# PUBLIC HEALTH
Open Journal

*Openventio*
PUBLISHERS

## *Original Research*

# Epidemiological Profile of Hypertension, and Its Determinants Amongst Adult Patients in Cameroon: A Hospital-Based Study

Christine Fernande Nyangono Biyegue, PhD[1,2]*; Pierre Mintom Medjo, MD, PhD[3]; William Dakam, PhD[4];
Marthe Edwige Banini, MSc[1,2]; Yvette Noume, MSc[1,2]; Marie Modestine Kana Sop, PhD[5]

[1]Higher Teacher's Training School for Technical Education, University of Douala, Douala 1872, Cameroon
[2]Laboratory of Nutrition and Nutritional Biochemistry, University of Yaounde I, Yaounde 812, Cameroon
[3]Deido District Hospital, Douala 8037, Cameroon
[4]Faculty of Medicine and Pharmaceutical Sciences, University of Douala, , Douala 2701, Cameroon
[5]Faculty of Science, University of Douala, Douala 24157, Cameroon

*Corresponding author
**Christine Fernande Nyangono Biyegue, PhD**
Higher Teacher's Training School for Technical Education, University of Douala, Douala 1872, Cameroon; E-mail: spfernande@yahoo.fr

▌ ABSTRACT ▐

**Background:** Hypertension (HTN) is the major risk factor of cardiovascular diseases. Despite the increasing trends suggesting that HTN is a growing public health problem in developing countries; studies on its prevalence, associated risk factors, and extent of blood pressure control have been mostly done in communities in these countries. In Cameroon, there exists few data on the prevalence of hypertension in hospital area.

**Aim of the study:** To determine the prevalence of hypertension and identifying the cardiometabolic risk factors associated with HTN of the patients attending to Deido District Hospital.

**Methodology**: Descriptive and cross sectional survey was carried out at the Deido District Hospital. For this, 805 cameroonians male and female aged 20 years above were recruited on their arrival at the hospital. After filling a questionnaire related to their lifestyle (cigarette, food consumption frequency, practice of physical activity), the following parameters were recorded: age, gender, weight, height and glycemia. HTN was defined according to 2017 American College of Cardiology and the American Heart Association (ACC/AHA) guidelines. Hyperglycemia was diagnosed with Intermediate distribution frame (IDF) criteria. Body mass index was calculated and physical activity was defined according to World Health Organization (WHO) recommendations.

**Results:** The prevalence of hypertension was 28.4%. Concerning subtypes of HTN, the prevalence of subdural hematoma (SDH) was 27.1%, that of ISH was 15.7% and that of intradialytic hypotension (IDH) was 17.8%. Women were more affected than men (63.8% *vs* 36.2%). The prevalence of hyperglycemia was 16.2%, obesity was 40.2% and overweight was 30.6%. Adults aged 40-59, 60-79 and 80 and above were 1.99, 4.21 and 4.71 times more exposed to HTN (OR=1.99; *p*=0.002), (OR=4.21; *p*=0.000) and (OR=4.71; *p*=0.014). Concerning marital status, individuals "Divorced", "widowed" and "married" individuals were more exposed (OR=5.40; *p*=0.006), (OR=2.17; *p*=0.000) and (OR=2.10; *p*=0.006). Monthly Wages influences the onset of HTN. Individuals having high (OR= 4.40; *p*=0.000), middle (OR=2.92; *p*=0.000) and minimum (OR=2.08; *p*=0.015) monthly wages were more exposed to HTN than none. Concerning educational level, it appears that those with University education were 3.32 times exposed to HTN following by those with secondary education (OR=2.98; *p*=0.004) and primary education (OR=2.49; *p*=0.010). In the case of physical activity, those who don't practice physical activity were 0.24 times exposed than others (OR=0.24; *p*=0.050).

**Conclusion:** Around one-third of the subjects were hypertensive. Age, sedentarity (physical inactivity), monthly wages, marital status and education level were cardiometabolic risk factors associated to hypertension.

**Keywords**
Hypertension; Cardiometabolic risk factors; Deido District Hospital.

## INTRODUCTION

The Non communicable diseases (NCD) represent today a serious burden in the world and constitute one of the major development challenges for the development. These diseases are driven by forces that include rapid unplanned urbanization, globalization of unhealthy lifestyles and population ageing. Unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, elevated blood lipids and obesity.[1] However, all the ages are affected by NCD and more than 90% of the premature deaths due to the NCD occur in the poor countries.

Hypertension (HTN) is a major risk factor of cardiovascular and cerebrovascular diseases and is associated with a high degree of morbidity and mortality.[2] Hypertension accounts for approximately 1 million deaths amongst the 1 billion adults living with HTN worldwide.[3] Sub-Saharan Africa (SSA) bears a great burden of HTN, which is the leading cause of heart failure,[4] and stroke[5] and accounts for over 80% of all cardiovascular disease-related deaths.[6]

It is considered that the ageing of the population and the fast urbanization largely contribute to increase prevalence of hypertension in the urban areas. Nearly 30% of the adults of the area never control their blood pressure. Among the diagnosed people, 35% do not receive essential treatment.[7] In Cameroon, prevalence of HTN is reported to vary from 31.1% in rural milieu,[8] 32.2% in semi-urban[9] to 47.5% in urban milieu[10] with a national average of 31.0%.6 Moreover, many studies of HTN have been mainly done in communities in southern and northern regions of the country. Few studies have been done in hospital milieu. Referenced hospital based assessment have been carried out in Northern region (Ngaoundere or Maroua) and some of the results of these studies were based on retrospective datas.[11-13]

The present study aimed at determining the prevalence of hypertension and identifying the cardiometabolic risk factors associated with HTN of patients attending to Deido District Hospital.

