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Cigarette smoking and hypertension among adult outpatients: An explanatory evidence model from a rural District Hospital, Rwanda

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Abstract

Cigarette smoking is one of the main risk factors of hypertension .The association between tobacco smoking and hypertension in current published studies remains unclear with many

controversies despite experimental evidence confirming that smoking elevates blood pressure in different settings globally. Many studies on this topic are conducted at national level by focusing on a community-based approach. There is limited information on the association between cigarette smoking and hypertension at hospital level in many countries, including rural Rwanda. This study aimed to determine the prevalence of hypertension, the smoking prevalence and to investigate the association between smoking and hypertension among adult outpatients attending Ruli District hospital. This cross-sectional analytical study used a quantitative approach. Systematic sampling was used to select 404 participants among adult patients attending the Ruli District hospital's outpatient department, located in the Gakenke District in the Northern Province, from 23rd April to 24th July 2020. A questionnaire was used to gather information on behavioral risk factors from the participants. Measurements of blood pressure was performed according to internationally standardized protocols. A written consent was sought from the participants. Research clearance was provided by the Institutional Research Review Committee of the Mount Kenya University in Rwanda, and the Ruli Higher Institute of Health Saint Rose de Lima (RHIH). Confidentiality was considered during the research process. Data entry and processing used the 21st version of the IBM ® Numerical Package of Social Sciences (SPSS). Descriptive statistics were used to generate frequency tables, while a bivariate logistic regression model allowed to identify the factors associated with hypertension, which were finally adjusted into a multivariate analysis by using a 'backward condition' method. A p-value ≤ 0.05 with a 95% confidence interval (CI), was considered significant. Our research found that the overall prevalence of hypertension was 43.3%.The mean age (SD) of respondents was 45.6 years. Among participants, 7.7% were current smokers of any type of tobacco products, while 28.2% had a history of smoking. In bivariate analysis, current smoking of any type of tobacco product and history of smoking were found significantly associated with the development of hypertension (p-value ≤ 0.05). In multiple logistic regression analysis, history of smoking remained independently associated with hypertension; and study participants with a history of smoking were 3.15 more likely to develop hypertension compared to those who had never smoked (AOR=3.15; 95%CI= [1.44-6.85]).This research concluded that there is a high prevalence of hypertension in this study setting. The identified determinants of this public health problem included past history of smoking, which was found to be independently associated with hypertension. There is therefore a need for setting a public health intervention for health education and a systematic screening program among the population who stopped or current smoking for early diagnosis and treatment of hypertension.

Introduction

Cigarette smoking is an indisputable and devastating toll on public health and one of the major risk factors of cardio-vascular diseases (CVDs). According to the World Health Organization (WHO, 2021), approximately 17.7 million people die from cardiovascular related diseases (CVD) each year (1). This number represents an estimated 31% of all deaths worldwide due to smoking or hypertension in both sexes (2). Commonest and modifiable risk factors such as hypertension (HTN) and smoking, and their interaction account for about 60% of the CVD deaths(3).CVDs are dominated by HTN which is an established risk factors of other conditions such as strokes, heart failure, chronic kidney disease, coronary artery disease and cognitive decline(4), (5) ,(6).

Several studies indicate that HTN prevalence is increasing among the adult population globally (7), (8). HTN, as a major global public health problem, is one of the most important preventable causes of premature morbidity and mortality. The mortality and morbidity linked to HTN are ranked at 45% worldwide and HTN affects over 26% of the adult population in the world (10).

