A Cross-Sectional Study of Factors Associated with Prehypertension among Final Year Medical Students of University of Kisangani

ABSTRACT

Introduction : Prehypertension is a major health problem that exposes subjects to increase their risk of cardiovascular disease regardless of progression to overt hypertension. The objective of this study is to determine the prevalence of prehypertension and to identify its associated factors among final year medical students of University of Kisangani.

Methods : A descriptive and analytical cross-sectional study was conducted at Kisangani University Clinics over a period ranging from December 2022 to March 2023 and involved 130 final year medical students. Parameters of interest included sociodemographic data, clinical and anthropometric data, behavioral data, and environmental data. Factors associated with prehypertension were identified using logistic regression.

Results: Prevalence ofprehypertension 40% amongfinal year medical students. Factors associated with prehypertension were age varying between 30 and 39 years(p<0,05), family history of high blood pressure(p<0,05), family history of diabetes mellitus(p<0,05), moderate anxiety(p<0,05), coffee consumption(p<0,05), and irregular physical activity(p<0,05).

Conclusion : This study shows that the prevalence of prehypertension among final year medical students ofUniversity of Kisangani was high. Factors associated with prehypertension were identified. Multicenter studies with a larger sample size should be conducted to obtain more accurate results in the identification of factors associated with prehypertznsion so that early intervention can be implemented nationwide.

Keywords : Prehypertension, prevalence, associated factors, medical student, Kisangani.

I.INTRODUCTION

Prehypertension occurs when blood pressure is between 120/80 mmHg and 139/89 mmHg. The National Health and Nutrition Examination Survey (NHANES 1999-2000) found that the overall prevalence of prehypertension was 31% worldwide, higher among men than women [1].

Based on the seventh report of the Joint National Committee in 2003, prehypertension was introduced in the classification of blood pressure figures as a replacement for previous classifications of normal and high blood pressure [2].

Prehypertension is a major health problem that exposes people to increase their risk of cardiovascular disease regardless of progression to overt hypertension. The progression of prehypertension to hypertension can be rapid, especially when blood pressure is close to the threshold values for hypertension [3,34,35,.36,37].

According to the results of the Framingham cohort study, the rate of progression of prehypertension to hypertension in 4 years was estimated at 17.6% for normal blood pressure and 37.3% for high-normal blood pressureamong subjects under 65 years; for those over 65 years, the second figure reached 49.5%. Obesity was the most important determinant of this increase [4].

Zhang et al. reported in the European Flemish study (1456 subjects followed for 4.6 years) that their results were similar to those from the Framingham cohort, suggesting that the latter's findings could be extrapolated to Europe: the rates of progression of prehypertension to hypertension in 4 years, in individuals under 50 years, were 17.9% for normal blood pressure and 24.5% for high-normal blood pressure.

These figures increased to 26.3% and 54% respectively among those aged 50 and over ; multivariate analysis showed that body mass index and male sex were the strongest predictors of hypertension [5].

It is estimated that in 2025 almost three quarters of the world's hypertensive population will live in developing countries, with an impact stimulated by the phenomenon of massive urbanization [6].

Given the rate of progression of prehypertension to overt hypertension, it is advisable to regularly monitor prehypertensive subjects, on an annual or biennial basis. The management of the prehypertensive subject is based primarily on hygienic-dietary measures. For subjects at high cardiovascular or renal risk, pharmacological treatment, in particular a renin-angiotensin blocker, is nevertheless indicated [7].

Several studies conducted with students show that the prevalence of prehypertension varies by region and can be as high as 60% [8-11].

However, in DR Congo in general and in the city of Kisangani in particular, data on prehypertension among students are little available or almost non-existent.

As such, final year medicalstudentsof University of Kisangani are an important target of awareness on prehypertension because they are doubly concerned by the issue as a group at risk often unknown on the

one hand, and as future health actors on the other hand. Therefore, a study on the prevalence of prehypertension in this young population is essential to determine strategies for controlling and preventing this poorly documented health problem that exposes them to increased risk of cardiovascular disease.