## METHODOLOGY

Descriptive and cross sectional survey was carried out at the Deido District Hospital. Deido District Hospital is a public hospital with several specialties. For this, all cameroonians men and women aged 20 years above coming to the hospital for any health complaint or check-up were recruited on their arrival. The study proceeded between August 2015 and February 2016. At the end of this study, 805 patients have been recruited.

For this, participants gave a written informed consent prior to participation. Data were collected through predesigned questionnaire adapted from WHO STEP wise approach to surveillance (STEPS). An interviewer-administered face-to-face questionnaire was used to obtain participants demographic informations (tobacco, food consumption frequency, practice of physical activity), the following parameters were recorded: age, gender, weight, height, blood pressure, glycemia. Body mass index (BMI) was derived from weight and height measurements. Height was measured to the nearest 0.5 cm, weight to the nearest 0.5 kg, and the BMI was calculated (weight/height$^2$ (kg/m$^2$)).

Participants were classified as obese if they had a body mass index (BMI)≥30 kg/m$^2$, overweight for 25≤BMI≤29.9 kg/m$^2$ and normal weight for 18.5≤BMI≤ 24.9 kg/m$^2$ [47].

Measurement of blood pressure was done using Blood Pressure Monitor (OMRON HEM 7124) based on oscillometric measurement method with Fuzzylogic technique. Blood pressure records were made three times on the upper left 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 according to the 2017 American College of Cardiology/American Heart Association (ACC/AHA) guidelines (SBP≥130 mmHg, or DBP≥80 mmHg) as referred to Islam JY.[14] A participant was considered to have isolated systolic hypertension (ISH) for a SBP≥130 mmHg and DBP<80 mmHg; isolated diastolic hypertension (IDH) for a SBP<130 mmHg and DBP≥80 mmHg and the systo-diastolic hypertension (SDH) with a SBP≥130 mmHg and DBP≥80 mmHg.

Among 805 subjects, only 500 subjects have done their inform consent for blood intake to measure fasting blood glucose. To perform this, the fingertips of the patients were disinfected using ethanol (90%). With a sterile needle, a gently pressure was applied to the pricked finger and a drop of blood was collected for the determination of blood glucose concentration. For this purpose a glucometer (ONE TOUCH ULTRA 2) was used according to glucose oxidase method described by Trinder P.[15] Hyperglycemia was defined as fasting blood glucose>5.6 mmol/l for subjects without prior diagnosis of diabetes.[16]

Physical activity was defined according to World Health Organizaion (WHO) recommendations. Physical activity of each participant was defined on the basis of activities of work, transportation and leisure.

The smoking and alcohol intake constitute a cardiometabolic risk factor. Thus all those who consumed alcohol at least twice a week were considered drunker while all those who areed to consume tobacco regularly were considered smoker.

The age is a cardiometabolic risk factor independently of other factors.[17] In this study, age was represented in sections of 20-39 years, 40-59 years, 60-79 years, 80 years and more.

The gender constitutes a cardiometabolic risk factor[18]; in this study both genders were explored.

Monthly wage is defined by the decree N° 2014/2217/PM of 24 July 2014 to revalue the guaranteed minimum inter-

professional wage. This decree sets the minimum wage at 36,270 FCFA (73 US dollars). In our survey the minimum wage was set at 40,000 FCFA (80 US dollars), middle wage: 40,000 (80 US dollars)-100,000 FCFA (200 US dollars) and high wage: >100,000 FCFA (200 US dollars). Marital status and smoking have been also evaluated

### Statistical Analysis

Data analysis was performed using the statistical package for IBM SPSS Statistics version 22.0. Main analysis included descriptive statistics. Incidence of hypertension and cardiometabolic risk factors was expressed as the proportion of hypertensive in all study participants. Qualitative variables were reported as frequencies or proportions, while quantitative variables were reported as mean±standard error mean (SEM). Quantitative variables were compared using the Student $t$ test. Identification of cardiometabolic risk factors of our study population was done using binary logistic regressions (performed using STATA version 14.0) which evaluate the relative risk of HTN with statistical significance at $p<0.05$.

### Ethical Approval

One month preceding the survey, the communities and their leaders were informed by the study investigators about the goals, the importance and the benefits of the study. Participation in the study was voluntary. All the study participants provided written informed before inclusion in the survey. The study protocol was approved by the Deido District Hospital (Registry number N°959/ AV/MINSANTE/DRSPL/SSDD/HDD).

### RESULTS

### Characteristics of Population Study

In this study, 805 participants were aged 20-91 years, and BMI values range 15.63 to 63.29 kg/m²; 554 individuals (68.8%) were females and 251 males (31.2%); with SBP range between 88 and 236 mmHg and DBP between 36 and 153 mmHg and glycemia between 39 and 595 mg/dl.

The proportion of women is higher than that of men. Moreover, the most represented age groups are those of 20-39 years and 40-59 years (Table 1).

**Table 1.** *Distribution of Gender and Age in General Population*

| Gender Age | Men n (%) | Women n (%) | Total n (%) |
|---|---|---|---|
| 20 – 39 | 98 (31.8) | 211 (69.2) | 309 (100.0) |
| 40 – 59 | 87 (28.7) | 217 (71.3) | 304 (100.0) |
| 60 – 79 | 62 (35.2) | 114 (64.8) | 176 (100.0) |
| 80 and more | 4 (25.0) | 12 (75.0) | 16 (100.0) |
| Total | 251 | 554 | 805 |

Based on means obtained, all individuals are overweight but BMI of women (29.3±0.2 Kg/m²) are significantly high

($p<0.01$) than men (27.0±0.3 Kg/m²). The same result was observed with pulse (Table 2).

