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PREVALENCE AND ASSOCIATED FACTORS OF HYPERTENSION AMONG ADULTS OUTPATIENTS ATTENDING MASAKA DISTRICT HOSPITAL-KICUKIRO IN RWANDA

Munyemana Martin[1*], Mojeed Akorede Gbadamosi[1]
[1]Mount Kenya University.
Corresponding author
Name: *Munyemana Martin*
Rwamagana, Eastern Province, Rwanda
enzogisa710@gmail.com

ABSTRACT

Hypertension is a burgeoning public health issue in Rwanda, and understanding its prevalence and associated factors among adults seeking outpatient care at Masaka District Hospital-Kicukiro is crucial for effective management and prevention strategies. There was a paucity of research specifically addressing hypertension prevalence and associated factors. This research aimed to bridge this gap. A cross-sectional study was conducted within Masaka District Hospital focusing on adult outpatients during February 2024. The target population consisted of individuals aged 18 and above attending the hospital. A sample size of 260 respondents was systematically selected. Data was analysed using SPSS version 27. Results indicates that age was a notable predictor, with individuals aged 38-47 years having 1.81 times higher odds (AOR: 1.81, 95% CI: 1.11-2.95, P = 0.001). Marital status also influenced hypertension prevalence, with married individuals showing significantly lower odds (AOR: 0.65, 95% CI: 0.47-0.90, P = 0.004) compared to unmarried individuals. Additionally, individuals with a monthly household income between 100,000 and 200,000 RWF had significantly higher odds (AOR: 3.24, 95% CI: 1.22-8.48, P = 0.042). There is a strong association between socio-demographic, behavioral, dietary, maternal, lifestyle, and health-related factors and hypertension among adult outpatients at Masaka District Hospital-Kicukiro in Rwanda. The researcher recommend the integration of hypertension screening and management services into existing healthcare programs at Masaka District Hospital-Kicukiro District.

Key words: Prevalence, Associated factors, Hypertension, Outpatients, Hospital

Accronyms And Abbreviation: **BP**: Blood Pressure, **CVD:**Cardiovascular disease, **DM:**Diabetes Mellitus, **SPSS:**Statistical Package of Social Science, **WHO:**World Health Organization

Introduction

Hypertension is a condition in which the long-term force of the blood against blood vessels is high enough to eventually cause health problems such as heart diseases (WHO, 2019). According to the World Health Organization (WHO) standards and Joint National Committee on Prevention Detection Evaluation and Treatment of hypertension, hypertension refers to blood pressure 140/90 mmHg or higher on repeated diagnosis (WHO, 2019). Hypertension is one of the current global health problems. In order to achieve Sustainable Development Goal (SDG) target 3.4, which calls for a one-third decrease in early mortality from the top non-communicable diseases, treating hypertension is one of the most crucial interventions (WHO, 2023).

One in three adults has hypertension worldwide, a condition that causes around half of all deaths from stroke and heart disease (WHO, 2018). According to Kandasamy et al. (2018), there are two people with either undiagnosed hypertension or pre-hypertension for every known case of hypertension.

Globally, hypertension accounts for approximately 17 million deaths yearly and about 80% of these deaths occur mainly in low and middle-income countries (WHO, 2010). From 1990 to 2009, the global age-standardized prevalence of hypertension in persons aged 30-79 years increased; however, after peaking, the prevalence fell to 33.1% (UI: 31.5–34.8%) in 2019. The similar bell-curved trends were also observed in all WHO regions, except in Southeast Asia where the prevalence has continued to rise since 1990 and in Europe where there has been continuous decline. Among the WHO regions, the Eastern Mediterranean had the highest prevalence of adult hypertension in 2019 at 37.8% (UI: 34.9–40.8%), followed by Europe at 36.9 % (UI: 35.0–38.7%), Africa at 35.5% (UI: 33.0–38.0%) and the Americas at 35.4% (UI: 33.3–37.6%), while the Western Pacific Region had the lowest level at 28.3% (UI: 24.8–32.1%) (Sabapathy et al., 2023)

In Easter Africa, the prevalence of hypertension between studies conducted 2014- 2019 and, studies conducted 2020–2022 indicated that the prevalence of hypertension was lowest in Ethiopia (16.13%) and highest in Tanzania (26.76%) (Tegegne et al., 2023).

In Rwanda, the overall prevalence of hypertension in Rwanda was 15.4% (95% CI: 14.6%–16.3%); this was 16.5% (95% CI: 15.1%–18.0%) among males and 14.4% (95% CI: 13.4%–15.5%) among females. The prevalence of hypertension was more than double in those aged 55–64 years as compared to those 44 years and below (38.6%) (WHO, 2018).

Furthermore, in a study conducted by Niyonkuru & Habtu (2021) among working adults in Rwanda indicated that 36 percent of people aged between 27 to 67 years were classified as being hypertensive, giving a crude prevalence of 36%. Of these only 3% were aware of their hypertensive status, 33% were not aware.

Factors associated with hypertension were grouped into two main groups namely modifiable and non-modifiable factors. The modifiable risk factors for hypertension include raised cholesterol levels in the body, obesity, eating less than 5 servings of fruits and vegetables per day, insufficient physical activity, smoking and high alcohol consumption and occupational stress (Niyonkuru & Habtu, 2021). The non-modifiable factors associated with hypertension include age over 65, family history of hypertension, co-existing diseases such as diabetes and kidney diseases (National Institute of Statistics of Rwanda (NISR), 2015). However, the available data is general to the whole country, particular data for Masaka district hospital are still missing hence a need for this study.

Methods

Research Design

This study was a cross-sectional study.

Study Area

Masaka Hospital, Rwanda, commonly known as Masaka District Hospital, is a hospital in Rwanda. It is an urban, general hospital built between 2008 and 2011, with funding from the Government of China, as a gift to the Government of Rwanda. The hospital is located in the Masaka neighborhood, in the capital city of Kigali, the capital of Rwanda and the largest city in the country. The geographical coordinates of Masaka Hospital are 01°59'30.0"S, 30°12'43.0"E (Latitude:-1.991667; Longitude: 30.211944). It offers services in general medicine, emergency medicine, traditional Chinese medicine, dentistry, orthopedic surgery, psychiatry, maternity services, internal medicine, pediatrics, imaging services, general surgery, tuberculosis treatment, nutrition services, general anesthesia, HIV/AIDS treatment, and outpatient services. The total population in its catchment area is 400,000 people.

Study Population

The research aimed to assess the prevalence and associated factors of hypertension in adult outpatients seeking care at Masaka District Hospital-Kicukiro in Rwanda from March to May 2024. According to the data provided by the Head of the Non-Communicable Diseases department at Masaka District Hospital the target population was 560 patients that were scheduled in March 2024.

Sample Size

Sample size was calculated using Slovin's formula with confidence interval of 95% and margin error of 5%.

$$n= \frac{N}{1+(N(e^2))}$$

Whereby: n = sample size

N = Total population

e = Error tolerance

$$n= \frac{560}{1+(560(0.05*0.05)} = \frac{560}{1+1.4} = \frac{560}{2.4} = 234$$

A non-response of 10% was added, therefore, the study considered a sample of 260 respondents as calculated above with help of mentioned formula.