It is in this context that this study, the first to be conducted in our region, aims to determine the prevalence of prehypertension and identify its associated factors among final year medical studentsof University of Kisangani.

II. METHODS

2.1 Framework and nature of the study

We conducted a descriptive and analytical cross-sectional study conducted at Kisangani University Clinics over a period between December 2022 to March 2023.

2.2 Study population, sampling and sample size

The study population consisted of final year medical student enrolled at Kisangani University during the study period. This was non-probability sampling. For this study, 130 subjects were identified as respondents.

2.3 Selection Criteria

Was included in this study, any finalist student aged 18 years and over, of both sexes, present at the University Clinics of Kisangani during the internment and having agreed to participate in the study. Was excluded any investigated: hypertensive with or without treatment, known chronic renal failure (severe or dialysis), with a history of a cardiovascular event (acute coronary syndrome, stroke, lower limb arteriopathy, with progressive pregnancy.

2.4 Study Variables

Parameters of interest included sociodemographic data, clinical and anthropometric data, behavioral data, and environmental data.

2.5 Data Collection

The survey was conducted using a standard WHO STEP questionnaire adapted to meet local specificities. We used the KoboCollect Version v2022.4.4 mobile app for data entry.

Blood pressure was taken using an electronic blood pressure monitor type OMRON M6 comfort IT. Each subject surveyed systematically benefited from three blood pressure tests spaced five minutes apart at both arms, after ten minutes of rest and sitting in a quiet environment away from food and tobacco. The average of the figures was retained.

The weighing was carried out through aSECA well-calibrated scale placed on a stable and flat surface in a person lightly dressed, unpaved, and the result expressed in kilograms (kg). Height measurement, in centimeters (cm), was carried out using a portable height gauge in individuals without shoes and not wearing a hat. The waist measurement (cm) used a standard new soft tape measure, applied directly to

the skin. This measurement was performed along the middle axillary line, halfway between the lower base of the last rib and the upper edge of the iliac ridge on each side. Body mass index (BMI) was calculated by the ratio of weight (in kilograms) to the square of height (in meters).

2.6 Operational definitions

Prehypertensive was any subject whose systolic blood pressure ranged from 120 to 139 mmHg and/or diastolic blood pressure ranged from 80 to 89 mmHg according to WHO criteria [2].

The individual was said to be lean if BMI less than 18 kg/m2, normal if BMI greater than or equal to 18 and less than 25 kg/m², overweight between 25 and 30 kg/m² and obese if BMI greater than or equal to 30 kg/m². We retained abdominal obesity by a waist circumference greater than 102 cm in men and 88 cm in women.

The WHC risk (waist/ hip circumference ratio) is said to be low if the WHC ratio is less than 0.80 in women, 0.95 in men, it is said to be moderate if the WHC ratio is between 0.81-0.85 in women, 0.96-1 in men and it is said to be high if the WHC ratio is greater than 0.85 in women, 1 in men [12].

Physical inactivity was defined as the absence of daily physical activity or the presence of physical activity lasting less than 150 minutes per week. Active smoking was considered a risk factor when it was current or recently discontinued. Alcoholism was retained for alcohol consumptionplus 3 glasses of beer (male) or two glasses (female) per day.

Stress level was assessed by the Canadian Mental Health Association (CMHA) Stress Scale, Anxiety and Depression Scale (HAD) [13,14].

2.7 Statistical Analysis

The data was processed and analyzed using the SPSS software in its 22nd version. Data are expressed in absolute values or percentages and mean plus standard deviation or median. Khi² tests by Pearson and De Snedecor were used to compare proportions. The Odds ratio (OR) was used to look for factors associated with prehypertension. The statistical significance threshold was set at 5% ($p < 0.05$). Independent variables associated with prehypertension at the bivariate analysis level were selected for multivariate analysis. During this analysis, potential confounders or effect modifiers were investigated. The logistic regression model with a “step-down” modelling strategy was adopted and independent variables with a p-value higher than the 5% significance threshold were eliminated to finally arrive at the final model.

