

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 quit 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 planned 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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