

Prevalence, Awareness, Treatment and Control of Hypertension Among Adults Living in the Port City of Boma, Democratic Republic of the Congo

Blaise Makoso Nimi^{1, 2, 5}, Francois Lepira Bompeka¹, Benjamin Longo Mbenza^{1, 2, 5}, Carine Nkembi Nzuzi², Gédeon Longo Longo⁵, Aliocha Nkodila^{1, 5}, Roland Vangu Vangu⁴, Memoria Makoso Nimi², Jean Pierre Mvuezolo Ndenga², Bienvenu Nkongo², Jean Paul Nkambu Nlandu², Deo Tagize², Antoinette Ndele Nzita², Michel Lutete Nkelani¹, Jean René M'Buyamba-Kabangu¹

¹Department of Internal Medicine, University of Kinshasa, Democratic Republic of Congo

²Department of Internal Medicine, University of President Joseph KASA-VUBU, Boma, Democratic Republic of Congo

³Department of Internal Medicine, Walter Sisulu University, Mthatha, South Africa

⁴Department of Gynecology and Obstetric, University of Kinshasa, Kinshasa, Democratic Republic of Congo

⁵Department of Public Health, Lomo-University Research, Kinshasa, Democratic Republic of Congo

Email address:

docteurmakoso@gmail.com (B. M. Nimi)

*Corresponding author

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Abstract: Background and Aim: In limited resource settings, reliable epidemiological data generated from hypertension high risk geographical areas or people is a prerequisite for the planning of proven and effective interventions. The aim of the present survey was to assess the prevalence, awareness, control and factors associated with hypertension in adults living in the port City of Boma, located in the southwestern part of DRC. Methods: a cross-sectional survey using a modified WHO STEP wise questionnaire for data collection during face-to face interviews was conducted from March, 1 to April 15, 2018. We did multi-stage cluster sampling. Was an all-inclusive adult over the age of ≥ 18 years having given informed consent. Information on demographic parameters, lifestyles, anthropometric measurements and blood pressure (BP) were obtained. Hypertension was defined as a mean of two BP $\geq 140/90$ mmHg or a self-reported history of antihypertensive drug use. Independent factors associated with hypertension were identified using logistic pressure analysis. $P < 0.05$ defined level of statistical significance. Results: The prevalence of hypertension was 35% (Women 63, 5%) with 56,1% of hypertensive participants being unaware of their hypertension status. Of those who were aware and on treatment, only 47, 9% had a controlled BP. Older age ($p < 0.001$), FH-HT ($p = 0.021$), smoking ($p < 0.001$), overweight ($p < 0.001$), and obesity ($p = 0.030$) emerged as main cardiovascular risk factors associated with hypertension. Conclusion: Hypertension was characterized by a high prevalence, low rate of awareness and suboptimal BP control, high cardiovascular risk and associated with smoking and obesity as modifiable risk factors. Therapeutic lifestyle changes and pharmacological treatment are needed for those hypertensive participants with increased global cardiovascular risk.

Keywords: Hypertension, Prevalence, Awareness, Control, Associated Factors, Black Africans

1. Introduction

In sub-Saharan Africa (SSA), hypertension is recognized as the foundation of the epidemics of cardiovascular disease (CVD) [1] and is associated with increased cardiovascular (CV) morbidity and mortality [2]. Factors underlying this high CV morbidity and mortality include low awareness of hypertension and its complications, under-diagnosis and treatment as well as poor treatment control; all these factors are known to increase the likelihood of developing target organ damage and subsequent overt cardiovascular disease (CVD) [3, 4]. Therefore, prevention through increasing awareness, early diagnosis and management of hypertension has been recommended by international guidelines on the diagnosis and management of hypertension as a rationale strategy to mitigate the negative impact of hypertension on the health and socio-economic sectors [5, 6]. The implementation and success of such a strategy imply the availability of information on at risk groups, the burden of the disease in terms of prevalence and associated risk factors, awareness, treatment and control as well as the tracking overtime of hypertension and associated risk factors. Unfortunately, despite the evidence for the prevalence of hypertension in SSA, national data are still not up to date, hence the need to fill this gap. Thus, in order to fill this data gap in countries with low and limited resources, a STEPwise approach must be planned for the surveillance of these non-communicable diseases (STEPS) [7]. STEPS uses a modular structure with standardized questions and protocols, allowing adjustment of its application and appropriate comparisons of surveys [7]. In addition to launching STEPwise approach, WHO advises limited resource countries to adopt a strategy targeting high CV risk populations or settings, like ports, to mitigate the negative impact of hypertension and associated risk factors [1].