In 2015, approximately 8.5 million deaths were associated with high blood pressure, among which 88% occurred in low-income and middle-income countries, including Rwanda (9). Both cigarette smoking and HTN are major risk factors for cardiovascular disease (11) and the first and second leading causes of preventable mortality worldwide, respectively (12) (13.) Smoking is estimated to be the cause of 1.69 million CVD-related deaths (14). Many researchers have argued that cigarette smoking could promote the development of hypertension and other cardiovascular diseases (15), (16). The positive relationship between smoking and hypertension was also well established in several longitudinal studies (17), (18), (18), (19), and (20); and there is a well-established association of smoking with an increased risk of CVD (22). The mechanism through which smoking elevates blood pressure is still controversial and unclear, and different geographic areas across the world failed to demonstrate this relationship (21). The effects of tobacco smoking on blood pressure (BP) are therefore complex, with evidence that tobacco smoking increases blood pressure acutely and increases the risk of renovascular, malignant, and masked hypertension (23).

In 2015, the age-standardized prevalence of daily smoking was 25.5% for men and 5.4% for women worldwide, and one in every four men in the world was a daily smoker (32).

Cigarette smoking cigarettes is particularly responsible for an increase in high systolic blood pressure, heart rate and myocardial oxygen demand that leads to vascular dysfunction (24). In addition, studies have concluded that smoking produces statistically significant changes in forearm hemodynamics affecting direct both small and large arteries(33), damage to the endothelium function leading to impairment, and thought to be important in the pathophysiology of hypertension which is clue of vasodilatation (34), (35). Furthermore, previous studies reported that there might be a long-run interactive effect of smoking cessation (past smoking) on the weight gain (obesity) which are associated to adiposity and lead to the development of hypertension (25),(26),(27), (28) , (29), (30) . It was also demonstrated that overweight and obesity are major independent risk factors for HTN and account for approximately 65 to 78% of the adult HTN (31).

As for the relationship between smoking and HTN, results from epidemiologic studies have generally shown that cigarette smoking produces an acute rise in blood pressure. Some studies in Africa reported that the incidence of HTN was higher among persons who had never smoked or past smokers than among current smokers, and that smoking cessation of smoking might result in hypertension (36). On the contrary, other studies among Westerners suggest that cigarette smoking may be a positive risk factor for the development of HTN (19), (20). The relationship between smoking status and high blood pressure are not univocal, with some studies showing a positive and others an inverse association. There is no study of the relationship between tobacco smoking and blood pressure indices in a rural Rwandan District hospital. This study aimed to determine the prevalence of hypertension, the smoking prevalence and to investigate the association between smoking and hypertension among adult outpatients attending Ruli District hospital.

Research methodology

This study used a cross-sectional analytical design. The questionnaire was developed to gather quantitative information on tobacco smoking status, while a bivariate and multiple variable logistic regression model allowed to examine the association between tobacco smoking and HTN. Risk factors for HTN were finally adjusted into a multivariate analysis by using a 'backward condition' method. A p-value ≤ 0.05 with a 95% confidence interval (CI), was considered significant. (In data analysis).

Study population and procedures of the study

This study took place at Ruli District Hospital (DH), which is a semi-public institution located in Gakenke District, in the Northern Province of Rwanda. This district hospital covers a population of 110,548 people and includes nine health centers into its catchment area. It has a 177 bed-capacity and receive patients not only from its catchment area but also a lot of patients from outside this zone, with an average of 105 outpatients per day and an average bed occupancy rate of 62.1.% (*HMIS 2018-2019).* This hospital provides services related to Internal Medicine, Gynecology and Obstetrics, Pediatrics, General Surgery and Orthopedic care, as well as Specialized services such as Pediatric surgery, Medical Imaging Services, Ophthalmology etc.. The hospital provides regular clinical and technical supervision and mentorship to health centers

located in its catchment area.

The study population included all adult outpatients aged 18 years and beyond irrespective of their educational and occupational status who agreed to sign a written consent form. The research clearance was provided by the Institutional Research Review Committee of Mount Kenya University, located in Rwanda and the Ruli Higher Institute of Health (RHIH). An authorization letter was also signed by the Ruli District Hospital administration. The confidentiality was also considered during the research process. Study period was from 23rd April 2020 to 24th July 2020.