**Table 2.** *Hemodynamic and Anthropometric Parameters of Study Population*

| Parameters | Total Population (N=805) | Male (N=251) | Female (N=554) |
|---|---|---|---|
| Age (years) | 46.5±0.6 | 46.8±1.0 | 46.4±0.6 |
| BMI (kg/m2) | 28.6±0.2 | 27.0±0.3 | 29.3±0.2* |
| SBP (mmHg) | 130.9±0.8 | 132.9±1.4 | 130.0±0.9 |
| DBP (mmHg) | 80.1±0.4 | 81.0±0.8 | 79.7±0.5 |
| Heart rate (pulse/min) | 79.0±0.6 | 75.7±0.7 | 80.5±0.8* |
| *Results were significant for p<0.01* | | | |

### Prevalence of Arterial Hypertension and Hyperglycemia

The results of this study have shown that the prevalence of hypertension was 28.4%. The prevalence of systo–diastolic hypertension (SDH) was 27.1%, that of Isolated Systolic Hypertension (ISH) was 15.7% and that of Isolated Diastolic Hypertension (IDH) was 17.8%. The prevalence of hyperglycemia was 16.2% (Table 3).

**Table 3.** *Prevalence of Hypertension and Hyperglycemia*

| | | Frequency n (%) |
|---|---|---|
| Diagnosis criteria of HTN | 2017 ACC/AHA | 229 (28.4) |
| Subtypes of HTN | SDH | 218 (27.1) |
| | ISH | 126 (15.7) |
| | IDH | 143 (17.8) |
| Diagnosis criteria of Hyperglycemia | Based on IDF criteria | 500 (16.2) |

### Determinants of Hypertension

Several cardiometabolic risk factors are hypothesized to associate hypertension and including age, sex, family history, obesity, smoking, physical activity and socio-economic status.

• **Overweight and obesity** In our study, we observed a high prevalence of overweight and obesity in hypertensive patients. Prevalence of obesity was high in patients with systolic hypertension (Table 4). We also observed that prevalence of obesity is high among women and that of overweight is high among men (Table 5).

**Table 4.** *Prevalence of overweight and obesity*

| | Total Population n (%) (N=805) | Hypertensive n (%) (N=229) | Normal n (%) (N=576) |
|---|---|---|---|
| Underweight | 13 (1.6) | 2 (0.9) | 11 (1.9) |
| Normal weight | 205 (25.5) | 65 (28.4) | 140 (24.3) |
| Obesity | 316 (39.3) | 92 (40.2) | 224 (38.9) |
| Overweight | 271 (33.7) | 70 (30.6) | 201 (34.9) |
| Total | 805 | 229 | 576 |

**Table 5.** *Distribution of Hypertensive Patients Based on Overweight and Obesity Among Hypertensive Patients*

| | Hypertension | | Male | | Female | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Underweight (<18.5 kg/m2) | 2 | 0.9 | 2 | 2.4 | 0 | 0.0 |
| Normal weight (18.5-24.9 kg/m2) | 65 | 28.4 | 30 | 35.8 | 35 | 24.1 |
| Obesity (25-29.9 kg/m2) | 92 | 40.2 | 17 | 20.2 | 75 | 51.7 |
| Overweight (>30 kg/m2) | 70 | 30.6 | 35 | 41.7 | 35 | 24.1 |
| Total | 229 | | 84 | | 145 | |

**Table 6.** *Distribution of Hypertensive Patients According to Age and Gender*

| Gender | Men | | Women | | Total | |
|---|---|---|---|---|---|---|
| Age category | N | % | N | % | N | % |
| 20-39 | 28 | 46.7 | 32 | 53.3 | 60 | 100.0 |
| 40-59 | 28 | 29.8 | 66 | 70.2 | 94 | 100.0 |
| 60-79 | 26 | 37.7 | 43 | 62.3 | 69 | 100.0 |
| 80 and more | 2 | 33.3 | 4 | 66.7 | 6 | 100.0 |
| Total | 84 | | 145 | | 229 | |

**• Age and gender** The results of the study showed that women are more hypertensive than men. In addition, 70.2% of hypertensive women are in the age category 40-59 (Table 6).

The distribution of hypertensive patients according to BMI, gender and age showed that in hypertensive men the prevalence of overweight and obesity were high in age category 40-59. In hypertensive women, the prevalence of obesity was high in age category 60-79 and overweight in age category 20-39 (Table 7).

**Table 7.** *Distribution of Hypertensive Patients Based on BMI, Age and Gender*

| Gender | Males (N=84) | | | | | Females (N=145) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BMI (kg/m2) Age category (years) | <18.5 Underweight n (%) | 18.5-24.9 Normal n (%) | 25-29.9 Overweight n (%) | >30 Obesity n (%) | Total n (%) | <18.5 Underweight n (%) | 18.5-24.9 Normal n (%) | 25-29.9 Overweight n (%) | >30 Obesity n (%) | Total n (%) |
| 20-39 | 1 (3.6) | 12 (42.9) | 13 (46.4) | 2 (7.1) | 28 (100) | 0 (0.0) | 10 (31.2) | 11 (34.4) | 11 (34.4) | 32 (100) |
| 40-59 | 0 (0.0) | 6 (21.4) | 14 (50.0) | 8 (28.6) | 28 (100) | 0 (0.0) | 12 (18.2) | 17 (25.8) | 37 (56.0) | 66 (100) |
| 60-79 | 1 (3.8) | 11 (42.3) | 8 (30.8) | 6 (23.1) | 26 (100) | 0 (0.0) | 11 (25.6) | 6 (13.9) | 26 (60.5) | 43 (100) |
| 80 and more | 0 (0.0) | 1 (50.0) | 0 (0.0) | 1 (50.0) | 2 (100) | 0 (0.0) | 2 (50.0) | 1 (25.0) | 1 (25.0) | 4 (100) |
| Total | 2 | 30 | 35 | 17 | 84 | 0 | 35 | 35 | 75 | 145 |

**• Others cardiometabolic risk factors** Concerning physical activity, more hypertensive patients (60.7%) don't practice physical activity, 31% practice light physical activity (Table 8).