In the Democratic Republic of the Congo (DRC), the nationwide prevalence of hypertension and associated risk factors is not yet available due lack of an effective nationwide surveillance system and financial constraints; however, studies conducted in some urban and rural areas have reported a prevalence of hypertension ranging from 30% to 40% and an increased CV mortality due, among others, to low awareness, under-diagnosis and under-treatment as well as poor hypertension control [8-10]. If studies have been conducted in port cities like Kinshasa, Bukavu and Matadi, there are not yet epidemiological data on hypertension and associated risk factors in Boma, a Southwestern port City of the Kongo Central Province, located 440 Km far from Kinshasa, the Capital City. Therefore, the aim of the present study was to assess the burden of hypertension and associated risk factors among adults living in the port City of Boma.

2. Methods

2.1. Study Design

This was a population-based cross-sectional study

involving adult population randomly selected.

2.2. Study Setting

Boma is a port City located at 125 Km far from Matadi, the Capital City of the southwestern Province of Kongo Central and 440 Km far Kinshasa, the Capital City of DRC. It was created in XVI century and is the traditional homeland of Bakongo people of Bantu origin. The City is made up of all tribes of the DRC.

Study population and sampling

We carried out stratified sampling at several stages to identify the participants (people as well as residences). A sample of 1178 households was selected in which all eligible members (adults), after having given their informed consent, were included. A total of 3,510 eligible people were interviewed, resulting in a response rate of 91.4%.

2.3. Eligibility Criteria

Participants were included in the study if they were aged 18 years and above, living in the City for at least 1 year and willing to participate in the study. Non-inclusion criteria included pregnancy or any form of debilitation that makes obtaining past-medical anthropometric and measures difficult.

2.4. Data Collection

Data on demographics and risky habits were obtained during the interview.

Demographic variables included: sex, age, marital status, level of education, employment status and average monthly income. The following behavioral variables were obtained by self-report: smoking, alcohol consumption, physical activity, and fruit and vegetable consumption. Smoking and alcohol consumption. Levels of physical activity were reported based on the intensity of participants' daily physical activity.

A pilot study was carried out among volunteers in the Luzolo district, which was not included in the main study. A questionnaire made it possible to obtain information on the participants. The investigator also took blood pressure and heart rate measurements, as well as anthropometric measurements (height, waist circumference). Data collection occurred between March and April 2018.

2.5. Measurements

Anthropometric measurements (such as body weight, waist circumference, height) of blood pressure and pulse were broadcast by well-trained medical students. Blood pressure was used using OMRON MIT5 Connect brand electronic devices (Kyoto, Japan) and recorded using STEPS methods. The average of the two measurements was used in the analysis.

Height was checked while standing, participants without shoes, using a tape measure flexible tape (Hemostyl, Sulzbach, Germany). Body weight was also measured using an electronic scale (Deluxe GBS-721; Seca Deutschland, Hamburg, Germany), participant wearing light clothing, standing and without shoes. Body mass index (BMI) was calculated as the weight in kilograms divided by the height in

square meters (Kg / m^2). A flexible tape meter was used to measure the waist at the level directly above the iliac crest.

During the study participants were asked questionnaires on smoking and chewing tobacco, fruit and vegetable consumption and physical activity habits.

The Global Physical Activity Questionnaire Version 2 was used to collect information on physical activity.

Operational definitions

Hypertension was defined as having $\text{BP} \geq 140 / 90$ mmHg and / or the notion of taking an antihypertensive drug. Blood pressure is controlled if it is < 140 mmHg during treatment in people on treatment; Isolated, isolated and uncontrolled systolic-diastolic BP in treated patients was defined as $\text{SBP} \geq 140$ mmHg and $\text{DBP} < 90$ mmHg, $\text{SBP} < 140$ mmHg and $\text{DBP} \geq 90$ mmHg and $\text{SBP} \geq 140$ mmHg and $\text{DBP} \geq 90$ mmHg, respectively [11].

