



Original Research Article

A silent killer in the Far North Region of Cameroon: Increasing prevalence of hypertension among Kaele dwellers

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Hypertension (HTN) is the major risk factor of cardiovascular diseases. Its prevalence is still in perpetual increase worldwide. The aim of this study was to evaluate the prevalence and risk factors of HTN among Kaele dwellers, in the Far North Region of Cameroon where less attention seems to be paid on awareness and sensitization against overnutrition related diseases. Two hundred and four participants were recruited during free health campaign on cardiovascular diseases organized from 10-15th February 2017 in Kaele. Anthropometric and clinical parameters (weight, height, waist circumference, body mass index, blood pressure and heart rate) were measured. A blood sampling was collected for lipid profile analysis. HTN and sub-types were diagnosed according to World Health Organization (WHO) and International Diabetes Federation (IDF) definitions respectively meanwhile hypercholesterolemia and hypertriglyceridemia were diagnosed with IDF criteria. The overall prevalence of the HTN was 29.9%. Men were more affected than women (35% vs 22.6%, $p < 0.05$). Participants aged between 50-59 years and > 60 years were more affected ($p < 0.05$). Forty-one percent (41%) of the hypertensive subjects of the study had systo-diastolic sub-type of HTN meanwhile 36.1 % had isolated systolic HTN vs 23% with isolated diastolic HTN. Risk factors associated to HTN were : male gender (OR=2.236; $p < 0.05$); absence of education (OR= 24.296; $p < 0.05$); primary education level (OR=1.933; $p < 0.05$); marital status "married" (OR=3.117; $p < 0.05$), increased age (30-39, 50-59, and > 60 years, respectively with OR=4.113, $p < 0.05$; OR=31.405, $p < 0.05$ and OR=18.694, $p < 0.05$), abdominal obesity (OR= 2.476 ; $p < 0.05$) and low milky products consumption (OR=2.031, $p < 0.05$). HTN is quite present in Kaele locality and many non-modifiable, modifiable and socio-economic risk factors significantly contributed to its development.

Key words: HTN, prevalence, risk factors, kaele, cameroon.

INTRODUCTION

Non-communicable diseases represent a heavy burden at the global scale and constitute the first cause of death worldwide (WHO, 2015). According to WHO statistics, those diseases are responsible for 68% of 56 million deaths worldwide. In Africa, there is an important increase of their

prevalence and this situation causes, not only a big deficit in the budget of the states or families, but also impairs the health quality of individuals. Amongst these diseases, hypertension (HTN) is the most frequent (Sliwa et al., 2011; Mohsen and Damasceno, 2012). HTN is a chronic disease

characterize by progressive and permanent increase of blood pressure (BP). It is also called 'silent killer' due to the frequent occurrence of major complications and deaths in patients presenting high blood pressures figures without any clinical signs. HTN causes severe damages to brain, heart, kidney and sometimes premature death when not treated (Koopman et al., 2012). It is the major cause of 50% of heart disease, stroke and heart failure. It is also involved in over 40% of deaths in those with diabetes and increase the risk for foetal and maternal death during pregnancy, as well as for dementia and renal failure (Lim et al., 2013; Campbell et al., 2014). According to WHO (2011) 30 to 50% of deaths were attributed to HTN in developing countries. In Sub-Saharan African (SSA) countries, the prevalence is increasing (Campbell et al., 2014) and the overall prevalence was estimated at 16.2% (95% CI 14.2% to 20.3%) with an estimated number of hypertensive individuals to be 74.7 million. It is projected that the number of affected individuals will increase by 68% (125.5 million) by 2025 (Ogah and Rayner, 2013). This increase prevalence is mostly due to the rapid urbanization and industrialization (Hendriks et al., 2012) and also by mass migration of rural Africans to urban areas. As part of SSA countries, the prevalence of HTN still in perpetual increase in Cameroon. One third of adults have high blood pressure (Kingue et al., 2015). The prevalence of HTN is reported to vary from 31.1% in rural milieu (Arrey et al., 2016), 32.2% in semi-urban (Ntentie et al., 2014) to 47.5% in urban milieu (Dzudie et al., 2012) with a national average of 31.0% (Kingue et al., 2015). In our context, because most of patients are unaware of their disease, the increasing prevalence of hypertension is associated with an important proportion of target organ damage at diagnosis (Gnindjio et al., 2018). Given the fact that most of these damages are irreversible and associated with substantial morbidity and mortality, many projects and studies have been initiated in order to prevent, or delay the expansion of HTN and its complications among population. But those projects are mostly in favour of population of the Southern Regions of the Country meanwhile those of the Northern part of the country are no more concern. This situation is because the Northern part of the country is known to be facing undernutrition related problems (food insecurity and micronutrient deficiencies) (Ndedi, 2017; Tanankem and Fotio, 2016; Cumber et al., 2017) forgetting that the overall Cameroonian population have already stated nutritional transition process (Ntentie et al., 2014). So far, referenced studies carried in the Northern Regions are restricted to headquarters of Region (Ngaoundéré and Maroua) and were done only in the hospital milieu (Pancha et al., 2011; Pancha et al., 2015; Pancha et al., 2016; Tebeu et al., 2011). Thus, there is a need to describe and analyze HTN patterns and its risk factors. This, in order to fill the gap of data and also to contribute in the development of preventive and management policies to reduce the expansion of the pathology and its complications in this part of the Country. Therefore, the present study has been initiated and aimed at assessing the prevalence of HTN and identifying the risk

