



Body Mass Index, Blood Pressure and Hypertension Subtypes among Untreated Hypertensive Cameroonians

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Authors' contributions

This work was carried out in collaboration between all authors. Author JO conceived, coordinated the study and prepared the manuscript. Author LJM co-designed and worked on the initial draft of the manuscript. Author BGKA carried out anthropometric measurements, analytical work, statistical analyses and prepared the draft of the manuscript. Author RFN carried out anthropometric measurements, analytical work and processed results. Author DK carried out analytical work and statistical analyses. Author ANK carried out analytical work. Author WD carried out analytical work. Author HCMY carried out analytical work. Author MAM carried out analytical work and processed results. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: To study the prevalence of hypertension hemodynamic subtypes, prehypertension, hypertension (HTN) stages 1 and 2 as well as to evaluate the influence of overweight and obesity on those prevalences among untreated hypertensive Cameroonians.

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Study Design: This study was descriptive and cross-sectional.

Place and Duration of the Study: Participants were randomly selected in Yaounde, Nkongsamba and Fouban from January 2009 to October 2012.

Methodology: It involved 7042 Cameroonians of both sexes aged 18-85 years old. Blood pressure categories were defined using the 7th report of Joint National committee on hypertension. Hypertension subtypes were defined as Isolated Systolic Hypertension (ISH) [Systolic Blood Pressure (SBP) \geq 140 mmHg and Diastolic Blood Pressure (DBP) $<$ 90 mm Hg]; Isolated Diastolic Hypertension (IDH) (SBP $<$ 140 and DBP \geq 90); Systodiastolic Hypertension (SDH) (SBP \geq 140 and (DBP) \geq 90). Participants were classified based on their body mass index (BMI) as obese (BMI \geq 30 kg/m²), overweight (25 \leq BMI \leq 29.9) and normal weight (18.5 \leq BMI \leq 24.9).

Results: Close to 1/3 of individuals (2089) were pre-hypertensive (28.03% women vs 31.30% men, $P < .001$). 14.3% participants (14.28 % women and 14.32% men, $P = .05$) already suffering from hypertension stage 2, were diagnosed for the first time. IDH and SDH were the predominant subtypes: IDH (44.23% or 3115 participants), SDH (34.07%) vs ISH (21.7%) and varied with BMI classes. Distribution of frequencies (%) was the following for Normal weight: ISH (30.8%); IDH (41.3%), SDH (27.9%). Overweight: ISH (18.9%); IDH (46.8%), SDH (34.2%). Obese: ISH (15.3%); IDH (44.6%), SDH (40%). Fatness and waist circumference were predictors of IDH and ISH respectively.

Conclusion: Obesity was associated with HTN in all age groups and both sexes. IDH and SDH in Cameroon are not only associated with increasing age, but also are prevalent in most cases of obesity induced HTN. This suggests that there is a need to improve prevention and surveillance measures, tailored towards specific subtypes.

Keywords: Hypertension; hypertension subtypes; BMI; Cameroon; prehypertension; epidemiology.

1. INTRODUCTION

Nutritional and epidemiological transitions resulting from urbanization in emerging and developing countries have brought changes in population lifestyles, causing an increase in morbi-mortality of non-communicable diseases like obesity, hypertension and cardiovascular diseases [1,2]. Hypertension, which is likely the most common disease on Earth, represents the single greatest preventable cause of death in humans [3]. Additional factors like obesity and prehypertension increase the risk of cardiovascular diseases only modestly or when associated [4]. In fact, several studies indicate that obesity is associated with increased arterial stiffness [5] and various hemodynamic changes, that may contribute to hypertension and may not only impact the prevalence, but also the patterns of the disease [5,6]. According to O'Rourke [7], arterial stiffening is the principal cause of increasing systolic pressure with advancing years and in patients with arterial hypertension. It is associated with progressive arterial dilation and is due to degeneration of the arterial wall, probably as a consequence of repetitive cyclic stress. It increases systolic pressure directly by increasing amplitude of the pressure wave generated by a given flow impulse from the heart and indirectly by increasing wave velocity, so that wave reflection from the periphery occurs earlier, augmenting pressure in late systole. Arterial stiffness of the aorta is involved in the classification of different hypertension subtypes. An increase in the stiffness of the aorta and large elastic arteries not accompanied by a rise in arteriolar resistance may lead to isolated systolic hypertension (ISH). In contrast, a predominant rise in arteriolar resistance may lead to combined systodiastolic hypertension (SDH) if large artery stiffness also increases, or to isolated diastolic hypertension (IDH) if arterial stiffness is normal or low [8]. Thus, IDH might