**Table 8.** *Other Cardiometabolic Risk Factors and HTN*

| | | Total Population n (%) (N=805) | Hypertensive n (%) (N=229) | Normal n (%)(N=576) |
|---|---|---|---|---|
| Physical activity | None | 589 (73.2) | 139 (60.7) | 450 (78.1) |
| | Light | 178 (22.1) | 71 (31.0) | 107 (18.6) |
| | Intense | 29 (3.6) | 14 (6.1) | 15 (2.6) |
| | More intense | 9 (1.1) | 5 (2.2) | 4 (0.7) |
| Education level | Iliteracy | 117 (14.5) | 14 (6.1) | 103 (17.9) |
| | Primary | 306 (38.0) | 84 (36.7) | 222 (38.5) |
| | Secondary | 313 (38.9) | 100 (43.7) | 213 (37.0) |
| | University | 69 (8.6) | 31 (13.5) | 38 (6.6) |
| Wages | None | 241 (29.9) | 29 (12.7) | 212 (36.8) |
| | Minimum | 146 (18.1) | 35 (15.3) | 111 (19.3) |
| | Middle | 213 (26.5) | 73 (31.9) | 140 (24.3) |
| | High | 205 (25.5) | 92 (40.2) | 113 (19.6) |
| Cigarette Smoking | smokers | 55 (6.8) | 16 (29.1) | 39 (70.9) |
| | Non smokers | 750 (93.2) | 213 (28.4) | 537 (71.6) |
| Marital status | Single | 406 (50.4) | 79 (19.5) | 327 (80.5) |
| | Married | 288 (35.8) | 103 (35.8) | 185 (64.2) |
| | Divorced | 17 (2.1) | 11 (64.7) | 6 (35.3) |
| | Widowed | 94 (11.7) | 36 (38.2) | 58 (29.8) |

Concerning socio-economic parameters (instruction, marital status and monthly wages), hypertension is high among patients of primary (36.7%) and secondary school (43.7%). Prevalence of HTN is high among patients having middle (31.9%) and high (40.2%) monthly wages. The results of marital status showed that prevalence of HTN is high among married (35.8%), divorced (64.7%) and widowed (38.2%). Prevalence HTN is 29.1% among smokers (Table 8).

**Association between Some Cardiometabolic Risk Factors and Hypertension in the Study Population**

After binary logistic analysis, age, physical inactivity/activity, monthly wages, education level and marital status are the factors associated with HTN.

With respect to age, it appears it appears that advanced in age increases the risk of HTN. Individuals aged of 40-59 were 5.40 times more exposed than individuals aged of 60-79 (OR=4.21; $p$=0.000) and those aged of 80 and more (OR=4.71; $p$=0.014). Concerning marital status, individuals "Divorced", "widowed" and "married" individuals were respectively 5.40 times, 2.10 times and 2.17 times exposed than "single". Monthly Wages influences the onset of HTN. Individuals having high (OR=4.40; $p$=0.000), middle (OR=2.92; $p$=0.000) and minimum (OR=2.08; $p$=0.015) monthly wages were more exposed to HTN than none. Concerning educational level, it appears that those with University edu-

cation were 3.32 times exposed to HTN following by those with secondary education (OR=2.98; *p*=0.004) and primary education (OR=2.49; *p*=0.010).

In the case of physical activity, those who don't practice physical activity were 0.24 times exposed than others (Table 9).

**Table 9.** *Odd Ratio of Elevated Blood Pressure According to Some Cardiometabolic Risk Factors*

| CardioMetabolic Risk Factors | | Odd ratio (CI 95%) | *p* value |
|---|---|---|---|
| Age category | 20-39 | 1 | |
| | 40-59 | 1.99 (1.29-3.07) | 0.002 |
| | 60-79 | 4.21 (2.43-7.31) | 0.000 |
| | 80 and above | 4.71 (1.36-16.27) | 0.014 |
| BMI | Normal/underweight | 1 | |
| | Overweight | 0.81 (0.54-1.20) | 0.304 |
| | Obesity | 1.00 (0.68-1.48) | 0.964 |
| Gender | Male | 1 | |
| | Female | 0.72 (0.52-1.00) | 0.051 |
| Physical activity | More intense | 1 | |
| | None | 0.24 (0.06-0.99) | 0.050 |
| | Light | 0.35 (0.08-1.46) | 0.154 |
| | Intense | 0.38 (0.08-1.82) | 0.227 |
| Cigarette Smoking | Non smokers | 1 | |
| | Smokers | 1.00 (0.55-1.84) | 0.978 |
| Monthly Wages | None | 1 | |
| | Minimum | 2.08 (1.15-3.77) | 0.015 |
| | Middle | 2.92 (1.68-5.07) | 0.000 |
| | High | 4.40 (2.45-7.89) | 0.000 |
| Education level | Iliteracy | 1 | |
| | Primary | 2.49 (1.24-5.00) | 0.010 |
| | Secondary | 2.98 (1.40-6.34) | 0.004 |
| | University | 3.32 (1.29-8.56) | 0.013 |
| Marital status | Single | 1 | |
| | Married | 2.17 (1.47-3.20) | 0.000 |
| | Divorced | 5.40 (1.61-18.12) | 0.006 |
| | Widowed | 2.10 (1.16-3.80) | 0.006 |
| R2 Nagelkerke: 0.247 | | R2 Cox and Nell: 0.172 | |

## DISCUSSION

### Prevalence of Hypertension and Hyperglycemia

Hypertension is now an epidemic with developing countries being heavily burdened. Over the last 20 years various studies have shown that people in economically developing countries are increasingly having high blood pressure levels with a high prevalence of hypertension.[19] Our study revealed that the prevalence of hypertension was 28.4%. Concerning subtypes of HTN, the prevalence of ISH was 15.65%, IDH was 17.76% and SDH was 27.08%. The studies carried out on the general population in Yaounde by Azantsa Kingue GB[20] showed a weak prevalence of systolic arterial

hypertension (14.9%) and a high prevalence of diastolic arterial hypertension (32.8%). These findings are in line with previous work by OMS[7] in six companies of the Douala city that also showed a prevalence of hypertension equal to 24.6%. Our findings revealed that women had a higher prevalence of hypertension compared to men.