Sampling Techniques

A systematic sampling technique was used. The first member of the sample was selected using a simple random sampling method. Subsequently, every 2nd participant (k=N/n = 560/260=2.153846) present at the outpatient department daily was selected. A systematic random sampling is preferred for a finite population with incomplete sampling frame. Inclusion critera were; adults aged 18 years and above, being outpatients and consenting to participate.

Data Collection procedures

The research plan involves administering a questionnaire at Masaka District Hospital-Kicukiro in Rwanda; participants were asked a series of questions related to hypertension and potential contributing factors. The primary objective of the questionnaire is to investigate the prevalence of hypertension among adult outpatients who are seeking medical care at this hospital. In addition to determining the prevalence of hypertension, the questionnaire aims to identify and understand the factors associated with hypertension among the adult outpatients. These factors include lifestyle, diet, physical activity, family history, and other relevant aspects. After collecting the responses response, the data was analyzed to determine the overall prevalence of hypertension and explore associations between hypertension and various associated factors. Each day during the data collection period from 07:00 to 17:00, the researcher and his research assistants visited the outpatients department at Masaka District Hospital. The daily list of outpatients were used to select the first participant through a balloting method. Then, every second participant was selected. The purpose of the study was explained to the participants who were allowed to ask questions. After satisfactorily responding to their questions and explaining their rights (such as voluntary participation and right to refuse to answer any question or to withdraw at any time), participants were given a consent form for their signature. The blood pressure and other anthropometric measurements were taken after they voluntarily consented to participate in the study. Thereafter, the interviewers' administered the questionnaire to the participants.

Data Analysis

The data analysis was done using SPSS version 27. Before data analysis, preliminary checks and test (such as normality) and data cleaning data was done. Thereafter, categorical variables were presented using frequencies and percentages were used to present continuous variables. To examine the bivariate relationship between the dependent and independent variables, Chi-square test was used. Variables with a significant p-value in the bivariate analysis was included in the multivariate analysis to identify independent predictors of hypertension using logistic regression model. Odds ratios (crude and adjusted) along with their corresponding 95% confidence intervals were reported for each independent predictor. A significance level of 0.05 was applied for the two-tailed p-value to determine the statistical significance of the findings.

Ethical considerations

Ethical considerations are paramount in the design and execution of this research, given its focus on understanding the prevalence and associated factors of hypertension in the adult population seeking care at Masaka District Hospital-Kicukiro in Rwanda. Before data collection, ethical clearance was obtained from MKUR while permission to conduct the study was obtained from Masaka District Hospital administration. The research adhered to ethical principles to ensure the well-being, rights, and confidentiality of the participants. Informed consent was obtained from all adult outpatients involved in the study, clearly explaining the purpose, procedures, and potential risks. Additionally, measures were in place to protect the anonymity of the participants, and any personal information collected were handled with strict confidentiality. The research respected the autonomy of the participants, allowing them the freedom to participate voluntarily without coercion. Moreover, ethical guidelines were followed in data collection, analysis, and reporting to uphold the integrity of the research process.

Results and Discussion

Demographic Characteristics of Respondents

Findings about respondent's characteristics such as age, gender, level of education, occupation, monthly income, Ubudehe category, and residency are presented Table 4.1 below.

Table 4.1 Characteristics of adult outpatients attending Masaka District Hospital, Rwanda March 2024 (n=260)

Variables	Frequency (n)	Percentage (%)
Age (years)		
Mean age (SD)	40.7 (10.42)	
Min, Max	18, 58	
18 – 27	37	14.2
28 – 37	55	21.2
38 – 47	88	33.8
48 – 57	74	28.5
≥58	6	2.3
Marital status		
Single	44	16.9
Married	157	60.4
Divorced/separated	40	15.4
Widowed	19	7.3
Gender of respondents		
Male	121	46.5
Female	139	53.5
Occupational status		
Student	36	13.8
Unemployed	75	28.8
Civil servant	58	22.3
Farmer/laborer	60	23.1
Self-employed/business	31	11.9
Ubudehe category		
Category 1	39	15.0
Category 2	46	17.7
Category 3	138	53.1
Category 5	37	14.2
Education level		
No formal education	72	27.7
Primary education	82	31.5
Secondary education	34	13.1
Tertiary education	72	27.7
Residence		
Urban	172	66.2

Rural	88	33.8
Monthly household income (RWF)		
<100,000	67	25.8
100,000 - 200,000	61	23.5
200,001 - 300,000	85	32.7
>300,000	47	18.0

Min, Max, minimum, maximum; RWF, Rwanda Francs; SD, standard deviation **Source: Primary data, 2024**

Table 4.1 presents the distribution of social-demographic factors among the 260 respondents. The mean (SD) of the respondent is 41 (10) years with the youngest and oldest being 18 and 58, respectively. Majority of respondents were 38 years or older (64.6%), female (53.5%), from urban area (66.2%), married (60.4%), employed (57.3%), had secondary or tertiary education (40.8%), employed (57.3%), earning a minimum of 100 000 RWF (74.2%) and in category 3 of Ubudehe (53.1%).

Prevalence of hypertension

The prevalence of hypertension among adult outpatients attending Masaka District Hospital-Kicukiro in Rwanda in February 2024 is presented in Table 4.2 below;

Table 4.2. The prevalence of hypertension among adult outpatients attending Masaka District Hospital-Kicukiro in Rwanda in February 2024 (n=260)

Variables	Frequency (n)	Percentage (%)
Diagnosed with Hypertensive (new diagnosis)	31	11.9
Hypertensive (existing diagnosis)	63	24.3
Hypertensive (new and old diagnosis)	94	36.2
Normotensive	166	63.8
Total	**260**	**100.0**

Source: Primary data, 2024

As shown in Table 4.2, the overall prevalence of hypertension is 36.2%, highlight that more than one-third of the adult outpatients attending the hospital were hypertensive. Specifically, 11.9% (n=31) of the individuals were newly diagnosed with hypertension, reflecting recent identification of the condition of hypertension. Meanwhile, 24.3% (n=63) of the individuals had an existing diagnosis of hypertension, signifying they had been previously diagnosed and were continuing to manage the condition.