III. RESULTS

3.1 Sociodemographic data of study participants

These data show that the majority of participants in the study were male, aged 20 to 29, single, no dependants, Christian, living in Makiso and without profession. The above data are presented in Table 1.

3.2 Clinical and anthropometric data of study participants

This study showed that the majority of participants in the study had a normal BMI, a low WHC risk, a family history of hypertension, a moderate level of stress and anxiety, but had no family history of diabetes mellitus and was not depressed. These data are presented in Table 2.

3.3 Behavioural and environmental data of respondents

Reading these data indicates that the majority of respondents were physically active, consumed alcohol and salt, did not consume tobacco and coffee, ate less than 3 fruits per week and more than 3 vegetables per week. These data are given in Table 3.

3.4 Prevalence of prehypertension among respondents

52 respondents out of 130 are prehypertensive, which represents a prevalence of prehypertension of 40%.

3.5 Factors associated with prehypertension among study respondents

3.5.1 Sociodemographic and prehypertension

These data show that the prevalence of prehypertension increases with age, higher in the 30-39 age group with a significant difference ($p<0.05$). This prevalence was more marked among male respondents, living with a spouse, without profession, among residents of the Commune of Kisangani (71.4%), and among those who have the burden of 1 to 3 people. The data below can be found in Table 4.

3.5.2 Clinical and anthropometric data and prehypertension

The analysis of Table 5 shows that the prevalence of prehypertension was higher in overweight respondents (63.2%) and those with a low WHC risk, but the difference was not significant ($p>0.05$). This prevalence was higher in respondents with a family history of hypertension (51.5%) and diabetes mellitus (53.7%) with a significant difference ($p<0.05$), in those with a severe stress level (52.9%), in those with a moderate anxiety level (50.8%) with a significant difference($p<0.05$) and those with a moderate level of depression (53.6%) without a significant difference ($p>0.05$).

3.5.3 Behavioural and Environmental Data with prehypertension

Table 6 shows that the prevalence of prehypertension was higher among those not exercising (45.5%) with a significant difference. It was also higher among tobacco (60.0%) and alcohol (45.8%) and salt (40.6%) users but with no significant difference ($p>0.05$). On the other hand, coffee consumption was significantly related to prehypertension with a prevalence of 56.8% in consumers compared to 31.4% in non-domestic consumers ($p<0.05$). Trainees consuming less than 3 fruits per week had a slightly higher prevalence of prehypertension (40.6%) than those consuming more (37.9%), as well as those consuming vegetables less than 3 times per week (53.3%).

IV. DISCUSSION

IV.1. Sociodemographic data of respondents

In this study, the study population is largely dominated by male subjects. This result is similar to that of Venkatachelam R et al and Qaiser S et al [15,16]. The predominance of male subjects in our study reflects the image of the university population dominated by male subjects in our environment. This could be explained by the fact that cultural burdens and certain customs in sub-Saharan Africa that do not give much importance to the schooling of female subjects and push them early towards marriage.

This study shows that prehypertension progresses to high blood pressure proportionally with age.

The fact that prehypertension is more common in young subjects, and that its risk of progression to hypertension increases with age, has been highlighted in several publications [17-20].

In our study, the majority of respondents (79.2%) had a normal BMI. This result corroborates that found by Bhattacharjya J et al and Qaiser S et al [16,21].However, several studies have shown the role of overweight as an independent factor of prehypertension. [17,19, 22, 23].

