

# Prevalence and determinants of hypertension among students of the University of Kinshasa, Democratic Republic of Congo: a cross-sectional study

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## Abstract

**Background:** The 2017 ACC/AHA Guideline categorized blood pressure into 4 levels: normal (SBP < 120 and DBP < 80 mm Hg), elevated (SBP of 120–129 or DBP < 80 mmHg) and stage 1 (SBP of 130–139 or DBP of 80–89 mm Hg) or 2 (SBP ≥ 140 or DBP ≥ 90 mmHg). Compared with the JNC7 guideline, the 2017 ACC/AHA guideline recommends using lower SBP and DBP levels to define hypertension.

**Objective:** To determine the prevalence of hypertension as well as associated factors among students of the University of Kinshasa.

**Methods:** This was a cross-sectional study conducted at the University of Kinshasa and including 1 281 students aged between 18 and 30. Blood pressure was assessed according to the WHO STEPwise approach, which is a standardized method of data collection, analysis and dissemination for the surveillance of non-communicable diseases in WHO member countries. The Chi-square and Student's t-tests and a multivariate logistic regression analysis have been used to evaluate the results. Statistical analyses were done using IBM SPSS version 21.

**Results:** The prevalence of hypertension according to the guidelines from the 2017 ACC/AHA and the JNC 7 was 26.4 % (CI 95%; 23.9 - 28.9) and 7.3 % (CI 95%; 5.8 - 8.8), respectively. The results of multivariate logistic regression analysis showed that smoking, alcohol abuse, overweight, male sex, age ≥ 24 years old and low physical activity were associated with hypertension ( $p < 0.0001$ ).

**Conclusion:** At least one out of four students had hypertension. These data should encourage public health authorities to develop strategies for screening of BP and to promote the adoption of healthy lifestyle in young adults.

**Keywords:** Hypertension, risk factors, student, prevalence.

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## Introduction

The 2017 American College Cardiology/American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults, categorized hypertensives as individuals with systolic blood pressure (SBP) ≥ 130 mmHg or diastolic blood pressure (DBP) ≥ 80 mmHg<sup>1</sup>. This

guideline updated the Seventh report of the Joint National Committee on Prevention, Detection, Evaluation and treatment on high blood Pressure (JNC7), which was published in 2003<sup>2</sup>. Compared with the JNC7 guideline, the 2017 ACC/AHA guideline recommends using lower SBP and DPB levels to define hypertension.

Hypertension has been designated as a silent killer; it presents a significant disease burden on African population<sup>3,4</sup>. Given its magnitude, its excessive financial burden on populations, its severity and growth on a global scale and particularly in sub-Saharan Africa<sup>3</sup> hypertension is considered a modern epidemic and a major public health problem today.

Hypertension is responsible of around 7.5 million deaths per year worldwide<sup>5,6</sup>, through, mostly, cardiovascular dis-

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eases (CVD), such as coronary heart disease, congestive heart failure, stroke, kidney failure and peripheral arterial disease<sup>5,7</sup>. Hypertension is the leading cause and risk factor of CVD. The mortality from CVD is expected to increase by 120% for women and 137% for men<sup>7</sup>.

Often overlooked, the risk for CVD increases in a log-linear fashion; from SBP levels <115 mm Hg to >180 mm Hg, and from DBP levels <75 mm Hg to >105 mm Hg. A 20 mm Hg higher SBP and 10 mm Hg higher DBP are each associated with a doubling in the risk of death from stroke, heart disease, or other vascular disease<sup>8</sup>.

In persons  $\geq 30$  years of age, higher SBP and DBP are associated with increased risk for CVD, angina, myocardial infarction (MI), heart failure (HF), stroke, peripheral arterial disease, and abdominal aortic aneurysm. SBP has consistently been associated with increased CVD risk after adjustment for, or within strata of SBP; this is not true for DBP<sup>9</sup>.

Hypertension prevalence in the Democratic Republic of Congo (DRC) has been increasing from 14% in 1987 to 27.6% in 2009<sup>10,11</sup>.

Studies estimating the prevalence and the determinants of hypertension among youth in the DRC and sub-Saharan Africa are scarce. Those results are needed for planning and implementing preventive strategies in this region as it is happening in other countries such as the young adult population in the U.S<sup>12,13</sup>.