be viewed as a marker of a good elasticity of aorta and large arteries, possibly because of a paucity of atherosclerotic lesions [9,10]. A confounding factor in the assessment of hypertension subtypes is the progressive amplification of the pressure wave during transmission from aorta to peripheral arteries, a phenomenon that is predominant in the young and decreases with aging [11]. Other previous studies indicate that age is a strong determinant of hypertension subtypes, with a marked increase in isolated systolic hypertension and a decrease in diastolic hypertension and systodiastolic hypertension. [12,13]. In fact, elevations of systolic and diastolic blood pressure (BP) reflect distinct pathophysiological mechanisms, have different prognostic implications, and may require a different therapeutic approach [14].

Although multiple studies have documented the association between obesity and HTN, data regarding the relative prevalence of hypertension subtypes in sub-Saharan Africa are not only rare, but also are still needed. Findings from such studies may direct in adoption of new and targeted therapeutic approaches suitable for black African population; given that many treatments in use are developed based on results from American population and several others excluding Africa. Thus, those treatments may not be appropriate for black of African origin living in Africa. In Cameroon, a deep look at the blood pressure and hypertension hemodynamic subtypes would provide clinical differences between the hypertension subtypes, a more precise knowledge of their prevalence and clinical predictors. These may help to define and implement early, specific, and individualized prevention strategies [8]. In this study, we analysed the prevalence of HTN (in all its stages) and pre-HTN across BMI, sex, and age strata in a representative Cameroonian population. We also examined the changes in the frequency of different HTN subtypes: isolated systolic hypertension (ISH), isolated diastolic hypertension (IDH), and systodiastolic hypertension (SDH) according to BMI as well as variations in subtypes according to degrees of severity of obesity.

2. MATERIALS AND METHODS

This study was descriptive, cross-sectional and retrospective. It took place from January 2009 to October 2012. Cameroonian men and women of African origin aged 18-85 years were recruited in the study. Participants were from three cities of different ecological zones: Yaounde (urban zone, Centre region), the capital of the Republic of Cameroon, Nkongsamba (semi urban zone in the Littoral region) and Foumban (semi urban zone in the West region). They were recruited mostly among middle grade civil servants, students, jobless and middle income earners from the private and public sector. Participants were recruited during mass health campaign and nutritional surveys organized at the Laboratory of nutrition of the University of Yaounde I, Public school of Nkongsamba district, and Bafole district hospital in Foumban. The principal eligibility criteria for study participation included age between 18-85 years old and no evidence of pregnancy.

2.1 Anthropometric Measurements

Under assistance of well-trained and qualified technicians, participants filled out a questionnaire conceived from "WHO steps instrument for chronic diseases" related to their lifestyle (cigarette, alcohol, etc.). The following parameters: age, gender, weight, height, blood pressure, body fat, waist circumference were measured on the first and only visit. The Tanita™ BC-418 Segmental Body Composition Analyzer/Scale that uses bioelectrical impedance analysis for body composition analysis was used. Participants (12-hour fasted) were encouraged to wear light clothing before measurements were taken. Height was

measured with a Harpended™ stadiometer to the nearest 0.5 cm. Body Mass Index (BMI) derived from weight and height measurements was expressed as weight/height in kg/m². Waist and hip measures were obtained with a soft non-stretchable plastic tape to the nearest 0.5 cm. Waist circumference was measured on the narrowest and the widest part of the trunk; hip circumference was obtained at the widest point of the hip [15].