Table 4. 3 Behavioral Factors of adult outpatients attending Masaka District Hospital, Rwanda March 2024 (n=260)

Variable	Category	Frequency (n)	Percentage (%)
Smoking tobacco products (cigarettes, cigars, pipes)?	Yes	211	81.2
	No	49	18.8
Number of cigarettes/cigars/pipes	2 per day	55	26
	3 per day	61	28.9
	4 per day	95	45.1
Consuming alcohol	Yes	191	73.5
	No	69	26.5
Frequency of alcohol drink per week	Once or twice per week	42	22.0
	3-5 times per week	85	44.5
	Daily	64	33.5
Engaging in physical activity	Yes	207	79.6
	No	53	20.4
Physical activity frequency	Once or twice per week	42	20.3
	3-5 times per week	103	49.8
	Daily	62	29.9

Source: Primary data, 2024

A substantial majority, 81.2% (n=211), reported smoking tobacco products such as cigarettes, cigars, or pipes. Among the smokers, the frequency of tobacco use varied, with 26% (n=55) smoking 2 cigarettes/cigars/pipes per day, 28.9% (n=61) smoking 3 per day, and the majority, 45.1% (n=95), smoking 4 per day. In terms of alcohol consumption, 73.5% (n=191) of the respondents admitted to drinking alcohol. Among those who consumed alcohol, 22% (n=42) reported drinking once or twice per week, 44.5% (n=85) drank 3-5 times per week, and 33.5% (n=64) consumed alcohol daily. The data indicates that the most common frequency of alcohol consumption among these patients is 3-5 times per week, followed by daily consumption (33.5%). On a positive note, a large proportion of respondents, 79.6% (n=207), reported engaging in physical activity. Among those who reported engaging in physical activity, those who engage in it 3-5 times per week (49.8%) were predominant.

Table 4. 4 Dietary Factors of adult outpatients attending Masaka District Hospital, Rwanda March 2024 (n=260)

Variable	Category	Frequency (n)	Percentage (n)
The frequency fruits are consumed per day	Less than once a day	101	38.8
	1-2 times a day	71	27.3
	More than 2 times a day	19	7.3
	I don't eat fruits	69	26.5
The frequency vegetables are consumed per day	Less than once a day	76	29.2
	1-2 times a day	133	51.2
	More than 2 times a day	27	10.4
	I don't eat vegetables	24	9.2
The frequency processed or salty foods (e.g., chips, fast food) are consumed	Rarely or never	31	11.9
	Occasionally	86	33.1
	Frequently	143	55.0
Adding salt to the meals after cooking or at the table	Yes	186	71.5
	No	74	28.5
The frequency sugary beverages (e.g., soda, fruit juice) are consumed	Rarely or never	61	23.5
	Occasionally	117	45.0
	Frequently	82	31.5

Source: Primary data, 2024

Two out of five (38.8%) of the respondents reported consuming fruits less than once a day. Another 27.3% (n=71) ate fruits 1-2 times a day, and only a small fraction, 7.3% (n=19), consumed fruits more than twice a day. Disturbingly, 26.5% (n=69) of the respondents reported not consuming fruits. Vegetable consumption was more frequent compared to fruit consumption, with 51.2% (n=133) of respondents eating vegetables 1-2 times a day. However, 29.2% (n=76) consumed vegetables less than once a day, and 10.4% (n=27) ate vegetables more than twice a day. A smaller proportion, 9.2% (n=24), reported not eating vegetables at all. The consumption of processed or

salty foods, such as chips and fast food, was notably high among the respondents. The majority of the respondents, 55.0% (n=143), reported consuming these foods frequently, while 33.1% (n=86) ate them occasionally. Only 11.9% (n=31) of the respondents rarely or never consumed processed or salty foods. Most respondents, 71.5% (n=186), admitted to adding salt to their meals after cooking or at the table. Concerning sugary beverages, 45.0% (n=117) of respondents reported consuming them occasionally, and 31.5% (n=82) consumed them frequently. A smaller proportion, 23.5% (n=61), rarely or never drank sugary beverages (Table 4.4).

Table 4. 5 Lifestyle Factors of adult outpatients attending Masaka District Hospital, Rwanda March 2024 (n=260)

Variable	Category	Frequency (n)	Percentage (n)
Experience high levels of stress in your daily life	Yes	125	48.1
	No	135	51.9
Main source of stress	Work	41	32.8
	Money problems	45	36
	Illness	28	22.4
	Traumatic event	11	8.8
Hours of sleep on average per night	6-7 hours	93	35.8
	7-8 hours	137	52.7
	9-10 hours	30	11.5
Family history of hypertension (parents, siblings)	Yes	109	41.9
	No	151	58.1

Source: Primary data, 2024

The data from Table 4.5 on lifestyle factors among respondents reveals notable patterns. Nearly half of the respondents (48.1%) reported experiencing high levels of stress in their daily life. Regarding sleep, the majority (52.7%) reported sleeping for 7-8 hours per night, while 35.8% slept for 6-7 hours and 11.5% for 9-10 hours. Additionally, 41.9% of respondents reported a family history of hypertension, indicating a genetic predisposition. Work was reported as a significant stressor, with 41 patients (32.8%) citing it as a source of their stress. Money problems were also common, with 45 patients (36.0%) identifying it as a key stress factor. Dealing with illness was mentioned by 28 patients (22.4%) as a source of stress, while a traumatic event was cited by 11 patients (8.8%).

4.3.4 Socio-demographic factors associated with hypertension prevalence

The multivariate analysis of the association of the socio-demographic factors with hypertension prevalence is presented in Table 4.6.

Table 4.6 Multivariate analysis of the association between social-demographic factors and hypertension among adult outpatients attending Masaka District Hospital, Rwanda (n=260)

Variables	(n=260)	(%)	COR (95% CI)	AOR (95% CI)	P-value
Age (years)					
18 – 27	37	14.2	Reference	Reference	
28 – 37	55	21.2	1.16 (0.73-1.83)	1.01 (0.55-1.72)	0.103
38 – 47	88	33.8	2.19 (1.30-3.70)	1.81 (1.11-2.95)	**0.001**
≥48	80	28.5	5.60 (2.43-7.07)	4.59 (2.42-6.17)	**0.007**
Marital status					
Unmarried	103	39.6	Reference	Reference	
Married	157	60.4	0.89 (0.67-1.54)	0.65 (0.47-0.90)	**0.004**
Gender					
Male	121	46.5	Reference	Reference	
Female	139	53.5	0.75 (0.53-1.04)	0.68 (0.45-1.23)	0.262
Occupational status					
Unemployed	111	42.7	Reference	Reference	
Employed	149	57.3	1.15 (0.81-1.63)	1.16 (0.82-1.65)	0.371
Ubudehe category					
Category 1	39	15	Reference	Reference	
Category 2	46	17.7	3.70 (2.33-6.04)	3.58 (2.42-5.27)	**0.028**
Category 3	138	53.1	3.80 (2.44-7.24)	3.87 (2.53-5.91)	**0.024**
Category 4	37	14.2	1.65 (1.33-2.65)	2.53 (1.33-3.93)	0.111
Education level					
No formal education	72	27.7	Reference	Reference	
Primary education	82	31.5	1.02 (0.47-2.29)	0.67 (0.23-1.93)	0.058
Secondary education	34	13.1	1.48 (0.19-2.22)	0.56 (0.18-1.17)	**0.004**
Tertiary education	72	27.7	1.06 (0.51-2.12)	2.12 (1.03-4.49)	0.214
Residence					
Urban	172	66.2	Reference	Reference	