factors specific to population living in Kaele, a locality of the Mayo Kani Division in the Far North Region of Cameroon.

MATERIAL AND METHODS

Description of study area and population

A cross-sectional and descriptive survey was conducted from 10th to 15th February 2017 in Kaele, head quarter of the Mayo Kani Division in the Far North Region of Cameroon. The sampling was randomized and involved four towns: *Gouzougoui*, *Kililimbri*, *Djidoma* and *Lara*. A total of 204 apparently healthy participants aged 18 years and above were recruited during the health campaign organized by the Cameroon Nutritional Science Society on good nutritional practices.

Ethical considerations

The study protocol was approved by the National Ethics Committee N° 2014/08/488/EC/CNERSH and was conducted in strict compliance with the physical, moral and psychological integrity of all participants; following the principles outlined in the Helsinki Declaration.

Questionnaire

Data were collected using a questionnaire adapted from WHO STEPwise approach for chronic disease risk factor surveillance - Instrument v2.1. This questionnaire included informations on residence in Kaele (at least one year), smoking and alcohol consumption. Fruits, vegetables, meat, fish and milk intake were assessed by self-report under the assistance of well trained investigators. Alcohol consumption was classified into two categories: abstainers (never consumed) and occasional (drank in the past 12 months) or daily drinkers. Smoking included: manufactured or hand-rolled cigarettes, cigars, smoked, chewed or inhaled products. Participants were classified as abstainers or smokers. Fruits, vegetables, meat, fish, dairy products intake was based on the frequency of intake per week. From 0-1 time per week, intake was classified as low; 2-3 times/week as moderate and 4 to 7 times/week as high. The level of education, marital status, source of income, personal and family history of HTN were also assessed.

Anthropometric measurements, evaluation of nutritional status and abdominal obesity

Weight, height, waist circumference were measured on participants in light clothing, without shoes and motionless according to standard methods. Body Mass Index (BMI), were computed and categorized according to WHO (2003) criteria where a BMI <18.5 kg/m² is considered as underweight; BMI range 18,5- 25 kg/m² as normal, from 25 to 29 kg/m² individual was considered as overweight, and a BMI ≥ 30 kg/m² was referred to as obesity. Abdominal

Table 1. Classification of Blood pressure in Adults (age ≥ 18 years). (Update JNC-8 Guidelines recommendations)

	Systolic BP (mmHg)	and/or	Diastolic BP (mmHg)
Normal	≤ 129		≤ 84
prehypertension	130-139		85-89
Stage 1 HTN	140-159		90-99
Stage 2 HTN	≥ 160		≥ 100

obesity was diagnosed using IDF (2005) criteria (waist circumference ≥ 80 cm for women and ≥ 94 cm for men).