Diabetes was defined as fasting capillary blood glucose, $110 \text{ mg} / \text{dl}$ or history of antidiabetic treatment [12].

Low fruit/vegetable consumption of less than 5 portions of fresh and/or cooked fruits/vegetables a day [13]. The Global Physical Activity Questionnaire was used to assess the physical activity of all participants. The evaluation took into account the number of minutes per day and per week. [14].

Body Mass Index (BMI): was obtained by the ratio of the weight in Kg on the size of the waist in meters squared (Kg / m^2). BMI was then classified into four categories; underweight ($\text{BMI} < 18.5 \text{ Kg} / \text{m}^2$), normal ($\text{BMI} 18.5\text{-}24.99 \text{ Kg} / \text{m}^2$), overweight ($\text{BMI} 25\text{-}29.99 \text{ Kg} / \text{m}^2$) and obese ($\text{BMI} \geq 30 \text{ Kg} / \text{m}^2$) [15]. Waist circumference (WC) was used as surrogate for abdominal obesity, defined as a WC value > 94 cm in men and > 80 cm in women [16]. High cardiometabolic risk (CMR) as the waist-to-height ratio ≥ 0.5 [17].

Alcoholism was defined as consuming at least 20 g of alcohol per day or > 2 standard glasses of beer per day for men and > 1 standard glass of beer per day for women for at least a year [18]. Smoking was defined as current use of smoked or smokeless tobacco [19]. According to 2013 - 2014 DRC Demographic and Health Survey (DHS), low, middle and high socioeconomic status (SES) scores were defined as 0 - 3, 4 - 8 and > 9 respectively [19].

2.6. Data Analyses

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 21 for Windows. They were expressed as means \pm standard deviations (SD) for continuous variables and as frequencies (n) and percentages (%) for categorical variables.

The percentages were compared using the chi-square test.

Logistic regression was used to identify independent factors associated with hypertension. The threshold of statistical significance was set at a value of $p < 0.05$.

The demographic variables included in this model were age, sex (male or female), education, marital status, place of residence (urban or rural), socio-economic level of the household.

Age was recoded into six brackets < 30 , 30 to 39, 40 to 49, 50 to 59 and ≥ 60). The level of education has been classified

into four categories (out of school, primary, secondary and higher). The socio-economic level was assessed and estimated by referring to the 2013-2014 DHS Score which includes the goods owned by the household and equipment (housing construction materials, source of water for household consumption, type of sanitary installation, and fuel used for cooking [19].

2.7. Ethical Approval

Ethical approval was obtained from the Ethical Committee of the Ministry of Health (N°104/CNES/BN/PMMF/2018). Written informed consent was taken from the subjects who volunteered to participate in the study. Identified hypertensive subjects were referred to the nearby clinic for treatment.

3. Results

General characteristics of the study population

General characteristics of the study population as a whole and by hypertension status are depicted in table 1. Of the 3510 participants, 1396 (40%) were males while 2114 (60%) were females. Their mean age was 36.3 ± 15.9 years with 43.4%, 23%, 13.4%, 9.6.% and 10.5% participants aged < 30 years, 30–39 years, 40–49 years, 50–59 years and ≥ 60 years, respectively. Most participants (74.2%) were recruited from the rural suburb; the proportion of unemployed, married, single, secondary education level and low SES participants was 22.6%, 43%, 46.6%, 58.9% and 63.5%, respectively. Average levels of SBP, DBP, HR, BMI, WC, and capillary blood glucose were 122.2 ± 21.9 mmHg, 80.7 ± 14.9 mmHg, 80.8 ± 12.1 bpm, $23.1 \pm 5.7 \text{ Kg} / \text{m}^2$, 81.7 ± 11.9 cm and $118.1 \pm 31.1 \text{ mg} / \text{dl}$, respectively.

Table 2 summarizes cardiovascular risk factor profile of the study population as a whole and by BP categories. In the study population as a whole, physical inactivity (57.5%), alcohol intake (45.3%), FH-HT (43.6%), central obesity (38.1%) and DM (33.9%) were cardiovascular risk factors most frequently reported by the participants.

