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Urbanization and Metabolic Syndrome in Cameroon: Alertness on Less Urbanised Areas

Ntentie FR[1,2], Ngondi JL[*1], Azantsa KBG[1,3], Santy EV[1], Dimodi HT[1,4], Mbong AM-A[1], Chakokam NRM[1], Nguimkeng SB[1], Zambou H[1] and Oben EJ[1]

[1]*Department of Biochemistry, Faculty of Science, University of Yaounde I, Yaounde, Cameroon*

[2]*Higher Teacher's Training College, The University of Maroua, Maroua, Cameroon*

[3]*Departments of Biochemistry and Molecular Biology, University of Buea, Buea, Cameroon*

[4]*Institute of Medical Research and Medicinal Plants Study, Ministry of Scientific Research and Innovation, Yaounde, Cameroon*

[*]**Correspondening author:** Ngondi JL, Department of Biochemistry, Faculty of Science, University of Yaounde I, Yaounde, Cameroon, Tel: 23773290624; E-mail: ngondijudithl@hotmail.com

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Abstract

Aims: The prevalence of metabolic syndrome (MetS) is increasing worldwide and constitutes one of the major causes of morbidity and mortality due to cardiovascular diseases. This study evaluated the effect of urbanization process on the prevalence and risk factors of MetS in three different areas of Cameroon.

Methodology: A total of 5654 men and women were recruited (3512 in the urban area; 1683 in less urbanized and 459 in rural area) of 18 years and above. Anthropometric measurements, blood pressure, fasting blood glucose and lipid profile markers were analyzed and MetS was diagnosed using a slightly modified of International Diabetes Federation (IDF) criteria. Socio-demographic characteristics and lifestyle habits were recorded using a questionnaire.

Results: The prevalence of MetS significantly increased from (p<0.05) rural 7%, less urbanized areas 17.4% to urban area 12.7%. Women and persons of 50 years and above were the most affected (p<0.05). The prevalence of individual components of MetS such as hypertension (HTN) (32.2% for Systolic HTN ; 34.6% for Diastolic HTN) ; diabetes (6.5%) hypercholesterolemia (24%) and hypertriglyceridemia (24.9%) were significantly higher in less urbanized communities meanwhile overweight (65.5%) and abdominal obesity (49%) were more prevalent in urban city. Lifestyle habits were found modified. Low consumption or a real abandon of green vegetable sauces and fruits consumption was observed in the overall population. More than 45% participants living in urban area consumed green vegetable sauces at the frequency of at most once a week. Low physical activities 1.63 (1.27 - 2.09) (p<0.05) was the common risk factors of MetS among urban population

Conclusion: Urbanization influences the increasing prevalence of MetS in Cameroon. However, alertness should be on populations of less urbanized areas; more affected by the metabolic anomalies and MetS probably as a result of a poor sensitization and/or knowledge on nutritional diseases among the causes.

Keywords: Prevalence; Metabolic Syndrome; Urbanization, Risk factors; Cameroon

Abbreviations:

MetS: Metabolic syndrome; HNT: Hypertension; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure

Introduction

The clustering of metabolic abnormalities including central obesity, glucose intolerance, dyslipidemia and hypertension called metabolic syndrome [1] constitutes one of the major causes of morbidity and mortality in the world. This clustering of anomalies confers an increased risk of developing cardiovascular diseases [2]. The prevalence of metabolic syndrome has reached epidemic proportion worldwide [3] and varies between populations, race, gender, socio-economic status. The situation of Africa especially in sub-Saharan area is particular, due to the fact that although this continent is the least urbanized of the world, it is facing one of the fastest rates of urbanization in the world, perceptible through rapid demographic and epidemiologic transitions [4]. This development has greatly influenced their feeding habits and physical activity patterns, with rapid changes in the prevalence of nutrition-related chronic diseases [5]. These latter are projected to overcome infectious diseases by 2030 [6]. To this regard, many studies have been conducted to better understand the situation and bring possible solutions. In fact, previous studies on metabolic syndrome carried out in African countries like Benin [7], Ghana [8], Nigeria [9,10] and even in Cameroon [11,12,13] have been reported. From those studies, the prevalence of MetS varied from zero or low prevalence (0–4.1%) in rural communities in the above listed countries. In Benin, prevalence was higher in semi-urban (6.4%) and urban area (11.0%) [7]. Gyakobo et al. reported a MetS prevalence of 35.9% in a rural population in Ghana [8]. In Abuja an urban city of Nigeria, Ojji et al. [9] reported a prevalence of 13.0% in 2012 while in 2013, Awosan et al., [10] reported a prevalence of 13.8 % to 17.4% (NCEP and IDF definition respectively) among civil servants in a metropolitan city of Northern Nigeria.