2.2 Definitions and Blood Pressure Measurements

Given that medications may have differing effects on systolic versus diastolic blood pressure, investigation of the different HTN subtypes (ISH, SDH, IDH) included only newly diagnosed participants and who therefore were not receiving antihypertensive medications at the time of the survey. Persons with incomplete data and evidence of diabetes were also excluded given the association between the two diseases [16]. On that basis, overall, 7042 untreated participants (4105 women and 2937 men) were included in the study. Blood pressure (BP) was measured with a checked electronic sphygmomanometer (Omron). Blood pressure records were made three times on the upper right arm. The first measurement was taken after a 5 min rest in a sitting position and was followed by two subsequent measurements in the middle and at the end of the interview. The average of the three measurements was used to assess the presence or absence of hypertension. Pre-HTN and HTN were defined according to the seventh report of the Joint National Committee for the diagnosis, evaluation and treatment of high blood pressure (JNC-7) Prehypertension corresponds to SBP between 120-139 mmHg or DBP between 80-89 mmHg according to Chobanian et al. [17]. Isolated systolic HTN was defined as systolic blood pressure of 140 mmHg or higher and diastolic blood pressure lower than 90 mmHg. Isolated diastolic HTN was defined as systolic blood pressure lower than 140 mmHg and diastolic blood pressure of 90 mmHg or higher. Systodiastolic HTN was defined as systolic blood pressure of 140 mmHg or higher and a diastolic blood pressure of 90 mmHg or higher [18]. Also, participants were classified as obese if they had a body mass index (BMI) ≥ 30 kg/m², overweight for $25 \leq \text{BMI} \leq 29.9$ kg/m² and normal weight for $19 \leq \text{BMI} \leq 24.9$.

2.3 Statistical Analysis

To account for the clustering and stratification of the survey design, and to adjust for non-response, the data were weighted as much as possible to match the age distribution of the 2005 Cameroon population Census data. The weighting factor was based on the probability of selection in each cluster. Therefore, prevalence was related to the total 2005 Cameroon population census aged ≥ 18 years. All data analyses were conducted by use of Statistical Package for Social Sciences (SPSS 17) for Windows. Main analysis included descriptive statistics using cross tabulations and correlation of Pearson. Continuous variables were presented as mean values and standard deviation. Categorical variables were presented as frequencies. The prevalence estimates of hypertension subtypes were calculated by age, gender and hypertension subtype-specific proportions. A chi square test was used to examine gender and hypertension subtypes differences. For all comparisons, *P*-values $< .05$ were considered statistically significant. Univariate and multivariate logistic regression analyses were done to assess the influence of confounding variables on the incidence of hypertension and the relative risk to develop hypertension and its different subtypes.

3. RESULTS

3.1 Baseline Characteristics of the Study Population

Participants of this study were relatively young; (33.38 ± 11.77) and (34.51 ± 11.02) years old for men and women respectively. Although both men and women have similar body mass indices, waist circumference, body fatness was however higher in women compared to men. Cigarette and alcohol consumption were higher among men than women (Table 1).

Table 1. General characteristics of the study population

Parameters	Men	Women	P values
Sample size (%)	2937 (41.7)	4105 (58.3)	< .001
Age (years)	33.38 ± 11.77	34.51 ± 11.02	.02
Body Mass Index (kg/m^2)	26.83 ± 6.09	28.95 ± 6.29	.03
Body fatness (%)	26.83 ± 10.11	35.33 ± 9.26	< .001
Systolic Blood Pressure (mm Hg)	128.03 ± 19.77	125.93 ± 19.77	.04
Diastolic Blood Pressure (mm Hg)	83.07 ± 15.05	82.45 ± 15.05	> .05
Heart rate (beats/min)	73.57 ± 12.71	75.66 ± 12.47	.04
Waist circumference (cm)	88.79 ± 13.63	89.67 ± 15.48	.04
Drinkers (%)	546 (18.7)	415 (10.1)	< .001
Smokers (%)	776 (26.4)	387 (9.5)	< .001

Results are expressed as mean \pm standard deviation

3.2 Prevalence of Hypertension and Prehypertension: Influence of Sex and BMI in Age Strata

Prevalence of hypertension was highly influenced by body weight, age and sex in the study population. In men, prevalence of hypertension increases with BMI in younger adults (< 35 years). In medium and elder age men (35 – 85 years), it increases more in obese than in normal weight and overweight individuals. Prevalence of prehypertension was very high among normal weight and overweight men of 35-54 years. But with increasing age, prehypertension reduces leading to an increase in the frequency of hypertension stages 1 and 2 in obese above 55 years. Furthermore, in obese, age is responsible of 2.1% increase of the prevalence of hypertension in men from younger to older men. In normal weight men, age is responsible of 13.3% increase of the prevalence of hypertension from younger to older. Prehypertension is very common among older normal weight men (> 55 years) than overweight and obese men. Although newly diagnosed, more than 15.2% were already at hypertension stage 2. This was observed in all categories of BMI and ages (Fig. 1). Among men the overall prevalence was 35.60%. It was distributed in age strata as follows: 26.27%, 36.14%, 44.4% respectively for men under 35 years, between 35-54 years and above 55 ($P = .009$).

