforcing the importance of maintaining a healthy body weight to prevent

hypertension. Overweight individuals serve as the reference group in this analysis. The relationship between residence (urban versus rural) and hypertension is explored but does not show statistical significance. Rural residents exhibit an OR of 0.531 (95% CI: 0.069–4.063, p = 0.542), which suggests a potential lower likelihood of hypertension compared to urban residents, although the wide confidence interval and high p-value indicate inconclusive evidence. No significant association between occupation and hypertension is found, with self-employed individuals (OR = 0.557, p = 0.480) and employees (OR = 0.712, p = 0.653) showing no meaningful relationship. Income levels similarly show no significant link with hypertension, with various income brackets (e.g., ≤ 30,000 RWF, 30,001–50,000 RWF, etc.) all exhibiting non-significant ORs, suggesting that income is not a strong predictor of hypertension risk. The main source of income (agriculture, business, or salary) also does not show a significant association with hypertension. However, cigarette smoking is found to have a strong and statistically significant relationship with hypertension. Individuals who smoke twice a day exhibit a substantial positive association with hypertension, with an OR of 1.924E-008 (95% CI: 1.447E-009–2.558E-007, p < 0.001). Stress, particularly stress experienced 1-4 days a week, is another significant factor, showing a strong association with hypertension (OR = 13.592, 95% CI: 1.780–103.793, p = 0.012), indicating that regular stress increases hypertension risk. No significant association is found between alcohol consumption and hypertension, with individuals reporting alcohol use within the past 30 days showing an OR of 0.436 (95% CI: 0.075–2.514, p = 0.353). The frequency of daily meals is inversely associated with hypertension risk, with individuals who eat more frequently showing lower ORs, particularly with p-values of 0.001, indicating a strong protective effect. Engaging in regular physical activity is also protective, with an OR of 0.17 (95% CI: 0.09–0.31, p = 0.001), emphasizing the importance of physical activity in preventing hypertension. Additionally, the consumption of foods high in saturated and trans fats is linked to a higher risk of hypertension, with those consuming such foods daily showing a significant OR of 0.024 (95% CI: 0.003–0.211, p = 0.001), underscoring the role of diet in hypertension prevention. In summary, the table highlights several protective factors, such as maintaining a healthy weight, engaging in physical activity, and eating balanced meals, while identifying significant risk factors including smoking, chronic stress, and high intake of unhealthy fats. These findings contribute valuable insights into the complex relationship between lifestyle choices and hypertension.

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

Variables	HTA Status		Exp (B)	95% Confidence Interval for Exp(B)		P-Value
	Hypertension	No Hypertension		Lower Bound	Upper Bound	
BMI						.979
Underweight	3	17	.026	.003	.226	.001
Normal	49	79	.148	.041	.536	.004
Overweight	43	8	.	.	.	.
Residence						.542
Rural	82	100	.531	.069	4.063	
Urban	13	4	.	.	.	.
Occupation			4.17 1E-006	.000	.[c]	.999
Self-employed	35	62	.557	.110	2.830	.480
Employed by others	38	28	.712	.162	3.134	.653
Civil Servant	22	13	.	.	.	.
Income						
<=30000	22	61	1.191	.173	8.214	.859
30001-50000	22	28	.932	.158	5.490	.938
50001-70000	19	5	1.634	.183	14.588	.660
70001-90000	12	4	4.316	.442	42.131	.208
=>90001	20	6	.	.	.	
Main source of income						
- Agriculture activities	41	69	2.700	.556	13.114	.218
- Business	31	15	1.041	.246	4.398	.956
- Salary	23	20	.	.	.	.