IV.2. Prevalence of prehypertension

Our survey results indicate that the prevalence of prehypertension is 40%. They are similar to those of Jain J et al (42.6%), Shahi M et al (40%) and Logaraj M et al [25, 26]. However, lower prevalence than found in our survey was reported by Qaiser S et al (31%), Lucky B et al. (26%), Mohd F et al (20.6%) [16, 27, 28]. The reasons for this discrepancy in prevalence of prehypertension are not well understood but may be due to a difference in sample size in the studies, the type of activities and learning conditions of the finalist medical students in hospitals and the reference population. Males were more affected by prehypertension than females. The plausible explanation for this would be supported by the difference between the sexes in terms of hormonal activity, e.g. estrogen hormone and metabolic rate from an early age in male subjects [29].

IV.3. Factors associated with prehypertension

Family history of high blood pressure and diabetes mellitus were significantly related to prehypertension ($p<0.05$), corroborating the results of studies conducted in Kuwaiti and Indian students [30-31].

This would be justified by the fact that this history predisposes subjects to an increased risk of prehypertension.

Students with moderate anxiety were more affected by prehypertension than others ($p<0.05$). This is consistent with the study of Mohd F et al among Malaysian students [28]. Anxiety, stress and working conditions in the hospital setting may affect thestudent blood pressure numbers.

In this work, there is a significant association between coffee consumption and prehypertension.The study by Hafeez I et al led to the same conclusion [32].

The prevalence of prehypertension is high among tobacco users. This is the same as among Malaysian students [28,32]. Tobacco may contribute to hardening of the artery wall and disruption of blood circulation. The factors that contribute to the propensity for smoking among students are social.

Students may have the false impression that smoking eliminates stress and mimics their colleagues “just for fun.” And, far from their parents, they are attracted by this mode [32].

The present study shows that the absence of regular physical activity is a risk factor for prehypertension, thus joining the results of Abdulrahman MJA et al and Hafeez I et al [32,33].

CONCLUSION

The results of this study show that the prevalence of prehypertension among final year medical students ofUniversity of Kisangani was high, exposing them to an increased risk of cardiovascular disease. Factors associated with prehypertension were age varying between 30 and 39 years ($p<0,029$), family history of high blood pressure ($p<0,009$), family history of diabetes mellitus ($p<0,035$), moderate anxiety ($p<0,013$), coffee consumption ($p<0,004$), and irregular physical activity ($p<0,021$).

Multicenter studies with a larger sample size should be conducted to obtain more accurate results in the identification of factors associated with prehypertension so that early intervention can be implementednationwide.

Ethical Approval and Consent

Anonymity and confidentiality were guaranteed to the respondents. Participation in the study was voluntary after explanation and free informed consent. Authorization was obtained from provincial health authorities before initiating this study.

STUDY LIMITATIONS

The pregnancy test was not performed for female subjects before including them in this study. Factors related to substance use were not assessed using a standard tool. It should also be noted that certain cardiovascular risk factors such as dyslipidemia and hyperglycemia have not been evaluated. Blood pressure was based on the average of two measurements at a single visit. More accurate measurement is needed, such as ambulatory blood pressure measurement and blood pressure self-testing. The study focused on a homogeneous group of people with most similar backgrounds and sociodemographics. Finally, there is the small sample size and the lack of follow-up data of the respondents.

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COMPETING INTEREST

There is no conflict of interest.

Table 1. Sociodemographic data of study participants

Characteristics	Frequency (n=130)	%
Sex		
Male	98	75.4
Female	32	24.6
Age(years)		
20 à 29years	96	73.9
30 à 39 years	33	25.4
≥40 years	1	0.7
Marital status		
Lives alone	111	85.4
Lives with spouse	19	14.6
Dependants		
None	101	77.7
1-3	23	17.7
>3	6	4.6
Religion		
Christian	95	73.1
Islamic	15	11.5
Kimbanguiste	10	7.7
Other	10	7.7
Residential commune		
Makiso	83	63.8
Tshopo	13	10.0
Kabondo	14	10.8
Mangobo	13	10.0
Kisangani	7	5.4
Profession		
Without occupatio	117	90.0
With occupation	13	10.0