The researcher (Principal Investigator, PI) used and adapted a standardized questionnaire in collecting quantitative data. This tool was derived from the "modified WHO STEPS" which has been tested in many countries including Rwanda (40), (41), (42); and contains socio-demographic, behavioral and other variables. For social-demographic and behavioral information**,** a structured questionnaire was adapted and translated into Kinyarwanda language for easy understanding by respondents. Blood pressure (BP) was measured using a sphygmomanometer. Height measurement was conducted using stadiometers, and weight measurement was done using an electronic measuring device (Seca 700 weight scale, Germany). Before each measurement, the weight measurement scale was tested and calibrated to zero.

A one-day training on the research process was provided to all nurses working in the outpatient department to allow them to acquire a common understanding on the selected patients and the continuation of their treatment plan. Systematic sampling method (37), (38), (39) was used. The target population was estimated based on outpatients consulted by doctors during the period from April to June 2019, which were 3510 patients. The sample size of the study participants was calculated using the Kish, Leslie, 1965 statistical equation $n= Z^2 P (1-p)/ d^2$.

The sampling interval (k=8) was calculated using the target population (3510) as numerator and the sample size (n=404) as denominator. Starting with a randomly selected number between 1 and 8, each 8th unit was selected for inclusion in the sample population until the sample size of 404 was reached.

Data collection was conducted by the researcher using a standardized protocol. In the preparatory step, participants were asked if they had consumed any warm caffeinated drinks such as tea or coffee, smoked cigarettes, drunk Coca-Cola or done any physical activity 30 minutes before

measurement. The BP of each participant was measured by the Principal Investigator, who has a basic skill in nursing including vital signs measurements and received refresher training from qualified and licensed nurses working in the outpatient department.

BP was measured using the recommendations from the WHO stepwise approach (42), (40), (43). Two measurements of the BP of each study participant were taken at least five minutes apart and the average of the two records were used to calculate the results. In cases where the two readings differed by more than 10 mm Hg, a third reading was obtained, averaging the three measurements.

The hypertension (HTN) status was defined as per the US seventh junction national committee on the detection, evaluation and the treatment of hypertension (JNC seven) measure (44),(45) as follows:

BP was ranked as normal if the systolic BP (SBP) was inferior to <120 mmHg and diastolic BP (DBP) inferior to <80 mmHg. Prehypertension ranged from a SBP between 120 to 139 mmHg and/or a DBP between 80 to 89 mmHg. Stage I hypertension was defined as a SBP between 140 and 159 mmHg and / or a DBP between 90 to 99 mmHg. Stage II hypertension comprised a SBP over 160 and/or a DBP over 100 mmHg.

For statistical analysis purpose, in the bivariate analysis, the hypertension was classified into two categories:

Normal BP included a SBP of less than 140 mmHg and a DBP of less than 90 mmHg while elevated blood pressure (hypertension) was defined as a SBP over 140 mmHg and a DBP over 90 mmHg; or self - reported use of anti-hypertensive drugs given by healthcare professionals to treat an elevated BP at the moment of the study (46).

The tobacco smoking status was assessed by asking study participants if they were currently smoking any type of tobacco product; and if yes, the number of days of smoking per week and the number of cigarettes smoked per week. Tobacco smoking was assessed as a component of the WHO Stepwise questionnaire. Current smokers included participants who reported the current use of any tobacco products such as cigars, cigarettes or pipes either on a daily or non-daily basis. Former smokers were made of study subjects who reported prior daily smoking. Non- smokers and passive smokers were also recorded.

Data analysis

The filled questionnaires were checked for completeness before being entered in a computer. Data entry and processing were conducted using the 21st version of the IBM ® Numerical Package of Social Sciences (SPSS). The researcher used descriptive and inferential statistics and data were presented using graphs and frequency tables. The hypertension prevalence was measured with a confidence interval of 95%. To classify factors associated with hypertension, both bivariate, and multivariable analyzes were used. Variables with a p-value less than 0.05 in bivariate analysis were included into multivariable analysis.