Prevalence and clinical profile of hypertension

Hypertension was observed in 1245 (35.5%) participants (Figure 1), of whom 790 (63.5%), 620 (50.5%) and 916 (73.6%) were women, married and living in rural area, respectively (Table 1). Their mean age was 44.0 ± 17.0 years and average levels for BMI, WC, SBP, DBP, HR and blood glucose were $24.1 \pm 5.9 \text{ Kg} / \text{m}^2$, 85.4 ± 13.2 cm, 149.1 ± 25.8 mmHg, 93.1 ± 15.7 mmHg, 81.6 ± 12.2 bpm and $117.9 \pm 29.7 \text{ mg} / \text{dL}$, respectively; the median duration of hypertension was 6.5 (5.0-10.5) months. The proportion of unemployed participants and those with secondary education level and low SES was 28.3%, 53.2% and 60.6%, respectively. Compared to normotensive participants, those with hypertension were in average significantly older (44.0 ± 17.0 vs 44.0 ± 17.0 years; $p < 0.001$) and had higher levels for BMI (24.1 ± 5.9 vs $23.1 \pm 5.7 \text{ Kg} / \text{m}^2$; $p < 0.001$), WC (85.4 ± 13.2 vs 81.7 ± 11.9 cm; $p < 0.001$) and HR (81.6 ± 12.2 vs 80.8 ± 12.1 cm; $p = 0.003$).

Table 1. General characteristics of the study population as a whole and by hypertension status.

Variables	Over All n=3510	Normotension n=2265	Hypertension n=1245	P
Age, years	36.3±15.9	31.7±12.8	44.7±17.6	<0.001
Age categories, n (%)				<0.001
<30 years	1524 (43.4)	1239 (54.7)	285 (22.9)	
30-39 years	809 (23.0)	530 (23.4)	279 (22.4)	
40-49 years	469 (13.4)	258 (11.4)	211 (16.9)	
50-59 years	338 (9.6)	133 (5.9)	205 (16.5)	
≥60 years	370 (10.5)	105 (4.6)	265 (21.3)	
Gender, n (%)				0.002
Male	1396 (39.8)	941 (41.5)	455 (36.5)	
Female	2114 (60.2)	1324 (58.5)	790 (63.5)	
Residence, n (%)				0.263
Urban	904 (25.8)	575 (25.4)	329 (26.4)	
Rural	2606 (74.2)	1690 (74.6)	916 (73.6)	
Occupation, n (%)				<0.001
Senior Staff	923 (26.3)	688 (30.4)	235 (18.9)	
Businessmen	1187 (33.8)	781 (34.5)	406 (32.6)	
Students	513 (14.6)	338 (14.9)	175 (14.1)	
Public Servants	93 (2.6)	24 (1.1)	69 (5.5)	
Unemployed	794 (22.6)	434 (19.1)	360 (28.9)	
Marital status, n (%)				<0.001
Married	1509 (43.0)	880 (38.9)	629 (50.5)	
Divorced	94 (2.7)	46 (2.0)	48 (3.9)	
Widow	271 (7.7)	80 (3.5)	191 (15.3)	
Single	1636 (46.6)	1259 (55.6)	377 (30.3)	
Education level, n (%)				<0.001
Primary/no	699 (19.9)	371 (16.4)	328 (26.3)	
Secondary	2069 (58.9)	1407 (62.1)	662 (53.2)	
University/Superior	742 (21.1)	487 (21.5)	255 (20.5)	
SES, n (%)				0.018
Low	2229 (63.5)	1475 (65.1)	754 (60.6)	
Middle	988 (28.1)	616 (27.2)	372 (29.9)	
High	293 (8.3)	174 (7.7)	119 (9.6)	
DHT, years	6.5 (5.0-10.0)	-	6.5 (5.0-10.5)	-
BMI, Kg/m ²	23.1±5.7	22.5±5.4	24.1±5.9	<0.001
WC, cm	81.7±11.9	79.7±10.7	85.4±13.2	<0.001
SBP, mmHg	122.2±21.9	112.9±11.7	149.1±25.8	<0.001
DBP, mmHg	80.7±14.9	73.8±8.6	93.1±15.7	<0.001
MAP, mmHg	94.5±16.2	86.9±8.6	108.4±17.4	<0.001
PP, mmHg	41.6±14.3	39.2±9.9	45.9±19.3	<0.001
HR, bpm	80.8±12.1	80.3±12.0	81.6±12.2	0.003
Blood glucose, mg/dl	118.1±31.1	118.2±31.9	117.9±29.7	0.929