Table 2. Distribution of study participants by clinical and anthropometric data

Variables	Frequency(n=130)	%
BMI		
Thinness	7	5.4
Normal	103	79.2
Overweight	19	14.6
Obesity	1	0.8
WHC Risk		
Weak	98	75.4
Moderate	8	6.2
High	24	18.4
Family history of hypertension		
No	62	47.7
Yes	68	52.3
Family history of diabetes mellitus		
No	89	68.5
Yes	41	31.5
Stress level		
Light	18	13.8
Moderate	61	46.9
Severe	51	39.2
Level of anxiety		
No anxiety	56	43.1
Moderate	65	50.0
Severe	9	6.9
Level of depression		
No depression	102	78.5
Moderate	28	21.5

Table 3. Distribution of study participants by behavioural and environmental data

Variables	Frequency (n=130)	%
Exercise		
No	88	67.7
Yes	42	32.3
Tobacco consumption		
No	120	92.3
Yes	10	7.7
Alcohol consumption		
No	58	44.6
Yes	72	55.4
Salt consumption		
No	2	1.5
Yes	128	98.5
Coffee consumption		
No	86	66.2
Yes	44	33.8
Fruit consumption		
< 3 per week	101	77.7
> 3 per week	29	22.3
Consumption of vegetables		
< 3 per week	15	11.5
> 3 per week	115	88.5

Table 4. Relationship between sociodemographic data and prehypertension among respondents

Variables	Prehypertension		Univariate analysis		Multivariate analysis	
	No(n (%))	**Yes** (n (%))	**COR(95% IC)**	**p-val**	**AOR(95% IC)**	**p-val**
Age(years)						
20 to 29 years	63 (65.6%)	33 (34.4%)	—		—	
30 to 39 years	14 (42.4%)	19 (57.6%)	2.59(1.16 – 5.91)	**0.021**	3.09(1.14 – 8.77)	**0.029**
40 years and over	1 (100.0%)	0 (0.0%)	0	>0.9	0	>0.9
Sex						
Female	21 (65.6%)	11 (34.4%)	—			
Masculine	57 (58.2%)	41 (41.8%)	1.37(0.61 – 3.24)	0.5		
Marital status						
Lives with spouse	8 (42.1%)	11 (57.9%)	—			
Lives alone	70 (63.1%)	41 (36.9%)	0.43(0.15 – 1.14)	0.091		
Profession						
Professionally	9 (69.2%)	4 (30.8%)	—			
Unprofessional	69 (59.0%)	48 (41.0%)	1.57(0.48 – 6.04)	0.5		
Religion						
Christian	57 (60.0%)	38 (40.0%)	—			
Kimbanguist	6 (60.0%)	4 (40.0%)	1(0.24 – 3.74)	>0.9		
Muslim	11 (73.3%)	4 (26.7%)	0.55(0.14 – 1.73)	0.3		
Other	4 (40.0%)	6 (60.0%)	2.25(0.60 – 9.30)	0.2		
Residential commune						
Kabondo	9 (64.3%)	5 (35.7%)	—			
Kisangani	2 (28.6%)	5 (71.4%)	4,5(0.69 – 40.7)	0.13		
Makiso	49 (59.0%)	34 (41.0%)	1.25(0.40 – 4.37)	0.7		
Mangobo	10 (76.9%)	3 (23.1%)	0.54(0.09 – 2.86)	0.5		
Tshopo	8 (61.5%)	5 (38.5%)	1.13(0.23 – 5.52)	0.9		
Dependants						
None	64 (63.4%)	37 (36.6%)	—		—	
1-3	9 (39.1%)	14 (60.9%)	2.69(1.08 – 7.04)	**0.037**	2,6(0.84 – 8.38)	0.1
More than 3	5 (83.3%)	1 (16.7%)	0.35(0.02 – 2.25)	0.3	0.34(0.01 – 5.64)	0.5

Table 5. Relationship between clinical data and prehypertension of study respondents.