Type 2 diabetes is a heterogeneous disease resulting from the incapacity of the body to correctly react to the action of insulin. Insulin is either low or high (insulino-resistance or insulino-peny).[21] This incapacity depends on the environmental factors, the first of which is excessive consumption of saturated fats, rapid sugars, and sedentarity. Thus, to bring back the rate of blood glucose to the normal, the β cells of the pancreas secrete more insulin and end up becoming exhausted until producing some more. Peripheral resistance to insulin is thus a central factor in the pathogenesis of type 2 diabetes which is related to a failure to activate glycogen synthetase, and an increase in the availability of free fatty acids.[22]

In the study, prevalence of hyperglycemia was 16.2%.[23] have shown a prevalence of 6.1% of diabetes in general population of Cameroon (6.4% among men *versus* 5.7% among women) based on WHO STEP wise investigations. The high prevalence in the present study could be explained by urban environment where there is high risk of non communicable diseases.

During its evolution, diabetes can generate serious complications concerning heart, vessels, eyes, kidneys and nerves. These complications are microvascular and macrovascular[24]; they occur in long term with the evolution of the disease. These are the chronic complications whose prevalence increases with the rise in the diabetic life expectancy.

### Cardiometabolic Risk Factors

Several risk factors are hypothesized to associate hypertension and type 2 diabetes including age, sex, family history, obesity, smoking, physical activity and socio-economic status.

The cardiometabolic risk factors are a group of clinical and metabolic situations which increase the risk to develop cardiovascular diseases or type 2 diabetes.[25] The majority of the chronic diseases is strongly interrelated and has a bond of causality with four common behavioral factors: a bad quality of food, physical inactivity, smoking and excessive consumption of alcohol.[7] These behaviors lead to four great metabolic and/or physiological changes: HTA, overweight or obesity, hyperglycemia and dyslipidemia. A classification based on the nature of the modifiable and non modifiable risk factors was proposed by WHO.

### Obesity

Obesity represents a major risk of Hypertension. Distribution of BMI varied with gender, race/ethnicity, and age. In our study, we observed a high prevalence of overweight and obesity in hypertensive patients. Prevalence of obesity was high in patients with

HTN. This prevalence is also high in women than men and the prevalence of overweight is high among men. These results are in line with studies of WHO, CamBoD[26,27] which showed that the overweight is frequent among men and obesity is frequent among women.[28] Hypertension is approximately three times more frequent among obese people than normal weight people.[29,30] Showed that the increase in the body weight is a predictive element of a rise in the blood pressure. The loss of weight is clearly associated with a fall of the blood pressure. Hypertension is more often associated to abdominal obesity than femoral obesity.[31] The explained mechanism is the increase in the activity of the sympatric nervous system by an excessive food intake. It is necessary to note certain particular points: the simple excess of weight does not explain the relation between body weight and hypertension. The distribution of fats plays a role and there is a correlation between waist to hip ratio, dyslipidemia and blood pressure.[14] The abdominal obesity has a closer link with hypertension; indicating the possibility of a role of the sexual hormones, this overweight status depends on the distribution of adipose tissues.[32] In our study, the increase of BMI does not contribute to hypertension.

## Age

It is shown in our study that the risk of hypertension becomes higher as the individual advanced in age. The studies of Bita Fouda AA[33] showed that the prevalence of hypertension was higher among individuals aged from 45 years and above. After age 50, ISH becomes the major form of hypertension.[34] Elevated SBP has been thought to be more important than elevated DBP as a risk factor for adverse cardiovascular and renal outcomes.[35] With increasing age, there is a gradual shift from DBP to SBP as predictors of cardiovascular risk.[36] The risk of hypertension increases with the age because of the hardening of the blood vessels, although the ageing of the latter can be slowed down by the adoption of a healthy way of life, including a balanced diet and a reduction of the salt consumption.[7] In our study, age significantly contributes to the onset of HTN.

## Gender

Our study showed that women are most exposed to hypertension than men. This female prevalence appears in the studies of Azantsa Kingue GB.[20] This high prevalence of hypertension among women could be due to the menopausal state characterized by a stopping of the mechanism of the steroids hormones.[14] explained that the prevalence hypertension among women was due to obesity, the intake of hormonal contraceptives with high oestrogens contents, the abusive intake of growth regulators and non steroidic anti-inflammatory drugs. In addition to these factors, it would be necessary to add pregnancy and the nephropathy.[32] It is interesting to underline the significant and protective role of female hormones against arterial hypertension. In our study gender were not associated to the onset of HTN.

## Physical Activity

Sedentarity is defined as a state in which the body movements are at least reduced. Thus, energy expenditure is near to energy ex-penditure at rest. It is characterized by behaviors such as looking at television set, working on computer and move by cars.[37] It concerns much more the populations of urban areas, especially those with a modest life; because an improvement of the incomes allows an improvement of the living conditions, and reduction of painful physical works. Thus, the mechanization of transport and work, the development of the technological means of communication and leisure among the many factors which come to be added to the ageing of the population of the developing countries, exposing them to greater risks of sedentarity.[38] In addition, the urban environment supports sedentarity by expansion of the sector of the services, many means of transport, the passive distractions like cinema or television. Only a part of educated population is doing sporting leisures.[39] Physical inactivity is presented as one of the principal factors of the progression of obesity.[40] It increases the vascular lipid peroxidation, the production of the superoxide radical which supports endothelial dysfunction and atherosclerosis, thus increasing the activity of the NADPH oxidase which is a major source of superoxide.[41] Several studies show that physical inactivity is a risk factor of cardiovascular diseases. These studies attest that physical activity is a factor of protection against obesity, cardiovascular diseases and type 2 diabetes.[42] In the study, more hypertensive patients don't practice physical activity but sedentarity (physical inactivity) were associated to the onset of hypertension.