This study was carried out to assess the prevalence of undiagnosed hypertension among students of the University of Kinshasa according to 2017 ACC/AHA guideline, as compared with JNC7 guideline and to identify their associated factors.

## Methods

### Data collection

In this cross-sectional study conducted at the unit of physiology, data collection was open to all students residing in the campus at the University of Kinshasa who consented to be part of the study. In addition, specially assigned people managed quality control. Before the official investigation, a pre-investigation was conducted to explore the design of the questionnaire. An adapted questionnaire was administered to the participants. This questionnaire was structured around three sections: details on socio-demographic, lifestyle (smoking, alcohol use, physical activity) and clinical variables (anthropometric and blood pressure). The data collectors were final medical students and nurses who were systematically trained.

Trained final medical students completed the questionnaires on socio-demographic parameters, lifestyles and anthropometric measures, while trained nurses focused on blood pressure measurements. To ensure that the data collected were high-quality and representative, standard instruments were used, the certification requirements for data collection were strict, and a quality assurance program was conducted. The sample size was calculated as 1281, using the anticipated prevalence of hypertension in the study population as 15% with 2% relative precision, 95% CI, the total regular students of 23700, and a 5% margin of error. Participants were chosen by door-to-door visits within each of their student residences. The inclusion criteria were: to give informed consent and to be between 18 and 30 years of age. Students who were pregnant and students suffering from a known disease and who were receiving antihypertensive drugs or other medications were excluded from the study.

### Measurement of clinical parameters

The following variables were measured using the WHO STEPS5 requirements adapted to the context of the DRC: weight, height, body mass index (BMI), waist circumference and blood pressure.

Weight was measured using a balance (SECA GmbH Germany Model 7621019009) placed on a stable and level surface and the subject being barefoot and lightly clad.

Height in meters was measured using a portable wall-mounted gauge - subjects were requested to take off their shoes and hats.

The waist circumference was measured along the axillary line at the narrowest part of the abdomen midway between the lower part of the last rib and the upper iliac crest, during exhalation using a new ribbon tape applied to the skin. The measurement was taken only once close to the nearest 0.1 cm.

The BMI was calculated as follows: weight (kg) / (height (m) x height (m)).

BP was measured around 7 am before students have gone to school, using an Omron M6 comfort electronic sphygmomanometer (Tokyo, Japan) with an appropriately sized cuff. Cuff size was standard and covering two-thirds of the upper arm and placed at the height of the heart. Readings were obtained after 5 min of seated rest. Three BP measurements were obtained at 30-s intervals. The mean of the 3 measurements was used to define SBP and DBP<sup>14</sup>. Participants agreed not to smoke or take caffeinated drinks 30 minutes before the measurement.

## Operational definitions

- BP categories in the 2017 ACC/AHA guideline are<sup>1</sup>:
  - Normal BP: It corresponds to a SBP < 120 mmHg and a DBP < 80 mm Hg;
  - Elevated BP: It corresponds to a SBP between 120-129 mmHg and a DBP < 80 mmHg;
  - Hypertension stage 1: This stage is characterized by a SBP between 130-139 mmHg or a DBP between 80-89 mmHg;
  - Hypertension Stage 2: In this class, the SBP ≥140 or the DBP ≥ 90 mm Hg;
- According to JNC7 report, BP has been classified as follows<sup>2</sup>.
  - Normal BP: It corresponds to a SBP <120mmHg and a DBP <80 mmHg;
  - Pre-hypertension: It corresponds to a SBP between 120 - 139 mmHg or a DBP between 80 - 89 mmHg;
  - Hypertension stage 1: This class is characterized by a SBP of 140 - 159 mmHg or a DBP of 90 - 99 mmHg;
  - Hypertension stage 2: In this stage, the SBP ≥ 160 or the DBP ≥ 100 mmHg;
- Pulse pressure (PP): PP is the difference between SBP and DBP;
- Mean arterial pressure (MAP): The MAP is determined as follows:  $DBP + 1/3 (SBP - DBP)$ ;
- For obesity,  $BMI \geq 30 \text{ Kg} / \text{m}^2$ ; for overweight,  $BMI = 25-29.9 \text{ Kg} / \text{m}^2$ ; for normal weight,  $BMI = 18.5-24.9 \text{ Kg} / \text{m}^2$ ; and for thinness:  $BMI < 18.5 \text{ Kg} / \text{m}^2$ <sup>15</sup>.
- Central obesity corresponds to a waist  $\geq 94 \text{ cm}$  in men and  $\geq 80 \text{ cm}$  in women<sup>15</sup>
- Smoker was defined as a person who at the time of study smoked daily or occasionally and non-smoker, a person who did not smoke at all or smoked 1 year before the study.
- Drinker was defined as one who consumed one or more drinks of any type of alcohol at the time of the study or the year before the study and non-drinker, a person who does not consume alcohol.
- The level of physical activity was defined using the WHO STEP wise approach protocol as follows:
  - High: Intense physical activity (PA) at least 3 days a week, entailing higher energy expenditure of at least 1500 MET-minutes / week or at least 7 days walking and moderate or intense PA until a minimum of 3000 MET-minutes per week. MET (Metabolic Equivalent of Task) is a measure of the resting energy expenditure.
  - Moderate: A person achieving at least 20 minutes of intense physical activity per day for 3 days or more per