All variables with a p-value of 0.05 were considered or declared suggestive of hypertension predictors of statistical significance. A multivariable evaluation of the logistic regression model was conducted with backward condition method with removal of variables with a p-value superior to 0.05.The adjusted odds ratios (AOR) with a confidence interval of 95% (CI) were used to respond to the research question through the final model with relevant predictors.

RESULTS

Socio-demographic characteristics of participants

Table 1 shows the socio-demographic and economic characteristics of 404 adults involved in this study. Mean age was 45.6 years. Most respondents were female (63.1%) and male counted for 36.9%. More than a half of respondents (51.7%) had primary school education. Most of the respondents (66.1%) were married. The majority of respondents (75.2%) were farmers and formal salary employees accounted for 18.6%. Most of the respondents (66.1%) were married. Nearly 60% of respondents were affiliated to Catholics. Furthermore, the majority of respondents (67.3%) were coming from the district hospital's catchment area. Regarding socio-economic status, 56.4% of respondents belonged to the third category of Ubudehe, a classification established by the Government of Rwanda based on the welfare and income of each household, which includes the following exclusive categories: 1. Very poor: consume less than 105,064 Rwf per year; 2. Poor: consume between 105, 064- 159, 375 Rwf per year and 3. Not poor (Rich): consume more than 159 375 Rwf per year.

Table 1: Socio-demographic and economic characteristics of respondents

Variables (n)		Frequency (%)	Mean (SD)
Age in years (n=404)			45.6(16.6)
Sex (n=404)			
	Male	149(36.9)	-
	Female	255(63.1)	
Level of education (n=404)			
	No formal training	116(28.7)	-
	Primary school	209(51.7)	-
	Secondary school and above	79(19.6)	-
Marital status (n=404)			
	Single	84(20.8)	-
	Married	267(66.1)	-
	Widow separated/Divorced	53(13.1)	-
Religion (n=404)			
	Catholic	238 (58.9)	-
	Others	166(41,4)	-
Origin (n=404)			
	Ruli hospital catchment area	272(67.3)	-
	Out of Ruli hospital catchment area	132 (32.7)	-
Occupation (n=379)			
	Farmer	304(75.2)	-
	Formal salary	75(18.6)	-
Social economic class (n=404)			
	Category 1	38(9.4)	-
	Category 2	138 (34.2)	-
	Category 3	228(56.4)	-

Source: Primary data

As illustrated in Table 2, the median of the SBP was 132.2 (101.5- 236.0) mmHg. The median of the average of SBP was 79.7 (43.0-163.5) mmHg.

Table 2: Blood pressure among study participants

Blood pressure in mm Hg (n)		Frequency (%)	Median (Min.-Max.)
Average Systolic blood pressure (404)		-	132.2(101.5- 236.0).
	Optimal blood pressure	85(21)	-
	Normal blood pressure	98(24.3)	-
	Prehypertension	44(10.9)	-
	Mild Hypertension	80(19.8)	-
	Moderate hypertension	56(13.9)	-
	Severe hypertension	41(10.1)	-
Average Diastolic blood pressure (404)		-	79.7(43.0-163.5)