Blood pressure measurement and HTN definition

Blood pressure was measured on seated participant thrice on the right arm at five minutes interval; with uncrossed legs using an Automatic Digital Blood Pressure Arm Monitor SMARTHEART™ manufactured for Veridian Healthcare 1175 Lakeside Drive Gurnee, IL 60031 USA, made in China. Mean blood pressure of three closest measures was obtained. Hypertension was diagnosed using two definitions: WHO (1999) (Systolic Blood Pressure (SBP) ≥ 140 mmHg and/or Diastolic Blood Pressure (DBP) ≥ 90 mmHg) and IDF (2005) [23] (SBP ≥ 130 mmHg and/or DBP ≥ 85 mmHg). Hypertension subtypes were referred as per Franklin et al. (2005) criteria which diagnosis include Isolated Systolic Hypertension (ISH) for a SBP ≥ 130 and DBP < 85 mmHg; Isolated Diastolic Hypertension (IDH) for a SBP < 130 and DBP ≥ 85 mmHg and the Systo-Diastolic Hypertension (SDH) with a SBP ≥ 130 and DBP ≥ 85 mmHg. To classify hypertensive participants according to the grade of illness, the Joint National Committee 8 (JNC-8) criteria were used as presented in Table 1.

Blood sampling, biochemical analysis and diagnostic of hyperlipidemia

Blood sampling was done in the morning after a 10-hour overnight fasting. About 4 ml of venous blood was collected on EDTA tubes by venipuncture in the hand of each participant. The plasma was obtained by centrifugation and aliquots were frozen at -20°C for further biochemical analyses. As biochemical analysis, total cholesterol and triglycerides levels were measured with standard enzymatic spectrophotometric method using ChronoLab Diagnostic Kits in the laboratory provided by CHRONOLAB SYSTEMS, S.L., C/Diputació 260, 08007 Barcelona, SPAIN. IDF (2006) criteria were used to diagnose hypercholesterolemia (total cholesterol level ≥ 200 mg/dL) and hypertriglyceridemia (triglycerides level ≥ 150 mg/dL).

Data management and statistical analysis

Data were analyzed using SPSS 16.0 for Windows. Descriptive analysis results were presented as means \pm standard deviations for continuous variables and as

frequencies for categorial variables. Student t test and Chi square test were performed to compare continuous and categorial variables, respectively. Pearson correlation was performed to state the linear correlations between blood pressure and some anthropometric and biochemical parameters. Whereas binary logistic regressions were used to evaluate the relative risk of HTN with statistical significance at $p < 0.05$.

RESULTS

Baseline Characteristics

As shown in Table 2, the study population was constituted of 58.8% male (120) and 41.2% female (84). Ten point three percent amongst women were menopausal ($n=21$). Concerning the marital status, there was 39.7% ($n=81$) married, 56.4% (115) single and 3.9% (8) widowed or divorced. Participants were mostly from the Moundang ethnic group 87.7% (179), 3.9% (8) were Toupouri, 3.9% (8) were Guiziga and 4.4% (9) from other minor ethnic groups living in Kaele locality. 8.4% (17) were illiterates (no education level), 24.6% (50) had a primary level of education and 67% (137) were up to secondary school. According to nutritional status, 75% (153) participants were normal weight, 14.7% (30) were underweight and only 10.3% (11) were overweight or obese. Exploration of food habits and lifestyle revealed a high proportion of alcohol consumers (61.8%; $n=126$) as well as fruits, vegetables, fish, meat and dairy product consumption.

Anthropometric and hemodynamic parameters of the study population (Table 3) revealed that, according to gender, only systolic blood pressure was significantly higher among male (129.78 ± 21.79 mmHg) compared to female (120.64 ± 22.76 mmHg) meanwhile heart rate ($p < 0.05$) was higher among female (83.33 ± 13.44 Pulse/min).