Variables	Prehypertension		Univariate analysis		Multivariate analysis	
	No (n (%))	**Yes** (n (%))	**COR(95% IC)**	**p-val**	**AOR(95% IC)**	**p-val**
BMI (kg/m2)						
Thinness	5 (71.4%)	2 (28.6%)	—			
Normal	66 (64.1%)	37 (35.9%)	1.4(0.29 – 10.1)	0.7		
Overweight	7 (36.8%)	12 (63.2%)	4.29(0.71 – 36.0)	0.13		
Obesity	0 (0.0%)	1 (100.0%)	–	>0.9		
WHC Risk						
Raised	15 (62.5%)	9 (37.5%)	—			
Weak	58 (59.2%)	40 (40.8%)	1,15(0.46 – 2.98)	0.8		
Moderate	5 (62.5%)	3 (37.5%)	1(0.17 – 5.14)	>0.9		
Family history of the hypertension						
No	45 (72.6%)	17 (27.4%)	—		—	
Yes	33 (48.5%)	35 (51.5%)	2.81(1.36 – 5.94)	**0.006**	3.26(1.37 – 8.16)	**0.009**
Family history of diabetes mellitus						
No	59 (66.3%)	30 (33.7%)	—		—	
Yes	19 (46.3%)	22 (53.7%)	2.28(1.07 – 4.89)	**0.033**	2.68(1.09 – 6.88)	**0.035**
Stress level						
Light	12 (66.7%)	6 (33.3%)	—			
Moderate	42 (68.9%)	19 (31.1%)	0.9(0.30 – 2.93)	0.9		
Severe	24 (47.1%)	27 (52.9%)	2.25(0.75 – 7.33)	0.2		
Level of anxiety						
No anxiety	41 (73.2%)	15 (26.8%)	—		—	
Moderate	32 (49.2%)	33 (50.8%)	2.82(1.33 – 6.18)	**0.008**	3.27(1.31 – 8.62)	**0.013**
Severe	5 (55.6%)	4 (44.4%)	2.19(0.49 – 9.37)	0.3	3.69(0.70 – 19.9)	0.12
Depression level						
No depression	65 (63.7%)	37 (36.3%)	—			
Moderate	13 (46.4%)	15 (53.6%)	2.03(0.87 – 4.78)	0.1		

Table 6. Relationship between behavioural and environmental data and the prehypertension of study respondents.

VARIABLES	Prehypertension		Univariate analysis		Multivariate analysis	
	No(n (%))	**Yes** (n (%))	**COR(95% IC)**	**p-val**	**AOR(95% IC)**	**p-val**
Regular practice of physical activity						
Yes	48 (54.5%)	40 (45.5%)	—		—	
No	30 (71.4%)	12 (28.6%)	0.48(0.21 – 0.89)	**0.039**	0.31(0.11 – 0.81)	**0.021**
Tobacco consumption						
No	74 (61.7%)	46 (38.3%)	—			
Yes	4 (40.0%)	6 (60.0%)	2.41(0.65 – 9.87)	0.2		
Alcohol consumption						
No	39 (67.2%)	19 (32.8%)	—			
Yes	39 (54.2%)	33 (45.8%)	1.74(0.85 – 3.60)	0.13		
Salt consumption						
No	2 (100.0%)	0 (0.0%)	—	—		
Yes	76 (59.4%)	52 (40.6%)	—	>0.9		
Coffee consumption						
No	59 (68.6%)	27 (31.4%)	—		—	
Yes	19 (43.2%)	25 (56.8%)	2.88(1.37 – 6.17)	**0.006**	3.81(1.58 – 9.68)	**0.004**
Fruit consumption						
<3 fruits per week	60 (59.4%)	41 (40.6%)	—			
>3 fruits per week	18 (62.1%)	11 (37.9%)	0.89(0.37 – 2.07)	0.8		
Vegetable consumption						
<3 times a week	7 (46.7%)	8 (53.3%)	—			
>3 times a week	70 (61.4%)	44 (38.6%)	0.55(0.18 – 1.64)	0.3		

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