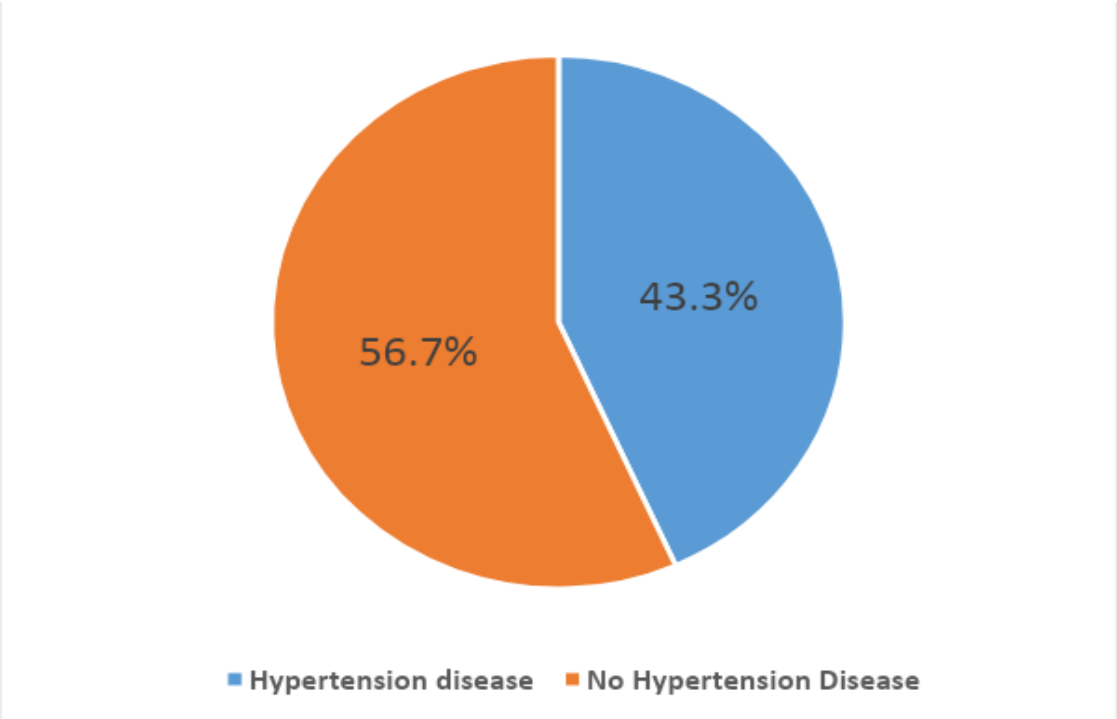
	0ptimal Diastolic blood pressure	209(51.7)	-
	Normal blood pressure	58 (14.4)	-
	Prehypertension	41(10.1)	-
	Mild Hypertension	58(14.4)	-
	Moderate hypertension	25(6.2)	-
	Severe hypertension	13(3.2)	-

Source: Primary data

Hypertension prevalence among study participants

The overall prevalence of hypertension was 43.3% (Fig.2).

Figure 2... Pie chart of prevalence of hypertension among respondents



Source: Primary data

As shown in Table 3, most of the participants (92.3%) did not smoke any type of tobacco products at the time of the study, while 7.7% reported current use of any tobacco products. Among smokers, the mean of cigarettes smoked per day was 4, while the frequency of smoking per week was 6. Concerning the history of smoking, 28.2% of participants had a history of smoking. A minority of patients (2%) reported chewing tobacco products, and the mean of days with chewing per week was 3.62.

Table 3: Characteristics related to tobacco smoking and tobacco smoking status

Tobacco smoking status (n)	Frequency (%)	Mean (SD)
Smoking of any type of tobacco product(Current) (n=404)		
Yes	31(7.7)	
No	373(92.3)	
Frequency of smoking per week (Number of days) (31)		6.06(1.99)
Number of cigarette smoked per day (31)		3.74(3.63)
History of smoking in past(n=404)		
Yes	114(28.2)	
No	290(71.8)	
Frequency in days of chewing per week (8)		3.62(2.13)
Chewing the chat (n=404)		
Yes	8(2)	
No	396(98)	

Source: Primary data

Association between tobacco smoking and hypertension

Table 4 displays the association between cigarette smoking and hypertension among the studied population. A high proportion (61.3%) of respondents who were current smokers had hypertension. The current smoking of any type of tobacco product among respondents was significantly associated with the prevalence of hypertension (X^2= 4.418, p-value 0.039). Moreover, 63.2% of past smokers had hypertension, and the association between past history of smoking and HTN was found to be statistically significant (X^2= 25.463, p-value <0.001).