Prevalence and characteristic of HTN in Kaele

As presented in Table 4, 29.9% ($n=61$) of participants were hypertensive according to WHO criteria and male were most affected (35%; $n=42$) than female (22.6% ; $n=19$) ($p < 0.05$). The results also revealed an important proportion of prehypertensive subjects (18.6%) in the

Table 2. Description of the study population

Characteristic	Categories	Frequency (N=204)	Percentage (%)
Gender	Male	120	58.8
	Female	84	41.2
Marital status	Married	81	39.7
	Single	115	56.4
	Divorced/widowed	8	3.9
Level of education	Illiteracy	17	8.4
	Primary school	50	24.6
	Secondary school	137	67
Ethnic group	Moundang	179	87.7
	Toupouri	8	3.9
	Guiziga	8	3.9
	Others	9	4.4
Income source	Permanent	14	6.9
	Temporary	30	14.7
	Assistance/help	160	78.4
BMI	Underweight	30	14.7
	Normal	153	75
	Overweight	18	8.8
	obese	3	1.5
Family history of HTN	yes	16	7.9
Alcohol	yes	126	61.8
Tobacco	yes	9	4.4
Fruits consumption	yes	168	83.2
Green vegetable consumption	yes	203	99.5
Meat consumption	yes	199	97.5
Fish	yes	200	98
Diary products consumption	yes	111	54.4

Table 3. Anthropometric and hemodynamic characteristics of the study population

Parameters	Population	Female	Male
Age (years)	34.16±17.18	36.02±17.87	32.85±16.63
BMI (kg/m²)	21.40±3.20	21.79±3.98	21.12±2.49
Waist circumference (cm)	78.78±11.25	78.34±11.62	79.09±11.02
SBP (mmHg)	126.02±22.60	120.64±22.76	129.78±21.79*
DBP (mmHg)	80.82±12.76	78.80±11.99	82.22±13.14
Heart rate (Pulse/min)	78.96±13.74	83.33±13.44	75.87±13.14*

*Significantly different between male and female at $p < 0.05$ with student t test. BMI: Body Mass Index, SBP: systolic blood pressure; DBP: diastolic blood pressure

study population. Most hypertensive participants suffering from combined systo-diastolic subtype, except among female were most of them presented isolated systolic subtype. The overall prevalence also increased with age.

HTN and other cardiometabolic risk factors

The relationship between HTN and other cardiometabolic risk factors such as overweight, abdominal obesity, hypercholesterolemia and hypertriglyceridemia were evaluated (Table 5 and 6). The Pearson correlation between BP and some anthropometric and lipid parameters revealed a positive correlation between BMI and SBP ($r=0.139$; $p=0.048$) or DBP ($r=0.181$; $p=0.010$); and between waist

circumference and SBP ($r=0.265$; $p=0.0001$) (Table 5). These observations were also confirmed by the significant higher waist circumference ((81.33±10.04 cm; $p=0.004$)) or BMI (21.85±3.66 kg/m²; $p=0.049$) among hypertensive group compared to non hypertensive individuals and also by a significantly high prevalence of hypertensive subjects with abdominal fat accumulation (Table 6). For lipid disorders, no significant difference was observed between hypertensive and non hypertensive individuals (Table 6) as well as no relationship between BP level and lipidic parameters (Table 5). But regardless of the prevalence of hyperlipidemia, the results on Table 6 shows that the number of subjects with hypercholesterolemia ($n=03$; 3.3%) and hypertriglyceridemia ($n=6$; 6.7%) was higher

Table 4. Prevalence and characteristic of HTN in the study population

		Population % (n)	Female % (n)	Male % (n)
Diagnostic criteria	WHO	29.9 (61)	22.6 (19)*	35 (42)
	IDF	48.6 (99)	36.1 (31)*	56.7 (68)
HTN stage	PreHTN	18.6 (38)	13.4 (12)	21.7 (26)
	Stage 1	16.2 (33)	14.3 (12)	17.5 (21)
	Stage 2	13.8 (28)	8.4 (7)	17.5 (21)
Subtypes	Isolated diastolic HTN	23 (14)	15.8 (3)	26.2 (11)
	Isolated systolic HTN	36.1 (22)	47.4 (9)	31 (13)
	Systo-diastolic HTN	41 (25)	36.8 (7)	42.9 (18)
Age strata % (n/N)	18-29 years	30.8 (37/120)	8.9 (4/45)	44 (33/75)
	30-39 years	64.7 (11/17)	66.7 (4/6)	63.6 (7/11)
	40-49 years	50 (12/24)	27.3 (3/11)	69.2 (9/13)
	50-59 years	93.3 (14 /14)	90.9 (10/11)	100 (4/4)
	≥ 60 years	89.3 (25 /28)	90.9 (10/11)	88.2 (15/17)