In women, prevalence of hypertension not only increases with BMI but also with age. The same profile was observed in hypertension stages 1 and 2. The highest proportion of hypertension stage 2 was observed in elder obese (> 55 years) and was two times higher than in younger obese (35-54 years) respectively 34.7% vs 17.3% ($P = .008$). Prehypertension increases with BMI in younger 18-34 years as well as in medium age 35-54. In elder (> 54 years), prehypertension is more common, in normal weight individuals compared to overweight and obese (Fig. 2).

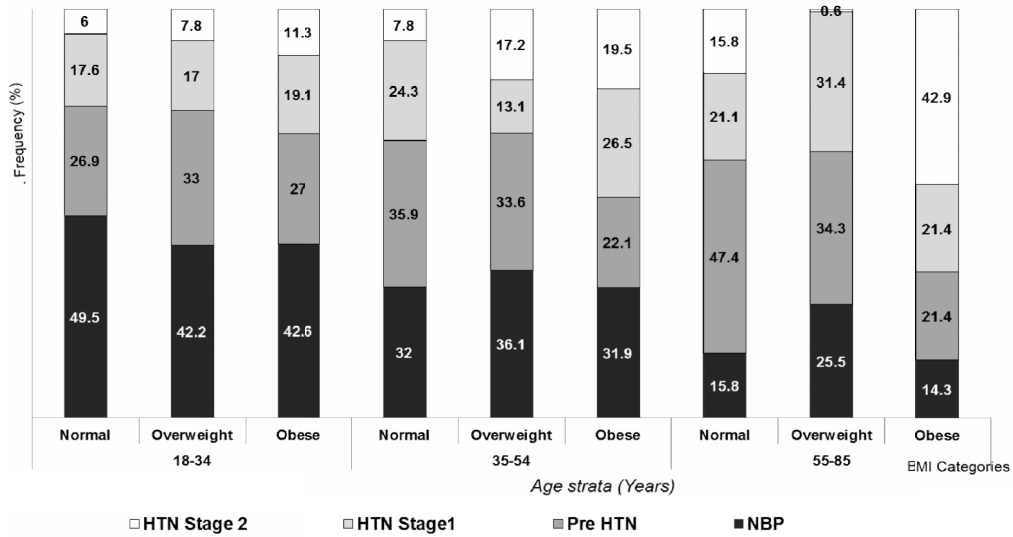


Fig. 1. Influence of the body mass index on the frequencies in blood pressure categories and hypertension of men

Frequency distribution in Blood Pressure categories, proportion of hypertension stages 1 and 2, prehypertension among men in predefined age groups. Proportions are expressed as percentage (%) and represented within the corresponding bars. HTN: hypertension, PreHTN: Prehypertension, NBP: normal Blood Pressure