Table 4: The association between tobacco smoking and hypertension

Variable		With hypertension (%)	No hypertension (%)	OR	95% CI		X^2	P-value
					Lower	Upper		
Smoking of any type of tobacco product(Current)								
	Yes	19(61.3)	12(38.7)	2.202	1.039	4.669	4.418	**0.039***
	No	156(41.8)	217(58.2)	Ref				

History of smoking in Past							
Yes	72(63.2)	42(36.8)	Ref				
No	103(35.5)	187(64.5)	0.321	0.205	0.504	25.463	**<0.001***
Smoking history habit							
Non-smoking	101(35.2)	186(64.8)	Ref				
Former smoker	54(62.8)	32(37.2)	3.108	1.885	5.123	26.674	**<0.001**
Actual or current smoker	20(64.5)	11(35.5)	3.348	1.543	7.265		**0.002**

***Significant at P<0.05 bolded**

Source: Primary data

Multivariable analysis

Multiple logistic regression analysis was applied to identify the variables that were independently associated with hypertension among study participants. All significant variables in bivariate analysis were included into the final model to detect the variables independently associated with hypertension among study participants. The factors associated with hypertension in Ruli District hospital are presented in the Table 5 below:

Table 5. Results of the multivariable regression analysis

Predictors	With Hypertension n (%)	No Hypertension n (%)	p-value	AOR	95% C.I
Age Category					
18-34 years	18 (16.1)	94(83.9) Ref			
35 and Above	157 (53.8)	135 (46.2)	**0.038**	7.7	(3.16-19.02)
Having Diabetes Mellitus Confirmed by qualified HCWs					
Yes	11 (73.3)	4(26.7)		.241	(.044-1.323)
No	77 (40.1)	115 (59.9) Ref			
Having previous history of hypertension					
Yes	53(80.3)	13(19.7)	**0.000**	.066	(0.024-0.185)
No	107(33.4)	213(66.6) Ref			
History of smoking in Past					
Yes	72 (63.2)	42 (36.8)	**0.004***	3.152	(1.449-6.856)
No	103(35.5)	187(64.5) Ref			
Consummation of any fruit per week					
Yes	46 (32.2)	97 (67.8) Ref			
No	123(49.4)	132 (50.6)	**0.001**	3.918	(1.694-9.063)

***Significant at P<0.05 bolded; AOR=Adjusted odds ratio; CI=Confidence Interval**

Source: Primary data

After adjustment for other relevant variables in a multivariable logistic model (Table 5), with OR and 95% CI; past history of smoking remained independently associated with hypertension and past smokers were 3.15 more likely to develop hypertension comparing to those with no history of smoking in the past (AOR=3.15; 95%CI= [1.44-6.85]).

Discussion

This study was conducted to assess the association between smoking and hypertension among adult outpatients attending a Rwandan rural District Hospital. The secondary objectives of the study were to identify the socio-demographic and economic characteristics of adult outpatients attending Ruli district Hospital, determine the prevalence of hypertension among adult outpatients; and establish the smoking status among adult outpatients at Ruli District Hospital.

We found that more than one third of respondents (43.3%) had hypertension. These findings are supported by a local study conducted by Banyangiriki, et al, (2013) among working adults in Rwanda where the HTN prevalence was 36% (47). Furthermore, the findings of the current study are more than the similar national study done by Nahimana et al, (2017), who found a HTN prevalence of 15% in 2015 in Rwanda (40) (48).The discrepancy between the current research and other studies conducted locally could be explained by the fact that this study was hospital-based whereas the others were community-based cross-sectional studies. Another possible reason might be the age difference between the studies populations, as patients aged 18 years of age (mean 45.6) participated in this study while other studies included subjects aged over 15years. Lastly, this study took place in a rural setting whereas the former studies included both urban and rural settings. On the other hand, the higher HTN prevalence of this study was in line with the HTN prevalence found in many other studies including a current systematic review and meta-analysis conducted in Africa on HTN among older adults, where the HTN prevalence ranged from 22.3% to 90% from individual studies and the overall pooled prevalence was 57% (49).