week or at least 30 minutes of moderate physical activity or walking per day for 5 days or more per week or at least 5 days walking and moderate or intense PA until reaching a minimum of 600 MET-minutes per week.

- Low: A person who does not meet any of the two criteria mentioned above.

## Statistical analysis

Data were analysed using SPSS version 21.0 (Chicago, USA) and MedCalcR. We described our included sample using frequency (% proportion) for sex, age groups, grade of study and mean ( $\pm$  standard deviation) for weight, height, systolic blood pressure, diastolic blood pressure, Pulse pressure, average arterial pressure, METs walk, METs moderate, METs vigorous, METs, Hours of studying and BMI. We categorized BMI into the following groups: 18.5–24.9, 25–29.9, and  $\geq 30 \text{ Kg}/\text{m}^2$ . We also categorized blood pressure to normotensive, elevated BP and hypertension.

We used Chi-square test followed by Z-test for proportions to analyse the relation between hypertension status (normotensive, elevated BP and stage 1 and 2 hypertension,) and sex and BMI category age groups and grade of study. The strength of association was reported as Odds ratio with a 95% confidence interval (CI). Logistic regression analysis was applied to study the independent association of risk factors and reported as adjusted OR with IC 95%. A p value threshold of 0.05 was used.

## Ethical consideration

The protocol was submitted and approved by the national ethics committee. Written informed consent was obtained from the participants after a full explanation of the object and procedure of the study in the traditional language. Those discovered with hypertension during the study were sent to nearby health centers.

## Results

Table 1 presents the general characteristics of subjects. Mean age and body mass index (BMI) of participants were  $23.1 \pm 2.7$  years and  $22.4 \pm 2.7 \text{ kg} / \text{m}^2$ , respectively. Males were older than females ( $23.4 \pm 3.0$  vs  $22.3 \pm 2.2$   $P < 0.05$ ). Men's BMI was higher than that of women ( $22.6 \pm 2.5$  vs  $22.3 \pm 2.8$   $p < 0.05$ ). The following characteristics: height, SBP, DBP, PP, MAP, and time of study were higher in males than females ( $P < 0.0001$ ). METs walk, total METs, METs moderate and METs vigorous were not significantly different between the two sexes.