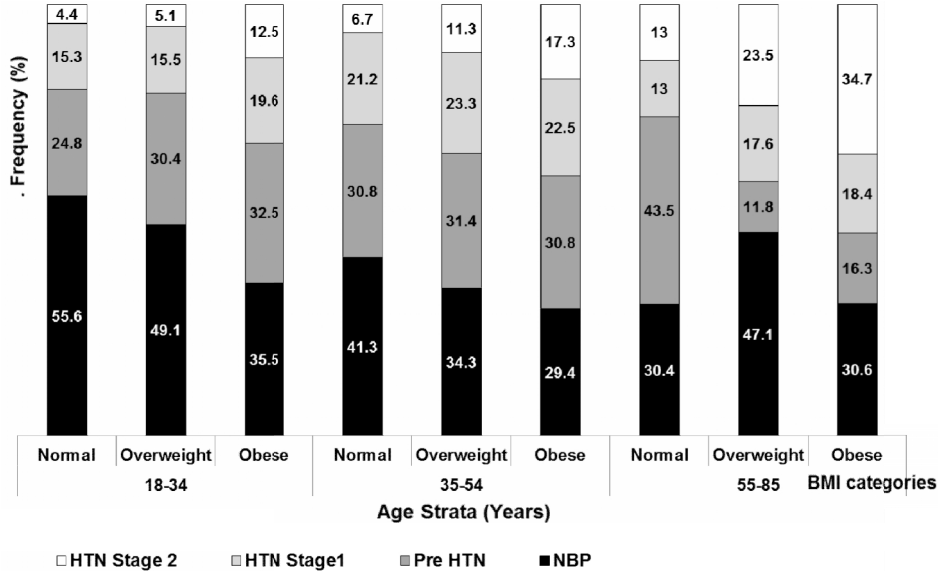


Fig. 2. Influence of the body mass index on the frequencies in blood pressure categories and hypertension of women

Frequency distribution in Blood Pressure categories, proportion of hypertension stages 1 and 2, prehypertension among men in predefined age groups. Proportions are expressed as percentage (%) and represented within the corresponding bars. HTN: hypertension, PreHTN: Prehypertension, NBP: Normal Blood Pressure

In women, age 18-34 and 35-54, the proportion of normal blood pressure decrease with BMI. But, among elder > 55 years, proportion of normal blood pressure patients is higher among overweight than obese and normal weight persons. Among women the overall prevalence was 32.77%. In each age stratum, proportions of hypertension were 24.1%, 34.1%, 40.06% respectively for women under 35 years, between 35-54 years and above 55. No matter the sex and age categories, not only obesity was strongly associated to hypertension stage 2 in this population but also, up to 29.67% (2089) were prehypertensive in proportions of 28.03% women vs 31.30% men, $P = .048$. Furthermore, 14.3% participants (14.28 % women and 14.32% men, $P = .05$) were suffering from hypertension stage 2 and were diagnosed for the first time, thus still naïve of treatment (Figs. 1 and 2).

3.3 BMI, Age and Risk Estimates of Hypertension

Increasing BMI was associated with a significant increased risk of HTN in general population. The odd ratio (OR) for HTN for each unit increase in BMI was 1.049 (95% CI, 1.028-1.053) ($P < .001$). However, the magnitude of the relative increase in the risk of HTN varied with body mass index according to sex.

In men The OR for HTN for each unit increase in BMI was 1.022 (95% CI, 1.000-1.042) ($P < .001$), compared to women 1.056 (95% CI, 1.040-1.073) ($P < .001$). The relative risk for hypertension also varied with body mass index according to age strata. And although not significant among the older > 55 years 1.039 (95% CI, 0.996-1.084) ($P = 0.07$), it was however lower among individuals aged 35-54 years, 1.037(1.018- 1.058) ($P < .001$) and 15-34 years 1.025 (95% IC 1.006 – 1.045).

3.4 Distribution of Hypertension Hemodynamic Subtypes

In the population, Isolated Diastolic Hypertension is more prevalent (44.23%), followed by the Systodiastolic (34.07%, $P = .009$) and Isolated systolic hypertension (21.7%). BMI strongly influences frequencies of subtypes. In fact, BMI was associated to a decrease in ISH and to an increase in SDH proportions. There was about 16% decrease of ISH proportion from Normal weight (33%) to overweight (17.2%) women and up to 20% increase on IDH proportions. Sex difference also contributed to 14.8% increase in IDH proportion for normal weight men (47.8%) than normal weight women (33%) and about 13.5% increase in overweight women (53%) than in overweight men (39.5%). Amongst overweight and obese, SDH was more prevalent in men while IDH was more prevalent in women. ISH was more common in normal weight men compared to normal weight women. Amongst overweight patients, proportion of SDH men was greater than in women (29.8% vs 39.5% respectively, $P = .008$) (Fig. 3).