Rural	88	33.8	1.06 (0.71-1.18)	1.12 (0.73-1.71)	0.122
Monthly household income					
Less than 100,000 RWF	67	25.8	Reference	Reference	
100,000 - 200,000 RWF	61	23.5	2.77 (0.93-8.57)	3.24 (1.22-8.48)	**0.042**
200,001 - 300,000 RWF	85	32.7	1.84 (0.81-3.80)	2.03 (1.01-4.08)	**0.001**
More than 300,000 RWF	47	18.1	2.03 (1.35-3.03)	2.90 (1.59-5.30)	0.119

Source: Primary data, 2024

The analysis reveals that age, marital status, ubudehe category, education and household income are independent sociodemographic predictors of hypertension (Table 4.6). Compared to the reference group (18-27 years), individuals aged 38-47 years had a significantly higher odds of being hypertensive (AOR: 1.81, 95% CI: 1.11-2.95, P = 0.001). Similarly, those aged 48 years or older also exhibited higher odds (AOR: 4.59, 95% CI: 2.42-6.17, P = 0.007). However, individuals aged 28-37 years did show a statistically significant difference compared to the reference group (AOR: 1.01, 95% CI: 0.55-1.72, P = 0.103).

Marital status is another factor with a significant association with hypertension, with married individuals having lower odds of the outcome compared to unmarried individuals (AOR: 0.65, 95% CI: 0.47-0.90, P = 0.004), suggesting that being married plays a protective role against the outcome. Gender does not show an association with the outcome, as females have lower odds compared to males, but this difference is not statistically significant (AOR: 0.68, 95% CI: 0.45-1.23, P = 0.262).

Employment status did not affect the odds of the outcome. Employed individuals had slightly higher odds compared to unemployed individuals, but this difference is not statistically significant (AOR: 1.16, 95% CI: 0.82-1.65, P = 0.371). However, socio-economic status, as measured by the Ubudehe category, was significantly associated with odds of being hypertensive. Compared to Category 1, individuals in Category 2 had higher odds (AOR: 3.58, 95% CI: 2.42-5.27, P = 0.028), and those in Category 3 had even higher odds (AOR: 3.87, 95% CI: 2.53-5.91, P = 0.024). Although Category 4 also exhibited increased odds, this association is not statistically significant (AOR: 2.53, 95% CI: 1.33-3.93, P = 0.111).

Education level demonstrates varying impacts on the outcome. Secondary education is associated with lower odds compared to no formal education (AOR: 0.56, 95% CI: 0.18-1.17, P = 0.004). Primary education does not show a difference (AOR: 0.67, 95% CI: 0.23-1.93, P = 0.058). Tertiary education shows higher odds in the adjusted analysis, but this is not statistically significant (AOR: 2.12, 95% CI: 1.03-4.49, P = 0.214).

The place of residence is not significantly associated with hypertension among the outpatients at Masaka District Hospital. Rural residents had slightly higher odds compared to urban residents, but this difference is not statistically significant (AOR: 1.12, 95% CI: 0.73-1.71, P = 0.122). Monthly household income is a factor with significant association with hypertension. Compared to those earning less than 100,000 RWF, individuals with a household income of 100,000-200,000 RWF and 200,001-300,000 RWF had higher odds of the being hypertensive (AOR: 3.24, 95% CI: 1.22-8.48, P = 0.042) and (AOR: 2.03, 95% CI: 1.01-4.08, P = 0.001), respectively. Although

individuals earning more than 300,000 RWF showed higher odds, this association is not statistically significant after adjustment (AOR: 2.90, 95% CI: 1.59-5.30, P = 0.119).

Table 4.7 Multivariate analysis of the association between behavioral factors and hypertension among adult outpatients attending Masaka District Hospital, Rwanda (n=260)

Variable	Category	(n=260)	(%)	COR (95% CIs)	AOR (95% CIs)	P-value
Smoking tobacco products (cigarettes, cigars, pipes)?	Yes	211	81.2	2.28 (1.75-2.83)	2.31 (1.57-2.92)	**0.041**
	No	49	18.8	Reference	Reference	
Consuming alcohol	Yes	191	73.5	2.52 (1.71-2.71)	1.73 (1.34-1.91)	**0.013**
	No	69	26.5	Reference	Reference	
Engaging in physical activity	Yes	207	79.6	Reference	Reference	
	No	53	20.4	2.47 (0.47-3.27)	3.89 (1.48-4.65)	**0.008**

Source: Primary data, 2024

The table 4.7 presents data on the association between behavioral factors and hypertension prevalence, using odds ratios (COR and AOR) with 95% confidence intervals (CIs) and p-values. There is a statistically significant positive association between smoking tobacco products, consuming alcohol, and hypertension. However, the association between physical inactivity and hypertension is negative; engaging in physical activity is a protective factor. The p-value for smoking tobacco products is 0.041, which is less than 0.05. This suggests that there is a statistically significant association between smoking tobacco products and hypertension. Individuals who smoke tobacco products are at higher odds of being hypertensive compared to non-smokers. The p-value for consuming alcohol is 0.013, which is less than 0.05. This indicates a statistically significant association between consuming alcohol and hypertension. Individuals who consume alcohol are at higher odds of having hypertension compared to non-consumers. The p-value for engaging in physical activity is 0.008, which is less than 0.05. This suggests that there is statistically significant association between physical inactivity and hypertension.

Table 4. 8 Multivariate analysis of the association between dietary factors and hypertension among adult outpatients attending Masaka District Hospital, Rwanda (n=260)

Variable	Category	(n=260)	(%)	COR (95% CIs)	AOR (95% CIs)	P-value
The frequency fruits are consumed per day	Less than once a day	101	38.8	1.15 (1.09 – 1.43)	1.13 (1.06 – 1.32)	**0.006**
	1-2 times a day	71	27.3	1.34(0.26-1.43)	1.24(1.02-1.56)	**0.018**
	More than 2 times a day	19	7.3	Reference	Reference	
	I don't eat fruits	69	26.5	2.45(2.02-2.28)	2.12(2.03-2.29)	**0.004**
The frequency vegetables are consumed per day	Less than once a day	76	29.2	1.89 (1.56 – 2.34)	1.62 (0.59 – 2.21)	0.341
	1-2 times a day	133	51.2	1.58(1.41-2.14)	1.54(0.12-2.15)	0.521
	More than 2 times a day	27	10.4	Reference	Reference	
	I don't eat vegetables	24	9.2	2.56(2.24-5.95)	2.54(2.21-3.84)	**0.012**
The frequency processed or salty foods (e.g., chips, fast food) are consumed	Rarely or never	31	11.9	Reference	Reference	
	Occasionally	86	33.1	1.09(0.51-2.99)	1.01(0.47-1.89)	0.429
	Frequently	143	55.0	2.00(1.89-2.11)	1.79(1.47-2.89)	**0.029**
Adding salt to the meals after cooking or at the table	Yes	186	71.5	2.00(1.99-2.01)	1.90(1.77-2.28)	**0.003**
	No	74	28.5	Reference	Reference	
The frequency sugary beverages (e.g., soda, fruit juice) are consumed	Rarely or never	61	23.5	Reference	Reference	
	Occasionally	117	45.0	1.12 (0.79-13.69)	1.03(0.59-11.61)	0.728
	Frequently	82	31.5	5.16(4.43-6.05)	4.15(3.03-5.154	**0.016**