**Table 1:** General characteristics of the population studied

	Females N = 711	Males N = 570	P value
Age (years)	22.9 ± 2.3	23.4 ± 3.0	P = 0.0008
Weight (Kg)	57.0 ± 7.2	65.3 ± 8.5	P < 0.0001
Height (m)	1.60 ± 0.06	1.70 ± 0.06	P < 0.0001
Body mass index (Kg/m <sup>2</sup> )	22.3 ± 2.2	22.6 ± 2.5	P = 0.0459
Waist circumference (cm)	74.6 ± 9.4	76.2 ± 6.2	P = 0.0005
Systolic BP (mmHg)	112.5 ± 5.0	122.7 ± 12.1	P < 0.0001
Diastolic BP (mmHg)	73.4 ± 6.2	77.0 ± 8.9	P < 0.0001
Pulse pressure (mmHg)	39.1 ± 7.0	45.7 ± 8.6	P < 0.0001
Average arterial pressure (mmHg)	86.4 ± 6.5	92.2 ± 9.2	P < 0.0001
METs walk	653.3 ± 198.3	662.7 ± 271.1	P = 0.0001
METs moderate	715.0 ± 411.3	687.3 ± 411.3	P = 0.8330
METs vigorous	1520.5 ± 826.8	1043.20 ± 956.2	P = 0.2631
METs	735.2 ± 340.6	772.5 ± 449.8	P = 0.0001
Hours of studying (minutes/week)	397.3 ± 35	375.0 ± 54.0	P < 0.0001
Age Groups n(%)			
18 – 23 years	412 (32.2 %)	319 (24.9 %)	P > 0.05*
24 – 30 years	299 (23.3 %)	251 (19.6 %)	
Grade of study n(%)			
1 <sup>st</sup> - 3 <sup>rd</sup> grade	478 (37.3 %)	427 (33.3 %)	P < 0.05**
4 <sup>th</sup> - 7 <sup>th</sup> grade	233 (18.2 %)	143 (11.2 %)	

BP = blood pressure; METs = metabolic equivalents. Include and indication of the kind of results expressed in this table eg Mean ±SEM. \*x<sup>2</sup>=1.54 \*\*x<sup>2</sup>=8.54.

Table 2 shows that the prevalence of hypertension according to the ACC/AHA guideline in the population studied was 26.4% (CI 95%; 23.9 – 28.9). This prevalence was higher among men than women (47.2 % vs.

9.7 %), (p < 0.0001). When age groups were considered, hypertension had higher values in subjects with age ≥ 24 years than those of age ≤ 23 years (35.8% vs. 19.3%), (p < 0.0001).

**Table 2:** Prevalence of hypertension according to the ACC/AHA guideline by sex, age, grade of study and BMI

	Whole group N=1281	Normal BP N=784	Elevated BP N=159	Hypertension N= 338	P value
Sex					P < 0.0001
Females	711 (55.5 %)	603 (84.8 %)	38 (5.5 %)	69 (9.7 %)	
Males	570 (44.5 %)	181 (31.8 %)	120 (21.1 %)	269 (47.2 %)	
Group of age					P < 0.0001
18 – 23 years	731 (57.1 %)	525 (71.8 %)	65 (8.9 %)	141 (19.3 %)	
24 – 30 years	550 (42.7 %)	259 (42.1 %)	94 (17.1 %)	197 (35.8 %)	
Grade of study					P < 0.0001
1 <sup>st</sup> – 3 <sup>rd</sup> grade	905 (70.6 %)	592 (65.4 %)	102 (11.3 %)	211 (23.3 %)	
4 <sup>th</sup> – 7 <sup>th</sup> grade	376 (29.4 %)	192 (51.0 %)	57 (15.2 %)	127 (33.8 %)	
BMI (Kg/m <sup>2</sup> )					P < 0.0001
< 18.5	52 (4.1 %)	42 (80.8 %)	1 (1.9 %)	9 (17.3 %)	
18.5 – 24.9	1042 (81.3 %)	667 (64.0 %)	125 (12.0 %)	250 (24.0 %)	
25 – 29.9	165 (12.9 %)	68 (41.2 %)	31 (18.8 %)	66 (40.0 %)	
≥ 30	22 (1.7 %)	7 (31.8 %)	2 (9.1 %)	13 (59.1 %)	
Total	1281 (100 %)	784 (61.2 %)	159 (12.4 %)	338 (26.4 %)	

BMI = body mass index BP = blood pressure

P-value compares the homogeneity between the variables and the category of blood pressure