## Monthly Wage

The studies of Mushtaq M[43] showed that stress factors are positive correlated with hypertension. Among the stress factors, monthly wage contributes to hypertension.[44] The general trends were that the higher the monthly wage, the lower the prevalence of hypertension.[44]

In our study we observed that monthly wages was implied in the onset of HTN and as the monthly wages increases as the prevalence of HTN also increases. These results showed that the burden of hypertension has been seen to be unequally distributed among different social classes. It could be explained by the job of our population study.

## Education Level

Education level is associated to the onset of HTN. The prevalence of hypertension is higher among patients having high education level compared to illiteracy patients. These results are different of these of Ntentie FR[8,45] who showed that the prevalence of hypertension is high among none educated patients. The difference between results could be due to the fact that these authors had been work in rural communities. Moreover, our study was conducted in hospital milieu and in urban areas (particularly in large metropolis) where the illiteracy rate is low. The high prevalence of HTN among individuals with high education level could be explained by the fact that being in urban areas and in a large metropolis, the majority of people met had a minimum of education level and was aware of the importance of going to the hospital in case of illness. Indeed, schooling would promote a better knowledge of the disease and the means to avoid it.[45]

*Openventio*
**PUBLISHERS**

## Marital Status

Marital status is associated with health. Recent evidence suggests that losing a spouse has differential impacts on men's and women's cardiovascular health in older ages.[46] It has been shown that marital disruption is associated with the onset of cardiovascular disease in middle-aged women but not in men.[47] Based on longitudinal data from a British cohort, being "single" (never married, divorced, or widowed) was significantly related to higher mortality in single men compared with married men. Being never married put women at no greater risk for mortality, but being widowed, divorced, or separated increased their risk of death compared with married women.[48] Using cross-sectional data from six European countries,[49] found-at all ages and for both genders—there was a significant protective effect of marriage on mortality. In general, marriage is thought to be protective against mortality[50] and against adverse health outcomes,[51] including cardiovascular disease.[52] In our study marital status increase the risk of HTN by 1.3 times, the prevalence of HTN being high with divorced, married and widowed status. This result could be due to stress observed during divorce period, widowhood period and daily living of married people. In fact, stress leads to a chronic increase in the secretion of catecholamine and cortisol resulting in a state of insulin resistance, visceral obesity, high levels of triglycerides and low levels of HDL cholesterol associated with hypertension.[53]

## Smoking

Cigarette smoking is a powerful cardiovascular risk factor and smoking cessation is the single most effective lifestyle measure for the prevention of a large number of cardiovascular diseases. Impairment of endothelial function, arterial stiffness, inflammation, lipid modification as well as an alteration of antithrombotic and prothrombotic factors are smoking-related major determinants of initiation, and acceleration of the atherothrombotic process, leading to cardiovascular events. Cigarette smoking acutely exerts an hypertensive effect, mainly through the stimulation of the sympathetic nervous system. Hypertensive smokers are more likely to develop severe forms of hypertension, including malignant and renovascular hypertension, an effect likely due to an accelerated atherosclerosis.[54] In our study, cigarette smoking was not associated to the onset of HTN.

This study was done in Deido District Hospital whose findings can be different in others hospital of Cameroon. Moreover, the risk factors like dyslipidemia and salt intake were no assessed in our study.

## CONCLUSION

This study showed that the prevalence of hypertension in Deido District hospital was 28.4% and that hyperglycemia was 16.2%. In addition age, BMI, wages, instruction and physical activity were the main risk factors amongst population of this hospital. As with nutritional transition and double burden of malnutrition, the implementation of nutritional education programs adapted to Cameroon having a goal to fight against hypertension and other chronic diseases related to nutrition become urgent. The promotion of frequent physical activity like walking, more consumption of fruits and vegetables is recommended.

## AVAILABILITY OF DATA AND MATERIALS

The primary data and materials of this study are available in Deido district hospital. Official registration is required to access the database *via* secretariat of Director. The datasets analyzed during the study are available from the corresponding author.

## AUTHORS' CONTRIBUTIONS

NBCF and MMP designed the study protocol and wrote the first manuscript draft. CB led the statistical analyses and contributed to the manuscript drafting. BM, NY and medical personal of hospital contributed to data collection. NBCF and MMP critically contributed to analysis, discussion and interpretation of the data and BME and NY contributed to data interpretation and the writing of the manuscript. All authors reviewed and approved the final manuscript draft.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted according to the principles of the Declaration of Helsinki and approved by the Deido District Hospital (Registry number N°959/AV/MINSANTE/DRSPL/SSDD/HDD). Participation to the study was voluntary and written informed consent was obtained from each participant.

## CONSENT FOR PUBLICATION

Not applicable

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES

1. World Health Orginization (WHO). Noncommunicable diseases. Web site. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. Visited April 21, 2019.

2. Lionakis N, Mendrinos D, Sanidas E, Favatas G, Georgopoulou M. Hypertension in the elderly. *World J Cardiol.* 2012; 4(5): 135-147. doi: 10.4330/wjc.v4.i5.135

3. World Health Organization (WHO). A Global Brief on Hypertension. Geneva, Switzerland, World Health Organization: 40. Web site. http://apps.who.int/iris/bitstream/10665/79059/1/WHO_DCO_WHD_2013.2_eng.pdf. Published April 2013.