*significantly different between male and female at $p < 0.05$ with Chi square test

Table 5. Pearson correlation between blood pressure level and some anthropometric and lipid parameters

		BMI	Waist circumference	Total cholesterol	Triglycerides
SBP	Correlation coefficient r	0.139	0.265	0.137	0.054
	P value	0.048	0.0001	0.060	0.458
DBP	Correlation coefficient r	0.131	0.181	0.066	0.043
	P value	0.062	0.010	0.366	0.555

Table 6 . Relation between other cardiometabolic risk factors and HTN

	Population (N=190)	Hypertensive (N=55)	Normal (N=135)	P value
Cholesterol (mg/dL)	116.38±34.46	120.62±41.02	112.55±26.91	0.107
Triglycerides (mg/dL)	76.42±46.50	77.48±45.95	75.46±47.20	0.765
BMI (kg/m ²)	21.40±3.20	21.85±3.66	20.97±2.63	0.049
Waist circumference (cm)	78.78±11.25	81.33±10.04	76.43±11.84	0.004
Hypercholesterolemia (Chol≥200mg/dL) (% (n))	1.6 (3)	3.3 (3)	0 (0)	0.066
Hypertriglyceridemia (TAG≥150mg/dL) (% (n))	4.2 (8)	6.7 (6)	2.0 (2)	0.110
Overweight (BMI≥25kg/m ²) (% (n))	10.3 (21)	13.1 (13)	7.6 (8)	0.195
Abdominal fat distribution (% (n))	23.1 (40)	31.3 (26)	15.6 (14)	0.014

Chol: Cholesterol; TAG: Triglycerides. Results are expressed as means±Standard deviation for lipid blood level, BMI and Waist and as % (n) for hyperlipidemia, overweight and abdominal fat distribution

among hypertensive group compared to non hypertensive individuals.

Influence of some risk factor on the incidence of high blood pressure in the study population

Table 7 shows gender influence on blood pressure elevation. It appears that men were 2.2 times more exposed to elevated blood pressure than women. Regarding the level of education, those with no education were 24.3 times more likely to be at risk of high blood pressure (HBP), and those with primary education level were 1.9 times more likely to suffer hypertension than those with a secondary education level. For marital status, "married" individuals

increased by 3.1 times the risk of HTN compared to "single" individuals. With respect to age, individuals aged 30-39, 50-59, 60 and older were respectively 4.1 times; 31.4 times and 18.7 times more at risk of high blood pressure than the younger ones. Regarding the consumption of dairy products, those who did not consume them were 2 times more exposed to hypertension. Another important fact was the increased risk of HTN (2.4 times) with the presence of abdominal fat distribution ($p < 0.05$).

DISCUSSION

The prevalence of HTN observed in Kaele locality (29.9%)

Table 7 . Odd ratio of elevated blood pressure according to some modifiable and non-modifiable risk factors