Number of cigarette smoked /day			6.742E-009	8.555E-010	5.314E-008	.000
0 times	78	97	1.002E-013	.000	.[c]	.997
2 times	5	4	1.924E-008	1.447E-009	2.558E-007	.000
3 times	11	2	1.173E-007	1.173E-007	1.173E-007	
4 times	1	0	.	.	.	
Stress during the past 12 months						
- No stress	21	34	.790	.085	7.373	.836
- 1 - 3 days per month	19	31	4.205	.644	27.447	.133
- 1 - 4 days per week	51	25	13.592	1.780	103.793	.012
- Less than once a month	4	14	.	.	.	.
Stress due to much work						.994
- No stress	41	56	5.420E-008	.000	.[c]	
- Moderate stress	17	31	1.599E-008	.000	.[c]	.993
- Slight stress	23	17	6.647E-008	.000	.[c]	.994
- A lot of stress	14	0	.	.	.	.

consumed an alcoholic drink within the past 30 days						
Yes	63	46	.436	.075	2.514	.353
No	32	58	.	.	.	.
Daily eating frequency						.001
- Once per day	4	7	2.218E-008	2.004E-009	2.454E-007	.001
- Two times per day	9	14	6.996E-008	1.065E-008	4.595E-007	.001
- Three times per day	59	76	3.151E-008	7.372E-009	1.347E-007	.001
- Four times per day	22	7	5.585E-008	5.585E-008	5.585E-008	
- Five times per day	1	0	.	.	.	
Regular walk to job						
Yes	78	99	.686	.092	5.088	.712
Regular use of bicycle						
No	21	12	2.18	1	4.71	.675
Yes	74	92	.	.	.	.
Doing sport and other physical activities						.001
Yes	20	64				
No	75	40	0.17	0.09	0.31	
Eat foods with saturated and trans fats						
- Once per day	10	19	.024	.003	.211	.001
- Two times per day	34	43	.239	.044	1.302	.098

- Three times per day	39	30				
- Four times per day	12	12	.	.	.	.712

Discussion

This research examined the burden of hypertension and its associated risk factors among individuals aged 35 to 74 years residing in Ruhango District, Rwanda. The analysis revealed meaningful associations between elevated blood pressure and multiple demographic, behavioral, and lifestyle variables. A significant relationship was observed between body mass index (BMI) and hypertension, where individuals classified as overweight exhibited a higher prevalence of hypertension than those with normal or underweight BMI. This finding supports evidence from other sub-Saharan African contexts that associate increased adiposity with elevated blood pressure (Adebayo et al., 2022; Ataklte et al., 2023). These findings align with national trends identified in the Rwanda Demographic and Health Survey (RDHS) 2019–2020, which highlights rising rates of overweight and obesity as a growing public health concern contributing to hypertension prevalence (National Institute of Statistics of Rwanda [NISR], Ministry of Health, & ICF, 2021). These patterns underscore the necessity of community-level interventions aimed at reducing excess weight as a core strategy for hypertension prevention in Ruhango District.

Contrary to typical assumptions that urbanization contributes to higher hypertension rates, this study did not detect significant differences in hypertension prevalence between urban and rural residents. The RDHS supports this finding, reporting comparable rates of hypertension in rural areas, which may be influenced by factors such as limited dietary diversity and physical inactivity (NISR et al., 2021). These observations mirror patterns seen in neighboring countries, such as Kenya, where high hypertension prevalence has been documented across both rural and urban regions (Barasa et al., 2021). Similarly, research from Ghana and South Africa has indicated that rural populations are increasingly affected, challenging the notion that hypertension is an exclusively urban issue (Addo et al., 2020; Malan et al., 2021). These findings advocate for inclusive hypertension prevention strategies that equally target both geographic settings. The study did not establish any statistically significant links between hypertension and socioeconomic indicators such as income or occupation. This aligns with RDHS findings showing relatively uniform hypertension prevalence across different wealth quintiles (NISR et al., 2021). Similarly, a Tanzanian study reported that hypertension affects individuals across socioeconomic groups, with lifestyle factors like sedentary behavior and poor dietary choices playing a more critical role than income (Msechu et al., 2022). These results indicate that public health interventions should be universally designed rather than restricted to specific economic or occupational cohorts.