Openventio
PUBLISHERS

4. Nyaga UF, Bigna JJ, Agbor VN, Essouma M, Ntusi NA, Noubiap JJ. Data on the epidemiology of heart failure in Sub-Saharan Africa. *Data Brief.* 2018; 17: 1218-1239. doi: 10.1016/j.dib.2018.01.100

5. Owolabi MO, Arulogun O, Melikam S, et al. The burden of stroke in Africa: A glance at the present and a glimpse into the future. *Cardiovasc J Afr.* 2015; 26 (2 H3Africa Suppl): S27-S38. doi: 10.5830/CVJA-2015-038

6. Kingue S, Ngoe CN, Menanga AP, et al. Prevalence and risk factors of hypertension in urban areas of Cameroon: A nationwide population-based cross-sectional study. *J Clin Hypert.* 2015; 17(10): 819-824. doi: 10.1111/jch.12604

7. OMS. Etat de mise en œuvre de la convention-cadre pour la lutte antitabac au Cameroun. https://untobaccocontrol.org/impldb/wp-content/uploads/reports/cameroon_2012_report.pdf. 2013.

8. Arrey WT, Dimala AC, Atashili J, Mbuagbaw JAJ, Monekosso GL. Hypertension, an emerging problem in rural Cameroon: Prevalence, risk factors and control. *Int J Hypertens.* 2016; 2016 (6): 1-6. doi: 10.1155/2016/5639146

9. Ntentie FR, Ngondi JL, Azantsa KGB, et al. Urbanization and metabolic syndrome in Cameroon: Alertness on less urbanised Areas. *Endocrinol Metab Syndr.* 2014; 3(2): 1-8. doi: 10.4172/2161-1017.1000137

10. Dzudie A, Kengne A, Muna WFT, et al. Prevalence, awareness, treatment and control of hypertension in a self selected sub-Saharan African Urban populations: A cross sectional study. *BMJ Open.* 2012; 2(4): pii: e001217. doi: 10.1136/bmjopen-2012-001217

11. Pancha MO, Adonis KK, Joachim C. Hypertension and classical risk factors in ambulatory patients: A hospital-based study in Adamawa region (Northern Cameroon). *Intern J Medicine and Medical Sciences.* 2011; 3(11): 331-336. doi: 10.5897/IJMMS

12. Pancha MO, Ngoufack OJ, Koona KA, Maha F, Samuel K. Place and evolutionary profile of cardiovascular diseases in Northern Cameroon: The case of regional hospital of ngaoundere. *Health Sciences and Disease.* 2015; 16(1): 1-7.

13. Tebeu PM, Foumane P, Mbu R, Fosso G, Biyaga PT, Fomulu JN. Risk factors for hypertensive disorders in pregnancy: A report from maroua regional hospital, Cameroon. *J Reprod Infertil.* 2011; 12(3): 227-234.

14. Islam JY, Zaman MM, Haq SA, Ahmed S, Al-Quadir Z. Epidemiology of hypertension among Bangladeshi adults using the 2017 ACC/AHA Hypertension Clinical Practice Guidelines and Joint National Committee 7 Guidelines. *J Hum Hypertens.* 2018; 32(10): 668-680. doi: 10.1038/s41371-018-0087-5

15. Trinder P. Determination of glucose in blood using glucose oxidase with an alternative acceptor. *Ann of clin Biochem.* 1959; 6: 24-27. doi: 10.1177/000456326900600108

16. International Diabetes Federation. The IDF consensus worldwide definition of the metabolic syndrome. Brussels, Belgium. https://www.pitt.edu/~super1/Metabolic/IDF1.pdf. 2006.

17. Agyemang C, Bruijnzeels M, Owusu-Dabo E. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. *J Hum Hypertens.* 2006; 20: 67-71. doi:

10.1038/sj.jhh.1001923

18. Silander K, Alanne M, Kristiansson K, Saarela O, Ripatti S, Auro K. Gender differences in genetic risk profiles for cardiovascular disease. *PLoS One.* 2008; 3: 3615. doi: 10.1371/journal.pone.0003615

19. Bromfield S, Muntner P. High blood pressure: The leading global burden of disease risk factor and the need for worldwide prevention programs. *Current hypertension reports.* 2013; 15(3): 134-136. doi: 10.1007/s11906-013-0340-9

20. Azantsa Kingue GB, Yangoua Mafo CH, Ngondi JL, Oben Enyong J. The effect of body weight on the incidence and prevalence of hypertension in Yaoundé. *Journal of Diabetes and Endocrinology.* 2010; 1(1): 6-12.

21. FID (Fédération internationale de Diabète). Diabetes Atlas. 6th ed. 2013. 19-24.

22. Oehrli M. Activité physique chez l'enfant atteint de diabète de type 1. Département de pédiatrie [In: French]. Hôpitaux Universitaires de Genève. 2004; 48.

23. Adler NE, Newman K. Socioeconomic disparities in health: Pathways and policies. *Health Aff (Millwood).* 2002; 21(2): 60-76. doi: 10.1377/hlthaff.21.2.60

24. Lee Z, Cheung A, Cape D, Zinman B. Impact of diabetes on coronary artery disease in women and men: A meta-analysis of prospective studies. *Diabetes care.* 2001; 23(7): 962-968.

25. Vanuzzo D, Pilotto L, Mirolo R, Pirelli S. Cardiovascular risk and cardiometabolic risk: An epidemiological evaluation. *G Ital Cardiol (Rome).* 2008; 9: 6-17.

26. World Health Organisation (WHO). Tobacco control: strengthening national efforts. 2003.

27. CamBoD (Cameroon Burden of Diabete Projet). Baseline survey report. Executive summary. https://www.who.int/ncds/surveillance/steps/STEPS_Cameroon.pdf. 2004. 33.