		Odd ratio (CI 95%)	p value
Gender	Female	1	
	Male	2.236 (1.262-3.960)	0.006
Education level	Secondary	1	
	Illiteracy	24.296 (3.130-188.595)	0.002
	Primary	1.933 (1.003-3.723)	0.049
Marital status	Single	1	
	Married	3.117 (1.724-5.633)	0.0001
	Widowed/divorced	2.897 (0.659-12.736)	0.159
Age (years)	18-29	1	
	30-39	4.113 (1.414-11.960)	0.009
	40-49	2.243 (0.922-5.457)	0.075
	50-59	31.405 (3.981-247.745)	0.001
	60 and above	18.694 (5.310-65.816)	0.0001
Income source	Permanent	1	
	Temporary	1.006 (0.324-3.124)	0.992
	Assistance/help	0.466 (0.149-1.452)	0.188
Overweight	no	1	
	yes	1.833 (0.725-4.633)	0.200
Abdominal fat accumulation	no	1	
	yes	2.476 (1.187-5.164)	0.016
Alcohol consumption	no	1	
	yes	1.632 (0.922-2.889)	0.093
Tobacco use	no	1	
	yes	3.918 (0.794-19.339)	0.094
Fruits consumption	yes	1	
	no	0.717 (0.340-1.513)	0.382
Vegetables consumption	yes	1	
	no	/	/
Meat consumption	no	1	
	yes	0.701 (0.115-4.286)	0.701
Fish consumption	yes	1	
	no	0.347 (0.035-3.392)	0.363
Dairy products consumption	yes	1	
	no	2.031 (1.160-3.554)	0.013

was lower than that 31.0% noted by Kingue et al. (2015) in Cameroon. This difference could be explained by the fact that Kaele is a less urbanized area and studies shown that urbanization increases the risk of chronic diseases (Ramachandran et al., 2008). In the general population, the systo-diastolic subtype was 41% followed by isolated systolic hypertension subtype (36.1 %). In women, isolated systolic HTN was the dominant subtype (47.4%), while among men, systo-diastolic HTN was the most prevalent (42.9%). The results obtained were different to those of Azantsa et al. (2010 and 2013) who noted that the isolated diastolic subtype was more common in Cameroonian obese and metropolis dwellers, respectively. The lower percentage of isolated diastolic HTA obtained in our study (23%) compared to that obtained by Azantsa et al. (2010) (32.8%), would be attributed to the lower degree of urbanization of the city of Kaele compared to the metropolis Yaounde. In fact, the lifestyle of urban population are risk factors for high blood pressure (sedentary lifestyle, high consumption of alcohol ...) (Maire

et al., 2002). In addition, this isolated diastolic subtype is strongly correlated with obesity; which was not the case among Kaele dwellers with only 10.3% overweight (Table 6). The significant difference between male and female HTA found in this study (Table 4) was consistent with most published data in Africa and elsewhere in the world (Rabarijaona et al., 2009 ; Ghadhban and Habib, 2011; Seed et al., 2011). However, it should be noted that in some countries, the prevalence has been higher among women (WHO, 2013). Indeed, HTN is more common in men before age 50, thereafter, the trend is reversed (Lloyd-Jones et al., 2010). In fact, ovarian hormones, especially estrogens (Hilliard et al., 2013a), appear to play an important protective role through the modulation of the renin-angiotensin-aldosterone system (Hilliard et al., 2013b), an effect on cardiovascular function via their kidneys, heart, vascular system and even the central nervous system (Xue et al., 2013). Women would therefore be much more protected against HTN before menopause (WHO, 1996). Only 10.2% of the women in this study were menopausal,

hence the higher prevalence among men.

Exploration of relationship between high blood pressure and some biochemical parameters (Table 5-6) revealed no significant difference of lipid profile between normal participants and those with elevated blood pressure meaning that HTN is not a matter of lipid abnormalities in this population, but the presence of such situation can contribute to increase the incidence of HTN among Kaele inhabitants according to mechanisms described by many studies (Halperin et al., 2006; Otsuka et al., 2016). In fact, atherogenic lipid abnormalities clearly cause endothelial dysfunction possibly through impaired nitric oxide production and activity, as well as alterations in endothelin-1, endothelin A and B receptor expression. The endothelial dysfunction could lead to an inability or difficulty in vasodilatation to appropriate stimuli and eventually to increased resting blood pressure (Oparil et al., 2003).