Data are expressed as mean±standard deviation, median (interquartile range) absolute (n) and relative (in percent) frequency. Abbreviations: M, male F, female SES, socioeconomic status BMI, body mass index WC, waist circumference SBP, systolic blood pressure DBP, diastolic blood pressure MAP, mean arterial blood pressure PP, pulse pressure HR, heart rate bpm, beat per minute

Table 2. Cardiovascular risk factor profile of the study population as a whole and by hypertension status.

Variables	All n=3510	Normotension=2265	Hypertension 1245	P
Older age*, n (%)	760 (21.7)	274 (12.1)	486 (39.0)	<0.001
FH-HT, n (%)	153 (43.6)	945 (41.7)	585 (47.0)	0.003
FH-DM, n (%)	392 (11.2)	260 (11.5)	132 (10.6)	0.232
FH-CVD, n (%)	222 (6.3)	138 (6.1)	84 (6.7)	0.244
Smoking, n (%)	515 (14.7)	281 (12.4)	234 (18.8)	<0.001
Alcohol intake, n (%)	1590 (45.3)	1010 (44.6)	580 (46.6)	0.136
Menopause, n (%)	557 (15.9)	47 (11.8)	362 (29.1)	<0.001
Overweight, n (%)	563 (16.0)	277 (12.2)	286 (23.0)	<0.001
Obesity, n (%)	282 (8.0)	135 (6.0)	147 (11.8)	<0.001
Central obesity, n (%)	1337 (38.1)	720 (31.8)	617 (49.6)	<0.001
PH-DM, n (%)	158 (33.9)	95 (25.1)	63 (37.1)	0.162
Physical inactivity, n (%)	2020 (57.5)	1245 (55.0)	775 (62.2)	<0.001
CMR, n (%)	1635 (46.6)	894 (39.5)	741 (59.5)	<0.001
Fruits & vegetables, n (%)				<0.001

Variables	All n=3510	Normotension=2265	Hypertension 1245	P
Low	2497 (71.1)	1428 (63.0)	1069 (85.9)	
High	1013 (28.9)	837 (37.0)	176 (14.1)	

Data are expressed as absolute (n) and relative (in percent) frequency. Abbreviations: M, male F, female FH, family history HT, hypertension DM, diabetes mellitus CVD, cardiovascular disease PH, personal history CMR, cardiometabolic risk

With reference to cardiovascular risk profile (Table 2), physical inactivity (62.2%), central obesity (49.6%), FH-HT (47.0%), and alcohol intake (46.6%) were cardiovascular risk factors more frequently observed among hypertensive participants. Compared to normotensive participants, hypertensive ones had a significantly higher proportion of older participants (39.0 vs 12.1%; $p<0.001$), smokers (18.8

vs 12.4%; $p<0.001$) and those with physical inactivity (62.2 vs 55.0%; $p<0.001$), central obesity (49.6 vs 38.1%), FH-HT (47.0 vs 41.7%; $p<0.001$), menopause (29.1 vs 11.8%; $p<0.001$), overweight (23.0 vs 12.2%; $p<0.001$), and obesity (11.8 vs 8.0%; $p<0.001$) and low legumes and vegetable consumption (85.9 vs 63.0%; $p<0.001$)

Table 3. Awareness, treatment and control of hypertension among hypertensive participants.