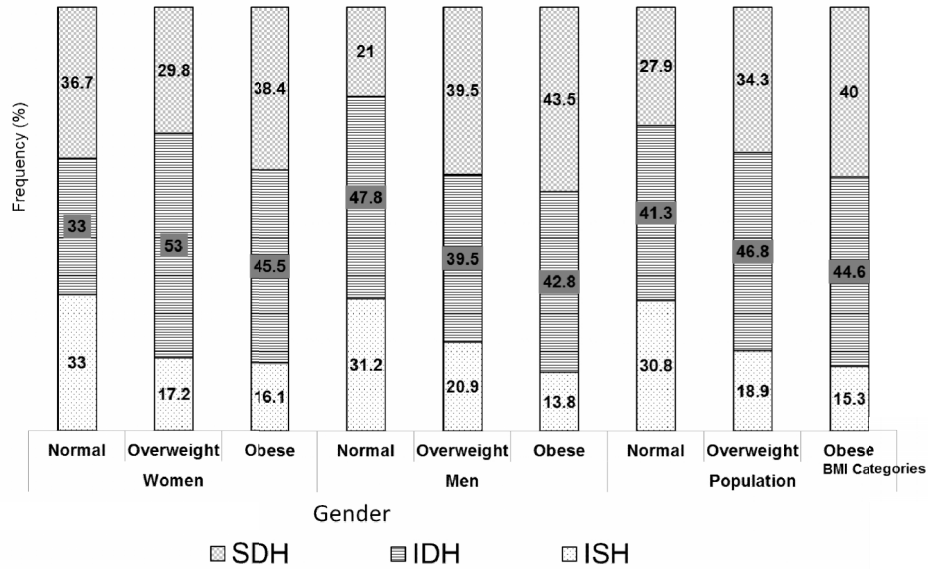


Fig. 3. Influence of BMI and sex on the frequencies of hypertension subtypes
 ISH: Isolated Systolic Hypertension. IDH: Isolated Diastolic Hypertension. SDH: Systodiastolic Hypertension (SDH) in predefined BMI strata among men and women with untreated Hypertension. BMI indicates body mass index (calculated as weight in kilograms divided by height in meters square). Proportions expressed as (%) are represented in corresponding bars.

3.5 Implication of the Severity of Obesity on Hypertension Subtypes

With increasing degree of obesity from obesity class 1 to obesity class 3 (morbid obesity), IDH and SDH were still more common than ISH in the population (Fig. 4). In obese class 3 (morbid obesity), proportion of isolated systolic hypertension was greater than in obesity to class 1 and class 2.

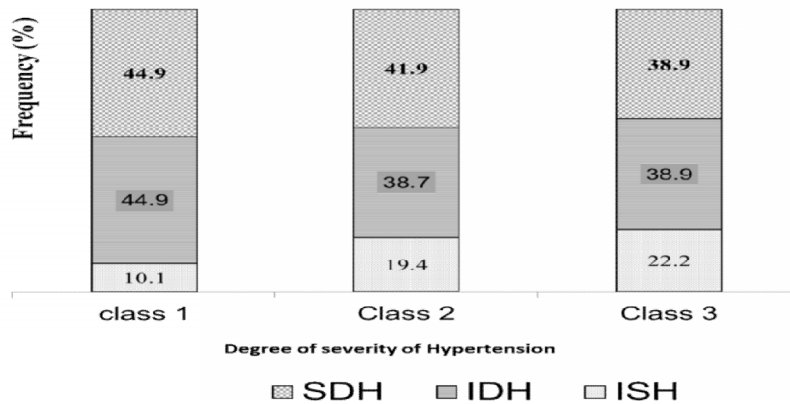


Fig. 4. Influence of the degree of severity of obesity on hypertension subtypes
 ISH: Isolated Systolic Hypertension; IDH: Isolated Diastolic Hypertension; SDH: systodiastolic hypertension. BMI indicates body mass index (calculated as weight in kilograms divided by height in meter square). it is used to define degrees of obesity. Proportions expressed as (%) are represented in corresponding bars.

3.6 Prediction Factors of Hypertension Subtypes in Untreated Hypertensive Patients

Following the assessment of the anthropometric parameters involved in the development of hypertension, Univariate logistic regression analyses revealed that waist circumference was associated to ISH and SDH. Body fat and BMI were associated to IDH and SDH. But, age was the main prediction factor in all hypertension subtypes (ISH, IDH, SDH) and even remained as the only variable influencing the model in multivariate analyses, despite Body mass index, body fatness and waist circumference interactions in all hypertension subtypes (Table 2).