28. Blacher J, Czernichow S, Iaria P. Traitement non pharmacologique de l'hypertension artérielle. *EMC-Cardiologie Angéiologie.* 2005; 2: 136-151.

29. Gani P, Priya KJ, Paramasivam S. Prevalence of hypertension in an urban area: A community-based survey in Trichy, Tamilnadu, India. *Int J Community Med Public Health.* 2016; 3(8): 2325-2329. doi: 10.18203/2394-6040.ijcmph20162592

30. Morrison LM. Reduction of mortality rate in coronary atherosclerosis by a low cholesterol-low fat diet. *Am Heart J.* 1951; 42: 538-545. doi: 10.1016/0002-8703(51)90150-0

31. Pannier B, Raison J. HTA et composition corporelle-Place du surpoids et du syndrome métabolique nutrition et facteurs de risque [In: French]. 2005; 3.

32. Ouologuem N. *Place de l'HTA dans la pathologie cardiovasculaire dans le District de Bamako* [master's thesis]. Bamako, Mali: Universite de Bamako; 2002.

33. Fouda AA, Lemogoum D, Manga JO, et al. Epidemiology of obesity in the work milieu, Douala, Cameroon [In: French]. *Rev*

*Med Brux.* 2012; 33: 131-137.

34. Chobanian AV. Isolated systolic hypertension in the elderly. *N Engl J Med.* 2007; 357: 789-796. doi: 10.1056/NEJMcp071137

35. James PA, Oparil S, Carter BL, et al. 2014 Evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA.* 2014; 311: 507-520. doi: 10.1001/jama.2013.284427

36. Franklin SS, Larson MG, Khan SA, et al. Does the relation of blood pressure to coronary heart disease risk change with aging: The framingham heart study. *Circulation.* 2001; 103: 1245-1249. doi: 10.1161/01.CIR.103.9.1245

37. PNNS (Programme national nutrition santé) Activité physique et santé. Arguments scientifiques, pistes pratiques [In French]. www.mangerbouger.fr/pro/IMG/pdf/SynthesePNNS-AP.pdf. 2005. Accessed on February 02, 2014.

38. Helmrich S, Ragland R, Leung W, Paffenbarger S. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. *N Engl J Med.* 1991; 325(3): 147-152. doi: 10.1056/NEJM199107183250302

39. Maire B, Delpeuch F. Les effets de la mondialisation du mode d'alimentation occidental [In French]. 2006; 11: 131-147.

40. World Health Organisation (WHO). Fighting non-communicable diseases: Africa's new silent killers. 2008.

41. Laufs U, Wassmann S, Czech T, et al. Physical inactivity increases oxidative stress, endothelial dysfunction and artherosclerosis. *Arterioscler Thromb Vasc Biol.* 2005; 25: 809-814. doi: 10.1161/01.ATV.0000158311.24443.af

42. Krishnan S, Rosenberg L, Palmer JR. Physical activity and television watching in relation to risk of type 2 diabetes: The black women's health study. *Am J Epidemiol.* 2009; 169(4): 428-434. doi: 10.1093/aje/kwn344

43. Mushtaq M, Najam N. Depression, anxiety, stress, and demographic determinants of hypertension disease. *Pak J Med Sci.* 2014; 30(6): 1293-1298. doi: 10.12669/pjms.306.5433

44. Naseem S, Khattak UK, Ghazanfar H, Irfan A. Prevalence of non-communicable diseases and their risk factors at a semi-urban community, Pakistan. *Pan Afr Med J.* 2016; 23: 151. doi: 10.11604/pamj.2016.23.151.8974

45. Ntentie FR, Mboindi MO, Dama G, et al. A silent killer in the far North Region of Cameroon: Increasing prevalence of hypertension among population living in Kaele. *BioRxiv.* 2016. doi: doi: 10.1101/472357

46. Cleeman JI. Executive summary of the third report on the National cholesterol education program (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in adults (Adult treatment panel III). *JAMA.* 2001; 285(19): 2486-2497.

47. Zhang Z, Hayward MD. Gender, the marital life course, and cardiovascular disease in late midlife. *Journal of Marriage and Family.* 2006; 68: 639-657. doi: 10.1111/j.1741-3737.2006.00280.x

48. Gardner J, Oswald A. How is mortality affected by money, marriage, and stress? *J Health Econ.* 2004; 23: 1181-1207. doi: 10.1016/j.jhealeco.2004.03.002

49. Murphy M, Grundy E, Kalogirou S. The increase in marital status differences in mortality up to the oldest age in seven European countries, 1990-99. *Popul Stud (Camb).* 2007; 61: 287-298. doi: 10.1080/00324720701524466

50. Manzoli L, Villari P, Pirone M, Boccia A. Marital status and mortality in the elderly: A systematic review and meta-analysis. *Soc Sci Med.* 2007; 64: 77-94. doi: 10.1016/j.socscimed.2006.08.031

51. Waite LJ, Lehrer EL. The benefits from marriage and religion in the United States: A comparative analysis. *Popul Dev Rev.* 2003; 29: 255-276. doi: 10.1111/j.1728-4457.2003.00255.x

52. Kiecolt-Glaser JK, Newton TL. Marriage and health: His and hers. *Psychol Bull.* 2001; 127: 472-503. doi: 10.1037/0033-2909.127.4.472

53. Hamer M, Molloy GJ, Stamatakis E. Psychological distress as a risk factor for cardiovascular events: Pathophysiological and behavioral mechanisms. *J Am Coll Cardiol.* 2008; 52(25): 2156-2162. doi: 10.1016/j.jacc.2008.08.057

54. Virdis A, Giannarelli C, Neves MF, Taddei S, Ghiadani L. Cigarette smoking and hypertension. *Curr Pharm Des.* 2010; 16(23): 2518-2525.