Variable	N	All	Male	Female	P
Awareness, n (%)	1245		455	790	<0.001
No		699 (56.1)	305 (67.0)	394 (49.9)	
Yes		546 (43.9)	150 (33.0)	396 (50.1)	
Treatment, n (%)	546		150	396	0.476
No		185 (33.9)	50 (33.3)	135 (34.1)	
Yes		361 (66.1)	100 (66.7)	261 (65.9)	
Drug regimen/class	361		100	261	0.119
1 drug, n (%)		263 (72.8)	78 (78.0)	185 (70.9)	
CCB		200 (55.4)	54 (54.0)	146 (55.9)	
ACEI		43 (11.9)	17 (17.0)	26 (10.0)	
Loop diuretic		5 (1.4)	2 (2.0)	3 (1.1)	
ARA II		6 (1.7)	1 (1.0)	5 (1.9)	
Betablocker		5 (1.4)	2 (2.0)	3 (1.1)	
Thiazide-like		4 (1.1)	2 (2.0)	2 (0.8)	
2 drugs, n (%)		98 (27.2)	22 (22.0)	76 (29.1)	
CCB + ACEI		96 (26.5)	20 (20.0)	76 (28.7)	
CCB +Betablocker		1 (0.3)	1 (1.0)	0 (0.0)	
CCB + Thiazide like		1 (0.3)	0 (0.0)	1 (0.4)	
BP control, n (%)	361		100	261	0,035
No		188 (52.1)	61 (61.0)	127 (78.7)	
Yes		173 (47.9)	39 (39.0)	134 (21.3)	
No BP control types, n (%)	188		64	124	0.324
Isolated systolic		23 (12.2)	8 (13.1)	15 (13.1)	
Isolated diastolic		38 (20.2)	19 (26.2)	19 (26.2)	
Systolic/diastolic		127 (67.6)	37 (60.7)	90 (70.9)	

Data are expressed as absolute (n) and relative (in percent) frequencies. Abbreviations: CCB, calcium channel blocker ACEI, angiotensin converting enzyme inhibitor ARA, angiotensin type 1 receptor antagonist BP, blood pressure

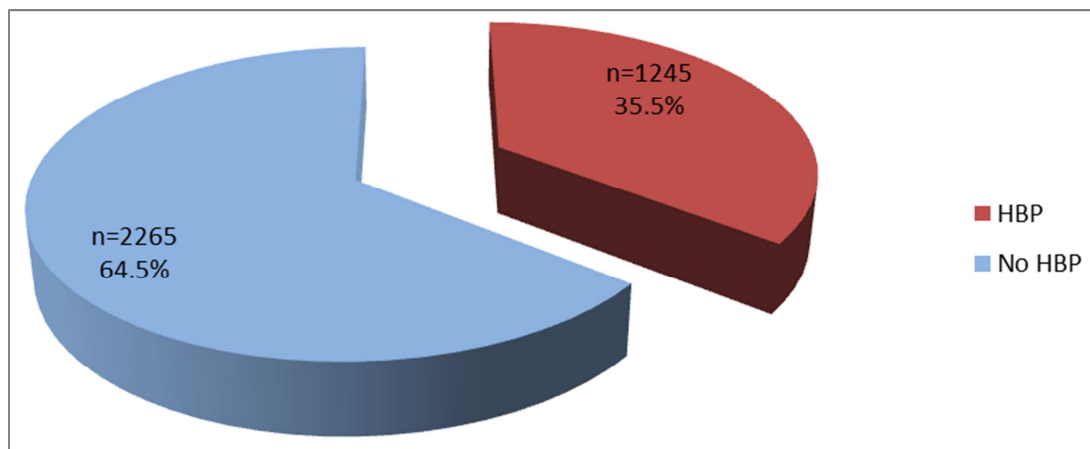


Figure 1. Distribution of the study participants according to hypertension status. Abbreviations: HBP, high blood pressure.

Table 4. Cardiovascular risk factors associated with prehypertension and hypertension in multivariate analysis.

Variables	Univariate		Multivariate	
	P	aOR (95%CI)	p	aOR (95%CI)
Older age, yrs				
No		1		1
Yes	<0.001	4.65 (3.93-5.52)	<0.001	2.88 (2.08-3.99)
FH-HT				
No		1		1
Yes	0.003	1.95 (1.08-3.42)	0.021	1.69 (1.21-2.64)
Smoking				
No		1		1
Yes	<0.001	1.63 (1.35-1.98)	<0.001	2.51 (1.21-3.87)
PH-Hyperuricemia				
No		1		1
Yes	0.011	2.13 (1.67-2.74)	0.095	1.27 (0.96-1.69)
Menopause				
No		1		1
Yes	0.013	4.35 (3.59-5.27)	0.864	1.03 (0.72-1.49)
Overweight				
No		1		1
Yes	0.041	2.14 (1.78-2.57)	<0.001	1.67 (1.34-2.08)
Obesity				
No		1		1
Yes	<0.001	2.11 (1.65-2.70)	0.030	1.82 (1.03-2.85)
Central obesity				
No		1		1
Yes	0.012	2.11 (1.83-2.43)	0.236	1.15 (0.91-1.46)

Abbreviations: PreHT, prehypertension HT, hypertension aOR, adjusted odds ratio CI.