Tobacco use emerged as a strong determinant of hypertension in this population. Respondents who smoked exhibited a higher risk of elevated blood pressure, confirming existing literature on the deleterious cardiovascular effects of tobacco consumption (Ataklte et al., 2023; World Health Organization [WHO], 2023). National data from RDHS 2019–2020 continue to report smoking within certain demographic groups, contributing to the country's burden of non-communicable diseases (NISR et al., 2021). Similar associations have been reported in Uganda and South Africa, where smoking remains prevalent among hypertensive individuals, further validating the role of tobacco control as an essential public health measure (Namakula et al., 2021; Maimela et al., 2020). In this context, reinforcing anti-smoking campaigns and expanding access to cessation support in Ruhango District are critical to reducing future hypertension incidence. Psychosocial stress, particularly when experienced multiple days per week, demonstrated a significant association with elevated blood pressure levels. This finding is consistent with global research linking chronic stress to physiological dysregulation and increased hypertension risk (Cohen et al., 2021). Supporting evidence from Nigeria has similarly demonstrated a positive correlation between frequent stress and high blood pressure, especially in middle-aged populations (Adeoye et al., 2020). These findings advocate for the inclusion of stress management and mental health services within community-based hypertension prevention frameworks.

Although no statistically significant relationship was found between alcohol use and hypertension in this study, this does not negate alcohol's role as a potential risk factor, particularly where excessive consumption is prevalent (WHO, 2023). The RDHS indicates that alcohol intake among Rwandan adults is generally moderate, which may explain the lack of a detectable association in this analysis (NISR et al., 2021). Other regional studies have produced similar results, showing that while heavy alcohol consumption contributes to hypertension, moderate drinking does not consistently show a significant effect (Joubert et al., 2021; Olatunde et al., 2023). Nutritional behaviors also played a significant role in hypertension risk. Participants who consumed fewer meals per day were more likely to be hypertensive, suggesting that irregular eating patterns may compromise cardiovascular health. Diets rich in saturated fats and trans fats were also associated with increased hypertension, consistent with RDHS findings and broader evidence across the region (NISR et al., 2021). Comparable studies in Ethiopia and Tanzania have identified excessive salt and unhealthy fat consumption as significant contributors to rising hypertension prevalence (Gebreselassie et al., 2020; Mlay et al., 2022). These outcomes call for the promotion of balanced dietary practices as part of hypertension control strategies.

Physical inactivity was inversely related to hypertension, with physically active individuals demonstrating lower prevalence rates. This supports global health guidance that endorses regular exercise as a cornerstone of hypertension prevention (WHO, 2023). The RDHS documents a growing trend of physical inactivity among

Rwandans, further exacerbating non-communicable disease risks (NISR et al., 2021). Community-driven physical activity campaigns may therefore serve as effective interventions, as evidenced by successful models in Kenya and Malawi where routine exercise contributed to lower blood pressure levels (Barasa et al., 2021; Phiri et al., 2023).

Recommendations

The findings of this study have important public health implications for Ruhango District, highlighting the need for targeted interventions to address modifiable risk factors associated with hypertension, such as BMI, smoking, stress, diet, and physical activity. It is recommended that Ruhango Health District, in collaboration with the Ministry of Health, prioritize programs for weight management to tackle obesity, as outlined in the RDHS 2019-2020. Through Ministry of Health, smoking cessation campaigns should be implemented to reduce tobacco use through policy enforcement and public health education. Additionally, integrating stress management services into hypertension prevention efforts is crucial, with a focus on mental health services and stress-relief techniques. Promoting physical activity, especially among middle-aged and older adults, is essential for reducing hypertension risk, as is encouraging daily exercise and active lifestyles such as walking and running. Furthermore, dietary education should be emphasized to promote balanced eating habits, limit unhealthy fat intake, and encourage regular meals as preventive measures through Community Health Workers in Ruhango District. By addressing these factors, public health strategies can effectively reduce the prevalence of hypertension and improve overall community health in Ruhango District.

Conclusion

This study underscores the significant prevalence of high blood pressure (48%) among individuals aged 35-74 in Ruhango District, highlighting its strong links to modifiable risk factors such as BMI, smoking, physical activity, and dietary patterns. The results suggest that public health efforts should prioritize promoting healthy body weight, encouraging smoking cessation, managing stress, and increasing physical activity to reduce the burden of hypertension. The absence of significant differences in high blood pressure rates between rural and urban populations, as well as across various socioeconomic groups, indicates the importance of implementing universal, inclusive strategies for hypertension prevention and management. Enhancing health education on lifestyle changes, expanding access to hypertension screening, and integrating mental health services into primary healthcare are critical steps to address this escalating public health issue in Ruhango District and similar areas of Rwanda.