Comparison of normal blood pressure to both hypertension and normal blood pressure by sex, age group showed a statistically significant difference ( $p < 0.0001$ ). Student's and Fischer's tests were used to compare those with hypertension vs. elevated BP, normal blood pressure vs. elevated blood pressure and normal blood pressure VAs. hypertension by gender, age group and grade of study and showed a statistically significant difference ( $p < 0.0001$ ). ACC/AHA and JNC7 guideline definitions respectively (table 3). The prevalence of hypertension was higher when defined by the 2017 ACC/AHA guideline com-

pared with the JNC guideline within all sex, age, BMI and grade of study. When hypertension was compared according the 2017ACC/AHA and JNC 7 guidelines definitions between sex, group of age, grade of study and BMI, hypertension was higher in the males (47.2 % vs 9.7 % for 2017 ACC/AHA and 13.0% vs 6.9 for JNC 7), 4<sup>th</sup> – 7<sup>th</sup> grade (33.8 % vs 23.3 % for 2017 ACC/AHA and 11.4% vs 5.6 for JNC 7 ), 24 – 30 years(35.8 % vs 19.3 % for 2017 ACC/AHA and 11.6 % vs 4.1 for JNC 7) and BMI  $\geq 30$ (59.1 % vs 40.0%, 24.0% and 17.3% for 2017 ACC/AHA and 45.5% vs 17.0%, 5.3 % and 1.9% for JNC 7).

**Table 3.** Proportion of students with hypertension according to the 2017 ACC/AHA and the JNC 7 Guidelines

	2017 ACC/AHA Guideline	JNC 2003	Guideline	2017 ACC/AHA Guideline But Not JNC Guideline
Overall	26.4 (23.9 -28.9)	7.3 (5.8 -8.8)		19.1 (17.0 – 21.2)
Sex				
Females	9.7 (7.5 -11.9)	2.8 (1.6 - 4.0)		6.9 (5.5 – 8.3)
Males	47.2 (43.0 - 51.4)	13.0 (10.2 - 15.8)		34.2 (31.6 -36.8)
Grade of study				
1st – 3rd grade	23.3 (20.5 - 26.1)	5.6 ( 4.1 - 7.1)		17.7 (15.6 – 19.8)
4th – 7th grade	33.8 (28.9 - 38.7)	11.4 (8.1 -14.7)		22.4 (20.1 – 24.7)
BMI (Kg/m <sup>2</sup> )				
< 18.5	17.3 (6.9 -28.0)	1.9( 1.7 – 5.5)		15.4 ( 13.4 – 17.4)
18.5 – 24.9	24.0 (21.4 – 26.6)	5.3 (3.9 – 6.7)		18.7 (16.6 – 20.8)
25 – 29.9	40.0 (32.4 – 47.6)	17.0 (11.2 – 22.2)		23.0 (19.7 – 25.3)
$\geq 30$	59.1 (30.1 – 88.2)	45.5 (24.5 -66.5)		13.6 (11.7 -15.5)
Group of age				
18 – 23 years	19.3 (16.4 - 22.2)	4.1 (2.6 - 5.6)		15.2 ( 13.2 – 17.2)
24 – 30 years	35.8 (31.7 -39.9)	11.6 (8.9 – 14.3)		24.2 (21.8 – 26.6)

Values are % of students with hypertension (95 % Confidence interval)

ACC/AHA = American College of Cardiology/American Heart Association

JNC7 = Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and treatment of High Blood Pressure

BMI = Body mass index

A binary logistic regression analysis was performed using SPSS to assess significant determinants of hypertension according to the 2017 ACC/AHA and JNC 7 guideline definitions. The results are shown in table 4 and 5. The risk of hypertension according to the 2017ACC/AHA and JNC 7 guideline definitions was very high in males, overweight; students aged  $\geq 24$  years, 4<sup>th</sup> – 7<sup>th</sup> grade students and students with high physical activity. Smokers and alcohol consumers, low physical activity had a high

risk of having hypertension compared to non-smokers, non-consumers of alcohol and no low physical activity. Therefore for the model fit, the risk factors for hypertension according to the 2017 ACC/AHA guideline were the male sex associated with the age  $\geq 24$  years, smoking, overweight, low physical activity. Smoking associated with overweight, male sex and alcohol intake, low physical activity was shown to model fit as risk factors for high blood pressure according JNC7.