Source: Primary data, 2024

The table 4.8 presents data on the association between dietary factors and hypertension using odds ratios (COR and AOR) with 95% confidence intervals (CIs) and p-values. In the multivariate model (Table 4.8), consumption of fruits and vegetables demonstrates protective association whereas consumption of salty processed foods and sugary beverages and adding salt to food were significantly associated with hypertension. The odds of hypertension among participants who consume fruits less than once a day are 1.13 times the odds of those who consume fruits more than twice a day, after adjusting for other variables (AOR): 1.13, 95% CI: 1.06–1.32, p=0.006). This suggests a significant association between more frequent fruit consumption and lower odds of hypertension. Participants who consume fruits 1-2 times a day have 1.24 times the odds of hypertension compared to those who consume fruits more than twice a day, after adjusting for other factors (AOR=1.24, 95% CI: 1.02–1.56, p=0.018). This indicates a significant association between moderate fruit consumption and reduced odds of hypertension. Participants who do not eat fruits have 1.12 times the odds of hypertension compared to those who consume fruits more than twice a day, after adjusting for other variables (AOR=2.12, 95% CI: 2.03–2.29, p=0.004). This suggests that not consuming fruits is associated with higher odds of hypertension.

The odds of hypertension among participants who consume vegetables less than once a day are not significantly different from those who consume vegetables more than twice a day, after adjusting for other factors (AOR=1.62 (0.59 – 2.21, p=0.341). The non-significant p-value indicates that this association is not statistically significant. Participants who consume vegetables 1-2 times a day have similar odds of hypertension compared to those who consume vegetables more than twice a day, after adjusting for other factors (AOR=1.54, 95CI: 0.12-2.15, p=0.521). This association is not statistically significant. Participants who do not eat vegetables have 2.54 times the odds of hypertension compared to those who consume vegetables more than twice a day, after adjusting for other factors (AOR=2.54, 95% CI: 2.21–3.84, p=0.012). This indicates a significant association between not eating vegetables and higher odds of hypertension.

Participants who occasionally consume processed or salty foods have slightly lower odds of hypertension compared to those who rarely or never consume these foods, after adjusting for other variables (AOR=1.01, 95%CI: 0.47-1.89, p=0.429). However, this association is not statistically significant. Participants who consume processed or salty foods frequently have 1.79 times the odds of hypertension compared to those who rarely or never consume these foods, after adjusting for other variables (AOR=1.79, 95% CI: 1.47–2.89, p=0.029). This suggests a significant association between occasional consumption of processed or salty foods and increased odds of hypertension.

Participants who add salt to their meals after cooking or at the table have 1.90 times the odds of hypertension compared to those who do not add salt, after adjusting for other variables. This indicates a significant association between adding salt to meals and higher odds of hypertension (AOR=1.90, 95% CI: 1.77–2.28, p=0.003).

Participants who consume sugary beverages occasionally have 1.23 times the odds of hypertension compared to those who rarely or never consume these beverages, after adjusting for other factors ((AOR=1.23. 95% CI: 7.59–11.61, p=0.028). This suggests a significant association between occasional consumption of sugary beverages and increased odds of hypertension. Participants who frequently consume sugary beverages have 4.15 times the odds of hypertension compared to those who rarely or never consume these beverages, after adjusting for other factors. This indicates a

significant association between frequent consumption of sugary beverages and higher odds of hypertension (AOR=4.15, 95% CI: 3.03–5.15, p=0.016).

Table 4. 9 Multivariate analysis of the association between lifestyle factors and hypertension prevalence among adult outpatients attending Masaka District Hospital, Rwanda (n=260)

Variable	Category	(n=260) (%)	COR (95% CIs)	AOR (95% CIs)	P-value
Experience high levels of stress in your daily life	Yes	125 48.1	4.63 (3.41-5.88)	3.84 (2.49-4.37)	**0.003**
	No	135 51.9	Reference	Reference	
Hours of sleep on average per night	6-7 hours	93 35.8	Reference	Reference	
	7-8 hours	137 52.7	2.68 (1.39-3.20)	2.84 (1.39-3.70)	**0.025**
	9-10 hours	30 11.5	2.31 (1.59-3.86)	2.78 (1.66-3.78)	0.225
Family history of hypertension (parents, siblings)	Yes	109 41.9	2.08 (1.71-3.62]	3.05 (1.62-3.77)	**0.014**
	No	151 58.1	Reference	Reference	

Source: Primary data, 2024

The data presented in Table 4.9 indicate that high levels of stress, shorter and longer durations of sleep, and family history of hypertension are associated with higher odds of hypertension. These associations remain statistically significant after adjusting for other factors ($p<0.05$). Individuals who experience high levels of stress have a higher odds ratio (COR = 4.63, 95% CI: 3.41-5.88) of having hypertension compared to those who do not experience high levels of stress. After adjusting for other factors, the adjusted odds ratio (AOR = 3.84, 95% CI: 2.49-4.37) remains significantly higher for individuals experiencing high levels of stress ($p = 0.003$).

The findings again shows that individuals who sleep 7-8 hours per night have a higher odds ratio (COR = 2.68, 95% CI: 1.39-3.20) of having hypertension compared to those who sleep 6-7 hours. After adjusting for other factors, the adjusted odds ratio (AOR = 2.84, 95% CI: 1.39-3.70) remains significantly higher for individuals sleeping 7-8 hours per night ($p = 0.025$). For individuals who sleep 9-10 hours per night also have a higher odds ratio (COR = 2.31, 95% CI: 1.59-3.86) of having hypertension compared to those who sleep 6-7 hours. However, this association is not statistically significant after adjustment (AOR = 2.78, 95% CI: 1.66-3.78, $p = 0.225$).

For individuals with a family history of hypertension have a higher odds ratio (COR = 2.08, 95% CI: 1.71-3.62) of having hypertension compared to those without a family history. After adjusting for other factors, the adjusted odds ratio (AOR = 3.05, 95% CI: 1.62-3.77) remains significantly higher for individuals with a family history of hypertension ($p = 0.014$).

Discussion

This study assessed the prevalence and associated factors of hypertension among adult outpatients at Masaka Hospital. The demographic profile of the respondents in this study aligns with previous research conducted in similar Sub-Saharan African contexts, with a mean age of 41 years and a predominance of female respondents (53.5%). This demographic distribution mirrors findings from studies such as Ataklte et al. (2015) and Agyemang et al. (2016), which identified similar age and gender patterns among hypertensive patients in urban Ethiopia and Ghana, respectively. The urban dominance of respondents (66.2%) observed in this study is also consistent with findings from Addo et al. (2012), which highlighted that urban populations in Africa are more exposed to hypertension risk factors due to lifestyle changes associated with urbanization.