Awareness, treatment and control of hypertension

Of the 1245 hypertensive patients, 546 (43.5%) of them were aware of their status of hypertension with a significantly higher proportion of women (50.1% vs 33.0%; $p<0.001$) (Table 3). Current pharmacologic antihypertensive treatment was reported by 361 (66.1%) of 546 participants aware of their hypertension status. The antihypertensive regimen was based on 1 and 2 antihypertensive drugs in 263 (72.8%) and 98 (27.2%) treated hypertensive participants ($n=361$), respectively; no participant was receiving ≥ 3 antihypertensive drugs. In those receiving one antihypertensive drug, calcium channel blockers (55.4%) was the drug class most frequently reported by participants whereas the combination of calcium channel blockers (CCB) and angiotensin converting enzyme inhibitors (ACEIs) (26.5%) was most frequently mentioned by those receiving two drugs. BP control was observed in 164 (48.2.8%) of 188 treated hypertensive participants mainly in men than women (78.7 vs 61%; $p=0.035$). Systolic-diastolic uncontrolled hypertension (67.6%) was the type most frequently encountered among those with no BP control

Factors associated with hypertension

In univariate analysis (Table 3), cardiovascular risk factors significantly associated with hypertension were older age ($p=0.000$), FH-HT ($p=0.003$), smoking ($p=0.000$), personal history (PH) of hyperuricemia ($p=0.011$), menopause ($p=0.013$), overweight ($p=0.041$), obesity ($p=0.0001$), and central obesity (0.012) emerged as the main cardiovascular risk factors significantly associated with hypertension. In multivariate analysis (Table 4), the strength of the associations observed in univariate analysis persisted only for older age [aOR 2.88 (2.08-3.99); $p=0.000$], FH-HT [aOR

1.69 (1.21-3.87); $p=0.021$], smoking [aOR 2.51 (1.21-3.87); $p=0.000$], overweight [aOR 1.67 (1.34-2.08); $p=0.000$], and obesity (aOR 1.82 (1.03-1.46); $p=0.030$). Thus, the likelihood of having hypertension was nearly three-fold greater in the presence of older age (aOR 2.88; 95%CI 2.08-3.99; $p=0.0001$) and nearly two fold or more in the presence of FH-HT, smoking, overweight and obesity.

4. Discussion

The main findings of the present study are as follows. First, nearly 4 out of 10 participants, mainly women had hypertension. Second, the proportion of participants aware, treated and controlled was low in the present study. Third, despite high global cardiovascular risk, the majority of treated participants were receiving monotherapy with mainly calcium channel blockers. Fifth, older age and FH-HT as non-modifiable and smoking, overweight and obesity as modifiable risk factors were independent factors associated with hypertension.

Nearly 4 out of 10 participants, mainly women had hypertension in the present study. Our finding agrees with previous studies from the Democratic Republic of the Congo reporting increased prevalence of hypertension in urban and rural settings [8-10]. It is also consistent with findings of increased prevalence of hypertension from Central [20-22], Eastern [23, 24], Southern [25, 26] and Western [27-31] sub-Saharan African countries. Differences in study populations, sample size and methodology used as well as in geographical distribution of traditional and emerging cardiovascular risk factors could explain the observed disparities in hypertension prevalence between studies. The level and speed of the

epidemiological transition between sub-Saharan African countries could also contribute to these disparities [32]. Hypertension was more frequent in women than men in the present study. Our finding contrasts with that of previous studies from the Democratic Republic of the Congo [33, 8-10] who reported a higher prevalence of hypertension in men than women. However, it is consistent with that of studies from other sub-Saharan Africa countries [34-35]. The high prevalence of hypertension in women in the present study could be probably due to the inclusion of more women than men. The menopause with subsequent loss of estrogen-afforded cardiovascular protection could be an explanatory factor for the increased prevalence of hypertension in women [36, 37]; however, the mean age of the study population (36 years) does not allow to ascertain this hypothesis.