**Table 4:** Logistic regression analysis showing the association between hypertension and socio-demographic and lifestyle risk factors according to the 2017 ACC/AHA guideline

	Crude OR (95 % IC)	Adjusted OR (95 % IC)
Sex		
Females	0.120 (0.089 – 0.162) ***	0.114 (0.082 – 0.154) ***
Males	1	1
Age		
18 – 23	0.428 (0.332 – 0.552) ***	0.529 (0.372 – 0.754) ***
24 – 30	1	1
Grade of study		
1 <sup>st</sup> – 3 <sup>rd</sup> grade	0.596 (0.458 – 0.778) ***	0,676 (0.460 – 0.994)*
4 <sup>th</sup> – 7 <sup>th</sup> grade	1	1
Smoking habit		
No	0.125 (0.074 – 0.212) ***	0.320 (0.180 – 0.571) ***
Yes	1	1
Alcohol consumption		
No	0.290 (0.177 – 0.477) ***	
Yes	1	
Overweight		
No	0.424 (0.307 – 0.584)**	0.377 (0.256 – 0.554) ***
Yes	1	
Physical activity		
No	0.269 (0.125 – 0.289) **	0.178 (0.118 – 0.268)***
Yes	1	

\*p < 0, 05, \*\*p < 0, 01, \*\*\*p < 0,001, binary logistic regression considering the simultaneous effect of all the explanatory variables.

**Table 5:** Logistic regression analysis of the association between hypertension and socio-demographic and lifestyle risk factors according the JNC 7 guideline

	Crude OR (95 % IC)	Adjusted OR (95 % IC)
Sex		
Females	0.194 (0.117 – 0.322) ***	0.286 (0.165 – 0.498) ***
Males	1	1
Age		
18 – 23	0.325 (0.207 – 0.509) **	0.527 (0.320 – 0.870) *
24 – 30	1	1
Smoking habit		
No	0.064 (0.038 – 0.109)***	0.120 (0.064 – 0.225)***
Yes	1	1
Alcohol consumption		
No	0.290 (0.177 – 0.477)**	0.476 (0.259 – 0.877)*
Yes	1	1
Overweight		
No	0.212(0.135 – 0.331)***	0.166 (0.99 – 0.280)
Yes	1	1
Grade of study		
1 <sup>st</sup> – 3 <sup>rd</sup> grade	0.665 (0.516 – 0.858)*	
4 <sup>th</sup> – 7 <sup>th</sup> grade	1	
Overweight		
No	0.212(0.135 – 0.331)***	0.166(0.99 – 0.280)
Yes	1	1
Physical activity		
Low physical activity	0.685 (0.542 – 0.869)*	0.765 (0.632- 0.863)
No low physical activity	1	1

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, binary logistic regression considering the simultaneous effect of all the explanatory variables.

## Discussion

In this cross-sectional study, we found that if we were to apply the most recent threshold for the diagnosis of hypertension, 26.4 % of our university students will be diagnosed with hypertension (i.e., systolic blood pressure > 130 mmHg and diastolic blood pressure > 80 mmHg) compared to 7.3 % using the previous guidelines (i.e., systolic blood pressure > 140 mmHg and diastolic blood pressure > 90 mmHg). Moreover, we found significant gender differences in both systolic blood pressure with mean difference = 10.2 mmHg and diastolic blood pressure with mean difference = 3.6 mmHg, higher in males than in females.

Several studies conducted in academic institutions demonstrated that high blood pressure was a major health problem among students over the age of 18<sup>16-20</sup>. The prevalence of hypertension of 26.4% found in this study according to the 2017 ACC/AHA was higher when compared with the JNC 7 guideline (26.4 % vs 7.3%). We estimate that the 2017 ACC/AHA hypertension guideline will result in a substantial increase in the proportion of students defined as having hypertension in this study. This increase is explained following a difference in the categorization of hypertension. Stage 1 is defined in 2017 ACC/AHA report as a SBP between 130 and 139 mmHg or a DBP between 80 and 89 mmHg whereas a stage 2 hypertension corresponds to stages 1 and 2 in the JNC 7 report. However, non pharmacological therapy on its own is the recommended treatment for the adults with SBP/DBP of 130 to 139/80 to 89 mm Hg. The 2017 ACC/AHA guideline writing committee concluded that there is insufficient evidence to support a recommendation for antihypertensive drug treatment in addition to nonpharmacological therapy for adults with SBP/DBP of 130 to 139/80 to 90 mm Hg and low CVD risk. As a consequence, the new definition results in only a small increase in the percentage of students for whom antihypertensive medication is recommended in conjunction with lifestyle modification.