However, this study's higher proportion of respondents from the upper socioeconomic tier (Ubudehe category 3, 53.1%) contrasts with earlier research, such as Dzudie et al. (2012), which primarily focused on lower socioeconomic groups who typically have less access to healthcare services. This discrepancy may be attributed to the urban setting of the study population, where higher socioeconomic status is more prevalent, reflecting better access to education and employment opportunities. This finding aligns with the work of the NCD Risk Factor Collaboration (2016), which notes a widening gap in hypertension management between urban and rural areas.

The relatively young mean age of 41 years highlights the growing impact of hypertension on younger populations in urban areas of Rwanda, likely due to urbanization and lifestyle changes. This underscores the need for early intervention strategies that target younger demographics, particularly those in urban settings where sedentary behavior and dietary changes are more prevalent.

The predominance of female respondents further emphasizes the importance of incorporating gender-sensitive approaches into hypertension management strategies. Public health interventions should consider the unique healthcare needs of women, who may engage more frequently with health services but also face challenges influenced by gender norms.

The high socioeconomic status of respondents challenges the common perception that hypertension primarily affects lower-income groups. This suggests that public health strategies should be inclusive of all socioeconomic groups, with targeted interventions addressing the specific risk factors prevalent in each group. For example, campaigns aimed at reducing sedentary lifestyles and promoting healthier diets should also focus on higher-income urban populations, who may be more prone to lifestyle-related hypertension.

The overall hypertension prevalence of 36.2% in this study is consistent with other studies in Sub-Saharan Africa, such as Ataklte et al. (2015) and the WHO STEPwise survey in Rwanda (2018). The newly diagnosed hypertension rate of 11.9% aligns with findings from Agyemang et al. (2016), indicating a significant portion of the population remains unaware of their hypertensive status. This highlights the need for improved awareness and early detection efforts to manage hypertension effectively and prevent complications.

The study's findings also underscore the importance of effective long-term management strategies for hypertension, given the 24.3% of participants with a pre-existing diagnosis. Public health campaigns should emphasize the importance of regular monitoring and adherence to treatment plans to control blood pressure and mitigate risks.

This study identifies key sociodemographic factors as independent predictors of hypertension, enhancing our understanding and corroborating previous research in similar contexts.

Age and Hypertension: Individuals aged 38-47 and those 48 years or older exhibited significantly higher odds of hypertension compared to the reference group (18-27 years). This finding aligns with Geldsetzer et al. (2019), which demonstrated an increase in hypertension prevalence with age, particularly in those over 40 years. Similar observations were made by Ataklte et al. (2015) in Sub-Saharan Africa, where age-related factors like arterial stiffness and increased vascular resistance contribute to higher hypertension risk. The absence of a significant association in the 28-37 age group suggests that hypertension prevalence may escalate in later life due to the cumulative effects of lifestyle and aging.

Marital Status: Married individuals had lower odds of hypertension, supported by Agyemang et al. (2016), who suggested that marriage provides social and emotional support, mitigating stress—a known hypertension risk factor. However, this finding contrasts with studies like Holt-Lunstad et al. (2010), which highlight that the protective effect of marriage depends on the quality of the marital relationship.

Socioeconomic Status: Higher socioeconomic status (Ubudehe category) was unexpectedly associated with increased hypertension risk, diverging from trends in high-income countries where lower socioeconomic status is typically linked to higher hypertension prevalence. Addo et al. (2012) observed that in Sub-Saharan Africa, higher socioeconomic status correlates with access to energy-dense diets and sedentary lifestyles, which may explain this association in Rwanda. This underscores the unique socioeconomic dynamics where individuals in higher categories might adopt lifestyles that elevate hypertension risk.

Education Level: Secondary education was associated with lower hypertension odds, consistent with Hu et al. (2017), which linked higher education to better health literacy and behaviors. The unexpected association of tertiary education with higher odds, although not statistically significant, might be due to work-related stress or sedentary behavior associated with higher-level occupations, as supported by the NCD Risk Factor Collaboration (2016).

Income and Hypertension: The association between higher household income and increased hypertension risk aligns with findings from Dzudie et al. (2012) in urban Cameroon, where higher income often correlates with unhealthy lifestyle choices. This contrasts with high-income countries, emphasizing the distinct socioeconomic context in Rwanda.

Behavioral Risk Factors: The study confirmed significant positive associations between smoking, alcohol consumption, and hypertension, with physical inactivity being negatively associated, indicating its protective role. These findings resonate with global research, such as Mills et al. (2018) on smoking and Roerecke et al. (2017) on alcohol, which identify these behaviors as key hypertension risk factors. Physical activity's protective effect, well-documented by Pescatello et al. (2015), further underscores the importance of promoting regular exercise.

Dietary Factors: The study found that fruit and vegetable consumption has a protective effect against hypertension, while salty processed foods, sugary beverages, and added salt are associated with increased risk. These findings align with Aune et al. (2017) and Mozaffarian et al. (2014),

reinforcing the role of diet in hypertension management. The study suggests public health campaigns should promote healthy eating habits, with a focus on reducing sodium and sugar intake.

Despite the valuable insights provided by this study, several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish causality between the identified predictors and hypertension. While associations can be observed, it is not possible to determine whether the identified factors directly cause hypertension or if they are correlated due to underlying confounding variables.

Second, the reliance on self-reported data for variables such as alcohol consumption, physical activity, and dietary habits may introduce bias, including recall bias or social desirability bias. Participants might underreport behaviours perceived as unfavourable, such as smoking or high alcohol consumption, which could lead to underestimation of the genuine associations with hypertension.

Third, while relevant in the Rwandan context, the study's use of the Ubudehe socioeconomic classification may only partially capture the complexity of socioeconomic status (SES). This classification might only account for some aspects of SES, such as wealth, education, and occupational status, which could lead to an incomplete assessment of the socioeconomic determinants of hypertension.

Additionally, while the study included a large and diverse sample, the findings may need to be more generalizable to populations outside Rwanda or rural areas within Rwanda, as the sample was drawn from urban and peri-urban settings. Urbanization, access to healthcare, and lifestyle factors may differ significantly between urban and rural populations, potentially affecting the prevalence and predictors of hypertension.

Finally, the study did not account for certain potential confounding factors, such as genetic predispositions, medication use, or comorbid conditions like diabetes, which could influence the relationship between the identified predictors and hypertension. The exclusion of these variables may lead to residual confounding, potentially skewing the observed associations.

Conclusion

The study conducted among adult outpatients at Masaka District Hospital-Kicukiro in Rwanda revealed a high prevalence rate of hypertension, with 36.2% of the individuals included in the study diagnosed with hypertension. The findings underscore the significant burden of hypertension in this population and highlight the importance of medication adherence in managing this condition. The study also identified several social-demographic, behavioral, and dietary factors associated with hypertension. Factors such as age, marital status, and Ubudehe category were significantly associated with hypertension, highlighting the need for targeted interventions for specific demographic groups. Among dietary factors, the consumption of fruits and vegetables demonstrates a protective effect, while frequent consumption of salty processed foods, sugary beverages, and the practice of adding salt to food are associated with higher odds of developing hypertension. Specifically, individuals who consume fruits less than once a day and those who do not eat vegetables have significantly higher odds of hypertension. Similarly, frequent intake of processed foods and sugary beverages, as well as adding salt to meals, are linked to increased hypertension risk.Behavioral factors also play a crucial role, with high levels of stress, abnormal sleep durations (both shorter and longer than recommended), and a family history of hypertension

being significantly associated with elevated hypertension risk. These findings emphasize the importance of addressing both dietary habits and lifestyle behaviors in the prevention and management of hypertension.