Table 2. Independent predictors of hypertension subtypes

Variables	IDH (CI 95%)	ISH (CI 95%)	SDH (IC 95 %)
Body mass index (Kg/m²)	1.039 (1.022–1.056)*	1.008 (0.985–1.031)	1.060 (1.041–1.079)*
Body fat (%)	1.026 (1.016–1.036)*	0.992 (0.979–1.006)	1.020 (1.010–1.031)*
Waist circumference (cm)	1.006 (0.997–1.025)	1.019 (1.040–1.066)*	1.024 (1.015–1.032)*
Age (years)	1.022 (1.012–1.033)**	1.053 (1.040–1.066)**	1.074 (1.062–1.085)**

* $P < .1$; ** $P < .05$. Results are expressed as odd ratio (95% confidence Interval). Isolated Systolic Hypertension (ISH), Isolated Diastolic Hypertension (IDH), Systodiastolic hypertension (SDH)

4. DISCUSSION

Hypertension is a global health concern. One billion people worldwide have hypertension [19] and sixty five million inhabitants in the United States alone require treatment for their hypertension [20]. In developing countries, almost three-quarters of people live with hypertension (639 million people) [21]. In fact, in sub-saharan Africa in general and in Cameroon in particular, besides infectious and poverty related diseases which continue to decimate populations, hypertension is also a public health problem of great interest. However, the scarcity of available data both clinical and epidemiological on the disease limits the capacity of the government to adopt strategies/ policies for better prevention, awareness and treatment. This is why this study presents a broad picture of Hypertension from untreated patients in both urban and semi urban areas. This is from the best of our knowledge the first report on hypertension subtypes in Cameroon. One of the main findings of this study is the high frequency of IDH (44.23%) and SDH (34.07%, $P < .001$) in the population compared to ISH (21.7%). This is in contradiction with results obtained from both the Third National Health and Nutrition Examination Survey (NHANES III) and NHANES 1999-2004, where ISH was the predominant untreated hypertension subtype; independently of age, sex and BMI strata [8]. This result is also in contradiction with those obtained in China with adults of Tongshan County with high prevalence of ISH [22]. Although lifestyles of the above mentioned populations are different from that of our study population, the difference in phenotypes has however to be raised. The prevalence of hypertension subtypes was also highly influenced by sex and BMI, leading to increasing proportions of IDH and SDH detrimental to reduction in proportion of ISH. In fact, among overweight and obese, SDH is more prevalent in men while IDH is more prevalent among women (29.8% vs 39.5% respectively, $P < .001$). However, ISH is more common in normal weight men compared to normal weight women (Fig. 3). This is the confirmation of existence of gender differences in the pathogenesis and/or mediators of obesity-related HTN. Such differences

have been supported by experimental models and observational studies in humans [23]. The IDH and SDH subtypes, more prevalent in Cameroon should require more attention. In fact, several studies including those carried out by Murphy et al. [24] showed that ISH is the number one attributable risk factor for death throughout the world. It is also responsible for more than 60% of cardiovascular diseases and 50% of ischemic heart diseases in America and around the world. In Cameroon, despite that there is no existing study on the implication of the hypertension subtypes on the development of metabolic and cardiovascular diseases. Our results may suggest a different approach in the treatment and management of the disease in Cameroon. However, studies in Asia pacific region on prehypertension and all hypertension subtypes, including IDH, clearly predicted increased risks of coronary heart disease, ischemic stroke, and hemorrhagic stroke [25] and have also through its high frequency, demonstrated evidence of SDH in the metabolic syndrome in rural Chinese [26]. The contribution of obesity in the outcome of hypertension in Cameroon has earlier been documented [27,28]. In this study, even with the complications and degrees of obesity, sex-stratified analyses showed that most obese (men and women) with HTN showed high IDH and SDH frequencies. This result is in accordance with Chirinos et al. [8], where phenotypes other than ISH were observed only among morbid obese men (class 3). In Cameroon, as shown in Fig. 4, ISH represented only a small minority of cases of HTN in morbidly obese subjects, although proportions of ISH among obese increase two times from class1 (10.1%) to 22.2% class 3 (morbid obese). HSD and IDH are still common among all obese participants of the present study (Fig. 4). To better understand factors influencing hypertension subtypes in this population, the univariate analysis conducted (Table 2) revealed that an increase in a unit of waist circumference increases the risk to develop ISH Odd Ratio (OR): 1.019 (95% CI 1.040 – 1.066) and SDH 1.024 (1.015 – 1.032). BMI are associated to IDH 1.039 (1.022 – 1.056) and SDH 1.060 (1.041 – 1.079). Body fatness and BMI are associated to IDH 1.026 (1.016 – 1.036) and SDH 1.020 (1.010 – 1.031). This may explain association of IDH subtype with the greatest likelihood of metabolic syndrome [29]. Managing how to reduce one or two of those factors, would significantly impact on the reduction of a specific subtype of hypertension.