Just like others sub-Saharan countries, Cameroon seems to be facing a rapid urbanization of her society and the major consequence of this situation is the coexistence of nutritional double burden, with an important increase of non-communicable diseases. Although previous studies in Cameroon [11-13] have already been conducted to evaluate the effect of urbanization on the prevalence of non-communicable diseases, poor data exist on less urbanized areas. The present study has the particularity to take into account many less urbanized areas and villages, which represent different ecological areas of the country and aims at evaluating the effect of urbanization process on the prevalence of metabolic anomalies and metabolic syndrome using IDF criteria (slightly modified) as well as to study the influence of lifestyle habits on the prevalence of MetS in rural, less urbanized and urban areas.

Material and Methods

Description of population and area of study

We carried out a survey which took place from January 2009 to February 2013. Cameroonians of both sexes of age 18 years and above were randomly recruited during mass health campaign against cardiovascular risk factors and nutritional surveys. The recruitments were done in three defined urbanization (degree of urbanization) areas according to the administrative map. In each defined area; villages, towns and quarters were randomly sorted out haphazardly among the existing ones. The urban area was Yaoundé City (political capital of the country) ; the less urbanized /semi urban area includes : Foumban (Noun Division ; West-Region), Dschang (Menoua Division ; West-Region) ; Nkongsamba (Moungo Division ; Littoral Region) ; Maroua (Diamaré Division ; Far-North Region) ; Bertoua (Lom-et-Djérem Division ; East Region). The rural areas were represented by the following towns: Njimom and Bafolé (Noun Division); Ekangté (Moungo Division); Bafou (Menoua Division) and Angossas (Upper-Nyong Division). Apparently healthy participants with at least one year residence in the study place were included in the study while pregnant and breast-feeding women were excluded.

Questionnaire

Under the assistance of well-trained and qualified technicians, participants were invited to a face-to-face interview to fill a questionnaire conceived from “WHO STEPS instrument for chronic diseases” and related to their age, gender, main occupation, lifestyle habits (cigarette, alcohol, fruits and green vegetable sauce consumption, level of physical activity), parental history or personal medical history of cardiovascular diseases. Information from medical report of participants or participant’s relatives was collected to report on present or previous disorders like diabetes, hypertension, stroke or heart attack as family history. Also, participants provided information on their occupation or daily activities reorganized in three main categories named: Jobless (including housewives, students, retired and individuals with no income), Civil servants/Private sector (individuals with a permanent income), and self-employed (manual workers, farmers, sellers). Concerning physical activity levels, based on the Global Physical Activity Questionnaire (GPAQ) analysis guide developed by WHO, participants were classified as having low, moderate and high level of physical activities exploiting information related to their main activity at work, transport activity and activity during leisure time, as well as sitting.

Anthropometric measurements

The weight was recorded to the nearest 0.1 kg using an electronic balance (The Tanita™ BC-418 Segmental Body Composition Analyzer/Scale) clothing participants dressed in light, Height was measured with a Harpended™ stadiometer to the nearest 0.1 cm. Waist circumference measurements to the nearest 0.1 cm were taken at the mid-point between the bottom rib and the hip bone, without restrictive garments using a flexible non expandable tape measure. Body Mass Index (BMI) was calculated by the formula BMI = Weight (kg) / Height^2 (m) and expressed as kg/m^2 [14].

Arterial blood pressure measurements

Blood pressure (BP) was measured with an Automatic Blood Pressure Monitor with Heart Sense® (Samsung) in a sitting position after at least 10 minutes rest and three measurements were taken after 5 minutes intervals. The first measurement was taken after a 10 minutes 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.

Blood sampling

In the morning after a 10-hour overnight fast, 5 ml of venous blood was collected on EDTA tubes by venipuncture in the hand from each participant. The plasma was obtained by centrifugation and aliquots were frozen at -20°C for further biochemical analyses.

Biochemical analyses

Fasting blood glucose was measured by Glucose Oxidase–Peroxidase method (GOP–POD) immediately in the field by using a glucometer (GlucoPlusTM) and glucose test trips (GlucoPlusMD) directly at the participant’s fingertip. Concentration of plasma total cholesterol and triglycerides were measured with standard enzymatic spectrophotometric method using ChronoLab Diagnostic Kits.