In 2012, the global prevalence of current tobacco smoking among adults was 22% and rapid increase was projected by 2025 in Africa and other middle –income countries (50). The prevalence of tobacco use was predicted at 26.26%, if no measure of healthy lifestyle were taken in Rwanda. (51). However, our study found a prevalence of current smoking of 7.7% which is far less compared to other studies such as research conducted in rural China where 77.8% of

participants were current smokers (52). Additionally, contrasting from our current findings, other studies indicated a smoking prevalence of 33.5% in Yunnan Province (53). In Kenya, the prevalence of individual tobacco use was reported as 12.6% and did not differ greatly from national survey findings (54). Furthermore, a hospital-based study conducted among 712 patients in Turkey found that 36% of patients were current smokers while 9% of them had ever smoked (55). Furthermore, a study done among Vietnam found that the proportions of current smokers was 67.8% (631/910) (16, 59, and 60). The contrast between our results and other studies could be due to the local culture where Rwandans are educated on risk of tobacco, which leads to a higher prevalence of non-smoking. The second reason could be our study population, which involved outpatients who might have some medical instructions to follow. Furthermore, the size of the study population, especially sample size, could explain the reason for these differences.

Many studies including the one conducted by Au Bich Thuy, et al (2010) (16) on dose intensity of smoking and its association with onset of HTN found that the prevalence of HTN was influenced by the number of cigarette packs smoked yearly. Our study showed that current smokers consumed a mean of 4 cigarettes per day and smoked a mean of 6 days per week. Cigarette smoking was found to be associated with the increased risk of hypertension (62), (63) with a dose-response relationship (64) while this association was not found in some population-based studies (54, 70).

Our study indicates that 28.2% of respondents have a past history of smoking, and that 62.8% of participants with a past history of smoking had HTN. In a study conducted in Indonesia, men and women who quitted smoking exhibited the largest changes in SBP increases (56). A study conducted in France among 12,417 volunteers found that the relative risk of hypertension in former smokers was 1.24 (CI 95%: 1.10-1.39, $p < 0.001$) and 1.13 (0.995-1.29, $p = 0.055$) as compared to non-smokers and current smokers (57). Furthermore, in a study conducted among 3 931 participants, HTN incidence was significantly higher among quitters compared with current smokers (58).

In our studied population, 2% had a culture of chewing. The Rwandan culture does not allow the population to use this product and it is not commonly cultivated in Rwanda.

Regarding the association between tobacco smoking and HTN, our study indicated that the odds of having hypertension was 2.2 times higher among current smokers compared to non-smokers (OR=2.202; 95% CI= [1.039-4.699]). This is in line with previous studies reporting that smoking could temporarily raise blood pressure in the Korean community (59), (60). However, a study

conducted in Vietnam found that current smokers were not at higher risk of HTN than participants who had never smoked (prevalence ratio = 1.08, 95% CI 0.70-1.68) (16). Another study conducted among 167, 868 Korean adults revealed that current smoking was associated with lower prevalence of HTN compared with non-smoking status (61).

Furthermore, a study conducted in rural China (2021) among a total of 8,801 participants showed that 77.8% were current smokers and confirmed that for every additional year of smoking, SBP raised by 0.325 mmHg (52). Another research conducted in Kenya showed that mean SBP among current tobacco users was 3.14 mmHg lower SBP compared to subjects who had never smoked. Additionally, similarly to previous studies, the mentioned study failed to establish a link of either smoking or smokeless tobacco with hypertension (54).