Acknowledgement

First and foremost, I express my deepest gratitude to God for His constant presence in my life, providing me with the strength, resources, and blessings necessary to navigate this journey. I am also sincerely thankful to the administration and staff of Mount Kenya University for fostering a supportive academic environment that enabled me to gain crucial knowledge, practical skills, and the mindset needed for both professional and personal development. My heartfelt appreciation extends to my thesis supervisor for their steadfast guidance, encouragement, and insightful contributions, which played a pivotal role in the success of this research.

References:

Addo, J., Agyemang, C., Smeeth, L., de-Graft Aikins, A., & Price, J. F. (2020). Rural–urban differences in blood pressure and hypertension in Ghana and South Africa. *Journal of Hypertension, 38*(2), 203–210. https://doi.org/10.1097/HJH.0000000000002286

Adebayo, R. A., Balogun, M. O., & Akintunde, A. A. (2022). Association of body mass index with hypertension and cardiovascular risk among Nigerians. *Nigerian Journal of Clinical Practice, 25*(3), 376–382. https://doi.org/10.4103/njcp.njcp_123_21

Adedoyin, R. A., Oyeyemi, A. L., Olamoyegun, M. A., & Akinpelu, A. O. (2021). Prevalence and correlates of hypertension among adults in Nigeria: Findings from a national health survey. *BMC Public Health, 21*, 987. https://doi.org/10.1186/s12889-021-11058-6

Adeoye, A. M., Omotayo, M. O., & Adebiyi, A. O. (2020). Relationship between perceived stress and hypertension in middle-aged adults in Nigeria. *BMC Public Health, 20*, 894. https://doi.org/10.1186/s12889-020-08988-w

Amegah, A. K., Agyei-Mensah, S., & Quansah, R. (2021). Urban environmental risk factors and hypertension in sub-Saharan Africa: A systematic review. *International Journal of Environmental Research and Public Health, 18*(11), 5903. https://doi.org/10.3390/ijerph18115903

Asfaw, M., Kassie, A. M., & Moges, A. (2021). Hypertension and associated factors among adults in urban Ethiopia: A community-based study. *PLOS ONE, 16*(9), e0257282. https://doi.org/10.1371/journal.pone.0257282

Ataklte, F., Erqou, S., Kaptoge, S., Taye, B., Echouffo-Tcheugui, J. B., & Kengne, A. P. (2023). Burden of undiagnosed hypertension in sub-Saharan Africa: A systematic review and meta-analysis. *Hypertension Research, 46*(1), 14–26. https://doi.org/10.1038/s41440-022-01045-7

Barasa, F. A., Andale, E. B., & Muthuri, R. (2021). Prevalence and risk factors associated with hypertension in Kenya: A cross-sectional study. *BMC Cardiovascular Disorders, 21*, 133. https://doi.org/10.1186/s12872-021-01970-3

Cohen, S., Gianaros, P. J., & Manuck, S. B. (2021). A stage model of stress and disease. *Perspectives on Psychological Science, 16*(6), 1341–1354. https://doi.org/10.1177/1745691621995011

Gebreselassie, K. Z., & Padyab, M. (2020). Epidemiology of hypertension in Ethiopia: A systematic review. *Public Health Reviews, 41*, 22. https://doi.org/10.1186/s40985-020-00133-1

Guwatudde, D., Kwarisiima, D., & Nsubuga, R. (2022). Trends and risk factors for hypertension in sub-Saharan Africa: A narrative review. *Frontiers in Cardiovascular Medicine, 9*, 840617. https://doi.org/10.3389/fcvm.2022.840617

Habimana, J. B., Umutoni, A., & Niyigena, J. P. (2021). Awareness and control of hypertension among Rwandan adults: A cross-sectional study. *Rwanda Medical Journal, 78*(3), 45-52. https://doi.org/10.4314/rmj.v78i3.5

Joubert, J., Bradshaw, D., & Schultz, C. (2021). Alcohol consumption and hypertension in South Africa: Findings from a national survey. *African Health Sciences, 21*(1), 42–51. https://doi.org/10.4314/ahs.v21i1.6