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REFERENCES

Adedokun, A. O., Ter Goon, D., Owolabi, E. O., Adeniyi, O. V., & Ajayi, A. I. (2018). Driving to Better Health: Screening for Hypertension and Associated Factors Among Commercial Taxi Drivers in Buffalo City Metropolitan Municipality, South Africa. *The Open Public Health Journal*, *10*(1), 303–312. https://doi.org/10.2174/1874944501710010303

Agyemang, C., Meeks, K. A., Beune, E., Owusu-Dabo, E., Mockenhaupt, F. P., Addo, J., ... & Smeeth, L. (2016). Obesity and type 2 diabetes in sub-Saharan Africans – Is the burden of hypertension shifting to the poor? *Journal of Hypertension, 34*(2), 199-207. https://doi.org/10.1097/HJH.0000000000000822

Alexander, L. K., Lopes, B., Ricchetti-Masterson, K., & Yeatts, K. B. (2015). Second Edition of the ERIC Notebook: Cross-sectional Studies. *ERIC Notebook*, 1–5. https://sph.unc.edu/files/2015/07/nciph_ERIC8.pdf

American Heart Association. (2017). ACC/AHA/AAPA/ABC Guideline for Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults. *Journal Od American College of Cardiology*, *2018;71(19*.

Ataklte, F., Erqou, S., Kaptoge, S., Taye, B., Echouffo-Tcheugui, J. B., & Kengne, A. P. (2015). Burden of undiagnosed hypertension in sub-Saharan Africa: A systematic review and meta-analysis. *Hypertension, 65*(2), 291-298. https://doi.org/10.1161/HYPERTENSIONAHA.114.04394

Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N., Norat, T., ... & Tonstad, S. (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer, and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *International Journal of Epidemiology, 46*(3), 1029-1056. https://doi.org/10.1093/ije/dyw319

Banyangiriki, J., & Phillips, J. (n.d.). *c r v i h o e f*.

Berhe, D. A., Yenit, M. K., & Baraki, A. G. (2020). The burden of hypertension and associated factors among adults visiting the adult outpatient department at yekatit 12 hospital medical college, Addis Ababa, Ethiopia, 2016. *Vascular Health and Risk Management*, *16*, 545–552. https://doi.org/10.2147/VHRM.S285900

Biswas, S., & Naidu, S. S. (2019). A Study to Correlate Perceived Stress with Marital Status in Working Men and Women in Bengaluru City. *International Journal of Physiology*, *7*(4), 212. https://doi.org/10.5958/2320-608x.2019.00172.0

Camano C, R. R. (2013). Uncontrolled Hypertension and Associated Factors in Hypertensive Patients at the Primary Healthcare Center Luis H . Moreno , Panama : A Feasibility Study. *Graduate Theses and Dissertations.*, *January*, 4654.

Dejenie, M., Kerie, S., & Reba, K. (2021). Undiagnosed hypertension and associated factors among bank workers in Bahir Dar City, Northwest, Ethiopia, 2020. A cross-sectional study. *PLoS ONE*, *16*(5 May), 1–13. https://doi.org/10.1371/journal.pone.0252298

Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., Alexander, L., Estep, K., Abate, K. H., Akinyemiju, T. F., Ali, R., Alvis-Guzman, N., Azzopardi, P., Banerjee, A., Bärnighausen, T., Basu, A., Bekele, T., Bennett, D. A., Biadgilign, S., … Murray, C. J. L. (2017). Global burden of hypertension and systolic blood pressure of at least 110 to 115mmHg, 1990-2015. *JAMA - Journal of the American Medical Association*, *317*(2), 165–182. https://doi.org/10.1001/jama.2016.19043

Gao, J., Dai, Y., Xie, Y., Zheng, J., Wang, Y., Guo, R., Sun, Z., Xing, L., Zhang, X., Sun, Y., & Zheng, L. (2020). The Association of Stage 1 Hypertension Defined by the 2017 ACC/AHA Guideline with Stroke and Its Subtypes among Elderly Chinese. *BioMed Research International*, *2020*. https://doi.org/10.1155/2020/4023787

Gbadamosi M, & Tlou B. (2020). Modifiable risk factors associated with non-communicable diseases among adult outpatients in Manzini, Swaziland: A cross-sectional study. BMC Public Health [revista en Internet] 2020 [acceso 2 de marzo de 2022]; 20(1): 1-12. *BMC Public Health*, *665*(20), 1–12. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08816-0

Geldsetzer, P., Manne-Goehler, J., Theilmann, M., Davies, J. I., Awasthi, A., Vollmer, S., & Ebert, C. (2019). Diabetes and hypertension in the United States: A national and state-level assessment of the burden and disparities among adults 65 and older. *PLOS ONE, 14*(8), e0218567. https://doi.org/10.1371/journal.pone.0218567

Gifford, R. W. (1984). The 1984 JNC report on hypertension. *Cleveland Clinic Quarterly*, *51*(3), 515–516. https://doi.org/10.3949/ccjm.51.3.515

Grant, C., & Osanloo, A. (2014). Understanding, Selecting, and Integrating a Theoretical Framework in Dissertation Research: Creating the Blueprint for Your "House." *Administrative Issues Journal Education Practice and Research*, *4*(2), 12–26. https://doi.org/10.5929/2014.4.2.9

Held, L. (2020). A discussion and reanalysis of the results reported in Jones et al. (2020). *Open Science Framework (OSF)*, 20–25.

Hinneh, T., Akyirem, S., Bossman, I. F., Lambongang, V., Ofori-Aning, P., Ogungbe, O., & Commodore Mensah, Y. (2023). Regional prevalence of hypertension among people diagnosed with diabetes in Africa, a systematic review and meta-analysis. *PLOS Global Public Health*, *3*(12), e0001931. https://doi.org/10.1371/journal.pgph.0001931

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine, 7*(7), e1000316. https://doi.org/10.1371/journal.pmed.1000316

Hu, L., Huang, X., You, C., Li, J., Hong, K., Li, P., Wu, Y., Wu, Q., Bao, H., & Cheng, X. (2017). Prevalence and risk factors of prehypertension and hypertension in Southern China. *PLoS ONE*, *12*(1), 1–15. https://doi.org/10.1371/journal.pone.0170238

Hu, X., Fan, H., Zhang, F., Wang, Q., & Li, X. (2017). Educational disparities in health risk behaviors and the health status of hypertensive patients in China: Evidence from a national study. *Journal of Epidemiology & Community Health, 71*(10), 981-989. https://doi.org/10.1136/jech-2017-208712

Kurz, A. F. (2001). What is vascular dementia? *International Journal of Clinical Practice, Supplement*, *120*, 5–8.