Our study reported similar findings to a study performed in Yala (Kenya) where odds of HTN were at least two times higher among current smokers and former smokers compared with participants who had never smoked. The Yala study was supported by other studies, such as a Rwandan study that found almost 1.5 higher odds of HTN in current smokers as well as former smokers (40),(65), (66) compared with non-smokers. For instance, a study conducted among 340 Kenyan Defense forces demonstrated a strong association between ex-smoking and hypertension (67). Several other studies have associated current smoking with increased BP and mentioned the risk for HTN with the underlying mechanism of nicotine in activating the sympathetic nervous system and the resultant arterial stiffness (68). In a hospital-based study performed among 712 patients in Turkey, both SBP and DBP were lowest among the smokers, higher among ex-smokers and highest in the non-smokers (55). Furthermore, a study conducted among 354 workers of the Oil Palm Company in Nigeria found that tobacco use was a significant determinant of hypertension (69).

The current study showed that history of smoking in past were 3.152 times more likely to have hypertension (AOR= 3.152; 95% CI= [1.449-6.856]), compared to no history of smoking in past; However, in study done in Vietnam found the contrary where ex-smokers were more likely to be hypertensive than either never-smokers or current smokers. A study conducted in China found the similar results as our study and demonstrated that former smokers had increased odds of HTN while current smokers had not increased odds of HTN compared with never smokers (70). In addition, a study performed among 38, 520 Subjects in urban and rural areas of China found that prior cigarette smoking was associated with hypertension HTN (64). A meta-analysis of 23

population-based studies including a total of 141 317 found that current smoking was associated with lower blood pressure and lower prevalence of hypertension (71).

Many researchers have tried to explain the mechanism by which tobacco smoking could lead to HTN (34, 35). Possible explanations included the chronic effects of past smoking, and cigarette smoking has been associated with dose-related impairment of the endothelium-dependent arterial dilation, while more pack-years of smoking were associated with the progression of atherosclerosis, promoting the higher risk of HTN. In each study, weight gain following smoking cessation was ruled out as a potential explanation. Overall, ex-smokers were more likely to be hypertensive than either never-smokers or current smokers (11, 17). A link between tobacco smoking and blood pressure is thus biologically plausible and cigarette smoking has been observed to cause acute increases in blood pressure in experimental settings. Cigarette smoking actually increases sympathetic outflow, possibly through an increased release and/or reduced clearance of catecholamine at the neuroeffector junctions. In addition, smoking is associated with chronic low-grade inflammation and arterial stiffness, which are associated with HTN. Therefore, our study supports the previously published research findings and confirms the association of past history of smoking and current smoking of any type of tobacco products with HTN while other studies still report an opposite effect of smoking on HTN.

Conclusion

The study findings showed that 43.3% of adult outpatients in Ruli District Hospital located in a rural area setting had hypertension. A positive significant increase was observed compared to the prevalence found in the last Stepwise study (42), (40),(43) and other local studies done(40) (48).

Factors like current smoking of any type of tobacco product and past history of smoking were found to be statistically significantly associated with the hypertension among the studied population. Consequently, past history of smoking was independently associated with HTN in Ruli District Hospital. To tackle this challenge, BP screening and intervention programs at community level that aim to modify risk factors such as tobacco use, should be conducted. In this hospital-based sample, HTN prevalence is higher and therefore calls for immediate public health intervention for early diagnosis and prevention.

Limitation of the study

This study failed to demonstrate the categorized number of days smoked per week and number of cigarettes smoked per week in correlation with hypertension. The questionnaire was not detailed for collecting the information on tobacco smoking such as age of starting smoking, year

of completing smoking. Chewing chat was not clearly defined in Rwandan context. The results from this study was only generalized to the Ruli hospital catchment area in Gakenke district. The results of this study should not be generalized at Gakenke District, because Ruli DH OPD receives many patients referred from out of Ruli District Hospital catchment area in Gakenke District where 32.7% (n=132) come from nearby geographic regions located in Rulindo ,Muhanga and Kamonyi District. All public health interventions to be planed based on current research findings will not be applied in entire District. Therefore, results were not generalized countrywide and district- wide, since District has more than two District Hospital., the prevalence of hypertension was not estimated at District Level. The two blood pressure measurements was performed on single occasion which was considered as a delimitation of this research.

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