The present study showed a positive association between sex and hypertension. Indeed the prevalence of hypertension is generally higher in males than in the females<sup>16,20,21</sup>. This information is similar to that reported in several studies showing that the blood pressure of young men is higher than that of young women (age ≤ 30 years)<sup>16,18</sup>. Young men generally have high blood pressure compared

to young women and older men have a generally lower blood pressure compared to elderly women because it is known that menopause and overweight can increase the risk of hypertension<sup>23</sup>. This study also showed that the prevalence of hypertension increased with age, the prevalence of hypertension was low in the age group of 18 to 23 compared to the age group of 24 to 30. Previous studies by other authors confirm these results<sup>23,24</sup>. In addition, it is important to mention that those who are overweight had a high risk of developing hypertension compared to subjects with normal BMI. This was in line with previous reports from countries in sub-Saharan Africa<sup>24</sup>, India<sup>26</sup> and Portugal<sup>18</sup>. In the latter study, 68% of hypertensive patients were overweight. In the present cross-sectional study, the risk factors associated with hypertension were age, sex, physical inactivity, alcohol consumption, smoking habit and BMI. The male sex, age ≥ 24, low physical activity and overweight were the predictors of high blood pressure among students who participated in this study. These results corroborate those found by other authors<sup>23,27</sup>. The new guideline stated that some of the diet-related factors associated with high BP include overweight and obesity, excess intake of sodium, and insufficient intake of potassium, calcium, magnesium, protein (especially from vegetables), fiber, and fish fats. Poor diet, physical inactivity, and excess intake of alcohol, alone or in combination, are the underlying causes of a large proportion of hypertension<sup>28,29</sup>.

The prevalence of 26.4% and 7.3 % of hypertension according to 2017 ACC/AHA and JNC7 guidelines respectively among students aged 18 to 30 at the University of Kinshasa with the associated risk factors should be a wakeup call for the public authorities to implement screening strategies in universities and all segments of the Congolese population in this age group. Public health authorities should develop projects that encourage young adults to modify their lifestyles regarding personal habits (use of alcohol and tobacco), eating habits and physical activity because hypertension among university students is not really taken into consideration and will only be discovered later. Since students seem to be generally healthy, they may not see the need to visit a doctor for a routine checkup. This may explain why hypertension is discovered late among university students. In addition students must reduce sodium intake and increase potassium consumption as recommended by the 2017 guide-

line, because blacks are particularly sensitive to salt<sup>30</sup>. This sensitivity to salt can be a marker of increased risk of CVD and all-cause mortality, regardless of blood pressure<sup>31</sup>. Yet data on the prevalence of hypertension and other chronic non-communicable diseases are needed for planning, prevention and evidence to be used in resource mobilization<sup>12</sup>. Data from the present study draw attention to the importance of blood pressure screening programs among young adults.

### Limitations and strengths

The results should also be interpreted in the context of known and potential limitations. Our study is of a cross-sectional nature, which means that the associations between study variables may not involve causality. Certain variables such as tobacco use, alcohol consumption were measured only in terms of frequency and not quantity. Data on the family history of hypertension were not taken into account. BP was measured at a single visit in this study. The 2017 ACC/AHA and the JNC7 guidelines suggest basing the diagnosis of hypertension on the average of multiple BP measurements obtained at 2 or more visits. Despite these limitations, our sample size was large. The present study suggests that there is great potential for decreasing cardiovascular morbidity or mortality by optimizing modifiable risk factors in this young population.

### Conclusion

In our study, 26.4% and 7.3 % of students of the University of Kinshasa had hypertension according the 2017 ACC/AHA guideline and JNC7 respectively. Overweight, age group 24-30, male, lifestyle (alcohol and tobacco) and low physical activity appeared to significantly influence the presence of hypertension in these young adults. These results provide preliminary data on the high proportion of hypertension and its associated risk factors among students at the University of Kinshasa. These findings indicate that earlier detection and intervention should be carried out as soon as possible within the university setting and among the general public. In order to increase awareness of hypertension and other health-related issues, more promotions can be carried out using electronic media and social media networking.

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### Conflict of interest

None declared.

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