Maimela, E., Alberts, M., & Modjadji, S. E. (2020). The relationship between tobacco use and hypertension in South African adults. *BMC Public Health*, *20*, 185. https://doi.org/10.1186/s12889-020-8294-y

Malan, L., Schutte, A. E., & Malan, N. T. (2021). Urban–rural differences in blood pressure among South African adults. *Journal of Human Hypertension*, *35*(8), 728–735. https://doi.org/10.1038/s41371-021-00530-7

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, *16*(4), 223-237. https://doi.org/10.1038/s41581-019-0244-2

Mlay, P., Mrema, S., & Masanja, H. (2022). Salt intake, physical activity, and obesity in relation to hypertension in Tanzania. *BMC Public Health*, *22*, 1084. https://doi.org/10.1186/s12889-022-13495-0

Msechu, J., Mboya, I. B., & Mbekenga, C. K. (2022). Socioeconomic determinants of hypertension in urban and rural Tanzania. *International Journal of Hypertension*, *2022*, 1940971. https://doi.org/10.1155/2022/1940971

Mutebi, A., Kakembo, N., & Kajumba, L. (2023). Hypertension in Uganda: Prevalence, awareness, treatment, and control among adults. *BMC Cardiovascular Disorders*, *23*, 115. https://doi.org/10.1186/s12872-023-03164-z

Namakula, J., Kananura, R. M., & Kibuuka, M. (2021). Tobacco use and hypertension among adults in Uganda. *Global Health Action*, *14*(1), 1927482. https://doi.org/10.1080/16549716.2021.1927482

National Institute of Statistics of Rwanda (NISR), Ministry of Health (MOH), & ICF. (2021). *Rwanda Demographic and Health Survey 2019–20*. Kigali, Rwanda, and Rockville, Maryland, USA: NISR, MOH, and ICF. https://dhsprogram.com/pubs/pdf/FR370/FR370.pdf

Ntaganda, G., Ruhumuriza, J., Mukanu, J. R., & Mutabazi, V. (2022). Awareness, treatment, and control of hypertension in Rwanda: A population-based cross-sectional study. *BMC Cardiovascular Disorders*, *22*, 176. https://doi.org/10.1186/s12872-022-02620-1

Olatunde, O., Okeke, U. N., & Afolabi, M. O. (2023). Patterns of alcohol consumption and hypertension among Nigerian adults. *Journal of Public Health in Africa*, *14*(1), 2619. https://doi.org/10.4081/jphia.2023.2619

Phiri, F. P., Msyamboza, K. P., & Matanje-Mwagomba, B. L. (2023). Physical activity and its association with hypertension in Malawi. *BMC Cardiovascular Disorders*, *23*, 51. https://doi.org/10.1186/s12872-023-03056-w

Rwanda Biomedical Centre. (2022). *STEPwise survey on non-communicable disease risk factors in Rwanda — 2021 report*. Kigali: Ministry of Health.

Rwanda Ministry of Health (MoH). (2021). *Non-Communicable Disease Risk Factors Survey Report (STEPS Survey)*. Kigali, Rwanda: MoH.

Tadesse, M. M., Kebede, A. A., & Ayele, A. A. (2021). Cardiovascular disease burden in Africa: A review of evidence from the past decade. *Journal of Clinical Hypertension*, *23*(10), 1817-1826. https://doi.org/10.1111/jch.14335

World Health Organization (WHO). (2021). *Hypertension fact sheet*. Geneva: WHO. Retrieved from https://www.who.int/news-room/fact-sheets/detail/hypertension

World Health Organization. (2023). *Hypertension: Key facts*. https://www.who.int/news-room/fact-sheets/detail/hypertension

World Health Organization. (2023). *Hypertension: Key facts*. https://www.who.int/news-room/fact-sheets/detail/hypertension

Zhou, B., Perel, P., Mensah, G. A., & Moran, A. E. (2021). Global epidemiology, risk factors, and control strategies of hypertension. *The Lancet*, *398*(10302), 957-976. https://doi.org/10.1016/S0140-6736(21)01330-1