The proportion of participants aware, treated and controlled was low in the present study. Our finding is consistent with that of previous studies conducted in the Democratic Republic of the Congo [8-10]. Our finding of low proportion of participants aware of their hypertension is consistent with previous reports from our setting. In this regard, awareness rates of 32.5%, and 42.5% have been already reported by M'Buyamba-Kabangu *et al.* in Kinshasa, the capital City [38] and Katchunga *et al.* in Bukavu, a City located at the southern East part of DRC, respectively [8]. Low awareness remains still a big challenge for the control of hypertension in other sub-Saharan African countries and requires effective behavioral change communication and screening strategies to reduce the prevalence of undiagnosed hypertension and related life-threatening complications [30, 28, 39, 40]. The low proportion of participants on antihypertensive therapy in the present study is consistent with previous studies from DRC and other sub-Saharan African countries [7-9] that reported values less than 50% among treated patients. Similar picture has been found for patients who achieved recommended BP goals.

The majority of treated participants were receiving monotherapy with mainly calcium channel blockers. If the use a calcium channel blocker or a thiazide diuretic as first-line drug in the treatment of hypertension of blacks, known to have a low plasma renin activity and a subsequent volume-dependent hypertension [41], is conceptually rationale, the use of monotherapy in the present study where hypertension is associated with high to very high 10 years global cardiovascular risk is not rationale and may translate therapeutic inertia from caregivers [42]. Given their high cardiovascular risk, our hypertensive participants need at least a combination of two drugs, including a calcium channel blocker or a thiazide diuretic and a renin angiotensin inhibitor to afford end-organ protection et reduce 10 years global cardiovascular risk [43].

Older age and FH-HT as non-modifiable and smoking, overweight and obesity as modifiable risk factors were independent factors associated with hypertension. Older age has been reported to be one of the most powerful cardiovascular risk factors through oxidative stress-induced endothelial dysfunction [44] and subsequent vascular

remodeling as well as the coexistence of multiple cardiovascular risk factors via insulin resistance [45]. The association of FH-HT and hypertension does translate the existence of a potential genetic susceptibility that does interact with environmental factors for the development and progression of hypertension and related end-organ damage. In this regard, studies from African Americans (AA) have reported that young AA adults bearing apolipoprotein L1 (APOL1) gene variants, well-known renal-risk factors in people of African descent, manifested elevated systolic blood pressure (SBP) prior to glomerular filtration rate (GFR) decline and earlier hypertension suggesting that APOL1 variants affect initially vascular cells. Thus, APOL1 genetic testing can identify young individuals of African ancestry with increased BP burden and risk of hypertension related end-organ damage [46]. A recent study by Sumaili *et al.* from the University of Kinshasa Hospital has reported an association between APOL1 gene renal-risk variants and blood pressure among patients with hypertension-related kidney disease [47]. Smoking [48] and overweight/obesity are well-known traditional risk factors sharing insulin resistance, sympathetic nervous (SNS) and renin angiotensin aldosterone (RAAS) systems, oxidative stress and subsequent inflammation and endothelial dysfunction as a common pathogenic pathway for cardiac and vascular damage [48].

The interpretation of the results of this survey should take into account certain limitations. First, the cross-cutting nature of establishing the establishment of any relationship between the outcome and the variables of interest. Two things, the single measure of the variables of interest could have underestimated or overestimated the prevalence of hypertension and associated risk factors. Three factors, other factors usually associated with hypertension such as blood lipids were not measured.

5. Conclusion

The present survey showed that nearly four participants out of ten had hypertension that was associated with older age, family history of hypertension, overweight and obesity as main cardiovascular risk factors. A management strategy based on both therapeutic lifestyle changes (TLC) and pharmacological treatment is needed for those hypertensive participants with increased global cardiovascular risk.

Author's Contribution

All the authors contributed to the realization of this study

Conflict of Interest

The authors declare no conflict of interest.

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