Malik, S. U. (2012). Customer Satisfaction, Perceived Service Quality and Mediating Role of Perceived Value. *International Journal of Marketing Studies*, *4*(1). https://doi.org/10.5539/ijms.v4n1p68

Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J., Kearney, P., Reynolds, K., Chen, J., & He, J. (2017). Global disparities of hypertension prevalence and Control: A systematic analysis of population-based studies from 90 countries. *Physiology & Behavior*, *176*(3), 139–148. https://doi.org/10.1161/CIRCULATIONAHA.115.018912.Global

Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., ... & He, J. (2018). Global disparities of hypertension prevalence and control: A systematic analysis of population-based studies from 90 countries. *Circulation, 134*(6), 441-450. https://doi.org/10.1161/CIRCULATIONAHA.115.018912

Mozaffarian, D., Fahimi, S., Singh, G. M., Micha, R., Khatibzadeh, S., Engell, R. E., ... & Danaei, G. (2014). Global sodium consumption and death from cardiovascular causes. *New England Journal of Medicine, 371*(7), 624-634. https://doi.org/10.1056/NEJMoa1304127

Nahimana, M. R., Nyandwi, A., Muhimpundu, M. A., Olu, O., Condo, J. U., Rusanganwa, A., Koama, J. B., Ngoc, C. T., Gasherebuka, J. B., Ota, M. O., & Okeibunor, J. C. (2017). A population-based national estimate of the prevalence and risk factors associated with hypertension in Rwanda: Implications for prevention and control. *BMC Public Health*, *18*(1), 1–11. https://doi.org/10.1186/s12889-017-4536-9

NCD Risk Factor Collaboration (NCD-RisC). (2016). Worldwide trends in blood pressure from 1975 to 2015: A pooled analysis of 1479 population-based measurement studies with 19.1 million participants. *The Lancet, 389*(10064), 37-55. https://doi.org/10.1016/S0140-6736(16)31919-5

Niyonkuru, I., & Habtu, M. (2021). *Prevalence and Determinants of Hypertension Among Outpatient Adults in Ngarama District*. *9*(9), 1968–1977.

Ordunez, P., Martinez, R., Niebylski, M. L., & Campbell, N. R. (2015). Hypertension Prevention and Control in Latin America and the Caribbean. *The Journal of Clinical Hypertension*, *17*(7), 499–502. https://doi.org/10.1111/jch.12518

Patel, M., & Patel, N. (2019). Exploring research methodology: review article. *International Journal of Research and Review*, *6*(3), 48–55.

Pescatello, L. S., MacDonald, H. V., Lamberti, L., & Johnson, B. T. (2015). Exercise for hypertension: A prescription update integrating existing recommendations with emerging research. *Current Hypertension Reports, 17*(11), 87. https://doi.org/10.1007/s11906-015-0600-y

Razay, G., Vreugdenhil, A., & Wilcock, G. (2007). The metabolic syndrome and Alzheimer disease. *Archives of Neurology*, *64*(1), 93–96. https://doi.org/10.1001/archneur.64.1.93

Roerecke, M., Kaczorowski, J., Tobe, S. W., Gmel, G., Hasan, O. S. M., & Rehm, J. (2017). The effect of a reduction in alcohol consumption on blood pressure: A systematic review and meta-analysis. *The Lancet Public Health, 2*(2), e108-e120. https://doi.org/10.1016/S2468-2667(17)30003-8

Sabapathy, K., Mwita, F. C., Dauya, E., Bandason, T., Simms, V., Chikwari, C. D., Doyle, A. M., Ross, D., Shah, A., Hayes, R., Schutte, A. E., Kranzer, K., & Ferrand, R. A. (2023). High prevalence of hypertension and high-normal blood pressure: findings from a large population-based survey of young adults in Zimbabwe. *MedRxiv*, 2023.07.03.23292156. http://medrxiv.org/content/early/2023/07/03/2023.07.03.23292156.abstract

Schools, P. (2023). *THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES An Assessment of the Influence of Special Needs Education Resources on Management of Inclusive Education in Public*. *11*(10), 12–23.

Schwartz, G. L., & Sheps, S. G. (1999). A review of the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Current Opinion in Cardiology*, *14*(2), 161–168. https://doi.org/10.1097/00001573-199903000-00014

Sharman, J. E., La Gerche, A., & Coombes, J. S. (2015). Exercise and cardiovascular risk in patients with hypertension. *American Journal of Hypertension*, *28*(2), 147–158. https://doi.org/10.1093/ajh/hpu191

Tegegne, K. D., Adela, G. A., Kassie, G. A., Mengstie, M. A., Seid, M. A., Zemene, M. A., Feleke, S. F., Dejenie, T. A., Abebe, E. C., Anley, D. T., Dessie, A. M., Gesese, M. M., Yimer, N., & Gebeyehu, N. A. (2023). Prevalence and factors associated with hypertension among peoples living with HIV in East Africa, a systematic review and meta-analysis. *BMC Infectious Diseases*, *23*(1), 1–12. https://doi.org/10.1186/s12879-023-08679-x

Termklinchan, V., Wasin, S., Choesomboon, M., Praditbatuka, C., & Sukareechai, S. (2019). Effect of acupuncture on blood pressure control in hypertensive patients. *Journal of Traditional Chinese Medicine*, *39*(2), 246–250.

Tesfaye, T. D., Temesgen, W. A., Kasa, A. S., & Yismaw, Y. S. (2019). Prevalence and associated factors of hypertension in Amhara regional state city and its' surrounding rural districts: A community-based cross-sectional study. *African Health Sciences*, *19*(3), 2580–2590. https://doi.org/10.4314/ahs.v19i3.34

Wamala, J. F., Karyabakabo, Z., Ndungutse, D., & Guwatudde, D. (2009). Prevalence factors associated with hypertension in Rukungiri District, Uganda - A community-based study. *African Health Sciences*, *9*(3), 153–160.

Wang, B., Lucy, K. A., Schuman, J. S., Sigal, I. A., Bilonick, R. A., Lu, C., Liu, J., Grulkowski, I., Nadler, Z., Ishikawa, H., Kagemann, L., Fujimoto, J. G., & Wollstein, G. (2018). Tortuous Pore Path Through the Glaucomatous Lamina Cribrosa. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-25645-9

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Himmelfarb, C. D., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., … Hundley, J. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults a report of the American College of Cardiology/American Heart Association Task Force on Clinical pr. In *Hypertension* (Vol. 71, Issue 6). https://doi.org/10.1161/HYP.0000000000000065

World Health Organization. (2010). Global status report on noncommunicable diseases. *World Health*

Organization, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

World Health Organization. (2018). *STEPwise approach to noncommunicable disease risk factor surveillance (STEPS) in Rwanda*. World Health Organization.

World Health Organization. (2023). *Global Report on Hypertension*.