An important finding of the present study was the high risk of elevated blood pressure among subjects with abdominal fat accumulation (OR= 2.031 ; IC : 1.160-3.554) (Table 7). Knowing that the general prevalence of overweight was low (10.3%) (Table 5), and that Kaele city is a less urbanized area calling to become more urbanized, one can be afraid by the increased prevalence of weight gain and later HTN in this population in the upcoming years if nothing is done. Moreover, results also revealed an important number of prehypertensive participants (Table 4), although it is not yet the pathologic stage of the disease, it permits to identify those who are likely to progress to stage 1, and needs preventive measurements to reduce the expansion of the disease (Zhang and Li, 2011). As such, the identification of specific risk factors for a population become important and the analysis of data (Table 7) shows some specificities for Kaele dwellers. Regarding the level of education, those with no education were 24.3 times at risk of HTN than those with a secondary level of education. These results corroborated those of Bovet et al. (2002) who also found higher rates of hypertensive subjects with low levels of education. Indeed, schooling would promote a better knowledge of the disease and the means to avoid it. Thus, the establishment of education and awareness programs could be a good mean of prevention. Marital status "married" increased the risk of hypertension by 3.1 times compared to "single" status. This situation could be partly due to age because most unmarried people were young. These results were contrary to those of Hawkey et al (2010) who shown a direct link between loneliness and systolic blood pressure. In addition, some studies (Twagirumukiza et al., 2011; Campbell et al., 2014) have shown that married people are less likely to be hypertensive than single people. However, a study conducted in South Africa showed that living in a marriage was negatively associated with HTN. It appears that among unmarried people, a reduction in the rating of HTN (OR = 0.30, $p < 0.05$) was noted compared to the situation of married couples; while widows were associated with an increase in HTA odds (OR = 2.43, $p < 0.05$). This could be

due to the stress experienced by some married people since the association between stress and HTN has been proven. 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 HTN (Hamer et al., 2008). In terms of age, individuals aged 30-39, 50-59 and 60 and older were respectively 4.1 times; 31.4 times and 18.7 times more exposed to high blood pressure than the younger ones (Table 7). These results were consistent with several prospective and observational surveys, which found a positive relationship between age and high blood pressure in a number of populations, regardless geographic, cultural and socio-economic characteristics as reported by Guimaraes (2002), who noted that among 25 to 34 years old, the rate of HTN ranged from 5.5 to 17.8%, while among those aged 55 to 59 this rate rose to 41%. The reduction of elasticity (increased rigidity) of large arteries is pointed out (Aronow et al., 2011) leading to endothelial dysfunction that develops over time and hence contributes to increased arterial stiffness in the elderly with isolated systolic HTN (Oparil et al., 2003).

No parameter of the food behavior investigated in this study significantly explained the occurrence of HTN in this population except the consumption of dairy products; those who did not consumed dairy products were twice as likely to be expose (Table 7). Indeed, calcium is one of the numerous nutrients responsible for the beneficial effect of dairy products on the control of blood pressure (Kris-Etherton et al., 2009). Other minerals such as magnesium and potassium may also help regulate blood pressure, but their individual contributions are not easy to detect when present in calcium-rich foods (Xu et al., 2008). The most important effect could be attributed to bioactive peptide like casein, whose inhibitory effect on the angiotensin-1 converting enzyme has already been demonstrated in the process of controlling blood pressure (Rousseau-Ralliard et al., 2010; Ibrahim et al., 2017). Other studies have revealed that certain milk peptide derivatives also have hypotensive effects via endothelin 1 modulation, performed by the endothelial cell (German et al., 2009).

CONCLUSION

The present study suggests that Kaele populations were prone to HTN with a predominance of the systo-diastolic subtype. In addition, older age, male gender, abdominal fat accumulation, married individuals, low educational attainment, and low consumption of dairy products were the main risk factors for hypertension amongst population of this locality. As with undernutrition or nutrient deficiency problem, the implementation of programs against overnutrition related diseases becomes a need in the northern part of country. This will help to prevent the expansion of cardiovascular risk factors like hypertension the silent killer and then to solve the problem of double

burden of malnutrition.

Study limitations:

A few number of participants and the absence of data related to salt consumption of these Kaele dwellers constituted the limitations of our study.

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Author Contributions:

Study conception and design: NFR. Data collection and entering: FRN, MWN, BRTT, GD, OMM. Biochemical analysis : MWN, BRTT, OMM. Statistical analysis and interpretation: FRN, BGKA. Drafting FRN. Manuscript revision: JLN, EJO. All the authors approved the final version of the manuscript.

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