Population lifestyles are constantly changing both in semi urban and urban areas [1],[2] . This can explain why in this study the prevalence of High blood pressure is in net increase (36.1%). It varies from 28%, 36.14%, to 44.2% respectively among men from age less than 35, 35-54 years, to above 55 years. Among women, the overall prevalence of hypertension was 32.6% with proportions distributed as follows: 28.26%, 34.1%, and 35.63% respectively for age less than 35 years, 35-54 years and above 55 years. This result is in accordance with the findings of Cutler et al. [30]. They showed from NHANES study that in all age and racial groups between 1999 and 2004, men regardless race and ethnicity had a higher prevalence of hypertension than women in the 18-39 age group. Between the ages of 50-69, the prevalence of hypertension remained greater in men than women black population. A greater understanding of sex differences in the physiology and pathophysiology of blood pressure control and hypertension subtypes could yield treatments that are better tailored to the individuals [31], and could lead to the development of novel and improved antihypertensive therapeutics for specific populations.

Prevention, awareness and treatment measures of hypertension are really needed in Cameroon for better management of metabolic and non-communicable diseases as it is the case in most of low-income countries; where primary health-care systems have not adapted to cope with these new challenges [2]. The emphasis should be done on the surveillance of prehypertension. Indeed, this study revealed that the prevalence of prehypertension is also very high. 29.3% among women under 35 years and among both normal weight men

(47.4%) and women (43.5%) above 55 years (Fig. 1). According to Chobanian *et al.*, [8], the subjects with prehypertension are not necessarily candidates for drug therapy; rather, they should be rechecked in one year and are firmly advised to practice effective lifestyle modification [32]. Once more, the body weight control request attention not only for hypertension, but also for other diseases like breast cancer mainly in women [33]. Looking at the daily activities carried out by the participants of the study, sedentarity seems not to really be the first factor involved in the increasing prevalence. In fact, despite the relative professional occupation of participants, the energy expenditure seems to be very low. Their food consumption, more in quantity than in quality (street food) might be a good contributor to the increasing weight [28]. Many people eat at any moment, most often what they see available and affordable in cost, but not what they desired. Another evidence of poor management of hypertension in Cameroon remarkably, is the proportion of participants already suffering from hypertension stage 2 with no evidence of treatment or not aware of their status. This is the case with up to 23.73% among women above 55 years and 19.02% among men under 55 years (Figs. 1 and 2). Solution to tackle the problem of hypertension and its subtypes in Cameroon are urgently needed to improve its surveillance, control and management. Among them Mohsen *et al.*[2], suggest that developing countries need a simple algorithm for screening, treatment, and follow-up; a reliable drug supply; free or subsidized drugs (when possible), health education about blood pressure and cardiovascular diseases; community programmes; improved health record systems (electronic records); a cost-effective drug distribution system; health information systems (eg, mortality surveillance); and targets for and monitoring of the effect of intervention programmes.

5. CONCLUSION

Obesity was associated with HTN in all age groups and in both sexes. IDH and SDH are the main HTN subtypes in Cameroon. They are not only associated with increasing age, but also IDH and SDH are prevalent in most cases of obesity induced HTN. Therefore, there is a considerable prevalence of hypertension of various subtypes, each associated with distinctive risk factors. This suggests that there is a need for testing more diverse prevention measures, tailored towards specific subtypes and to particular age groups.

ETHICAL APPROVAL AND CONSIDERATION

This protocol was approved by the National Ethics Committee. All participants provided written and signed informed consent prior to participation to the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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