Data Analyses

Data were entered in Excel spread sheet and double-checked for errors. Statistical analyses were done using statistical package for social sciences (SPSS) Windows version 17.0. Descriptive analysis results are presented as mean values ± standard deviations for continuous variables. Frequencies are expressed in terms of percentage. Categorical variables were compared by the Chi square test. The p-values <0.05 were considered to be statistically significant. Student t-test and one way analysis of variance (ANOVA) were used to compare continuous variables followed by post hoc LSD. Logistic regressions adjusted for age were performed to evaluate the risk of developing MetS.

Ethical considerations

The Helsinki declaration on medical ethic was respected. Approval was obtained from the National Ethics Committee and all the participants provided a signed informed consent form.

Diagnosis of Metabolic syndrome

The metabolic syndrome was diagnosed using International Diabetes Federation (IDF) criteria [15] which have been shown to be the more appropriate definition of metabolic syndrome for Cameroonian population [16] (with slight modification). The IDF 2005 definition was based on waist circumference ≥80 cm (women) and ≥94 cm (men) plus any two or more of any of the following: fasting triglycerides ≥1.5 g/L or triglycerides lowering drugs; fasting total cholesterol ≥ 2g/L instead of HDL cholesterol, SBP ≥130 mmHg and/or DBP ≥85 mmHg, or blood pressure lowering treatment; fasting plasma glucose ≥1 g/L, or previously diagnosed type 2 diabetes.

Results

After applying inclusion and exclusion criteria, a total of 5654 participants were eligible and included in the study as follows: 3512 in the urban area, 1683 in less urbanized and 459 in rural area. The gender ratio was 58.2% female vs 41.8% male in urban area; 55.9% female vs 44.1% male in less urbanized area meanwhile in rural area 66.2% of participants were female vs 33.8% male. Civil servants constituted 47.1% of urban dwellers of this study against only 4.1% in rural area. Also, up to 65.9% were self-employed (Table 1). The highest report (53.1%) on positive family history of CVD was observed in urban area and only 21% in rural area.

From Table 1 below, the mean age, weight, BMI and total cholesterol were significantly different in all areas. BMI and waist circumference were higher in urban area than other areas meanwhile, systolic blood pressure (SBP), diastolic blood pressure (DBP) and concentrations of total cholesterol were more elevated in less urbanized areas. As far as the gender was concerned the smallest BMI was observed among men living in urban areas. Men also presented the highest SBP and highest Total Cholesterol in less urbanized area. A similar profile was observed with women.

		Urban area	*Less Urbanized Area*	*Rural Area*	*P value*
Women					
		N= 2043	N= 941	N= 304	
	Age (years)	36.3 ± 11.9a	44.8 ± 14.9 b	46.1 ± 16.6 b	0.0001
	BMI (kg/m2)	28.9 ± 6.2 a	28.2 ± 6.2 b	25.4 ± 4.9 c	0.0001
	SBP (mmHg)	128.2 ± 23.1 a	133.9 ± 23.4 b	131.9 ± 30.6 b	0.0001
	DBP (mmHg)	82.9 ± 15.2 a	86.2 ± 16.0 b	84.6 ± 20.6 a	0.490
	Waist (cm)	90.4 ± 14.4 a	90.0 ± 14.2 a	89.2 ± 13.6 a	0.0001
	Glycemia (mg/dL)	93.5 ± 23.9 a	100.0 ± 34.3 b	95.6 ± 30.1 a	0.0001
	Triglycerides (mg/dL)	87.7 ± 59.7 a	112.4 ± 80.9 b	98.4 ± 67.6 c	0.0001
	Total cholesterol (mg/dL)	156.3 ± 67.2 a	168.2 ± 80.7 b	141.6 ± 47.5 c	0.0001
Men		N= 1469	N= 742	N= 155	
	Age (years)	35.2 ± 12.6 a	43.2 ± 15.6 b	46.9 ± 18.4 c	0.0001
	BMI (kg/m2)	26.6 ± 5.7 a	25.5 ± 4.6 b	23.5 ± 3.9 c	0.0001
	SBP (mmHg)	129.8 ± 21.4 a	133.8 ± 22.2 b	128.7 ± 33.1 a	0.0001
	DBP (mmHg)	83.5 ± 14.5 a	85.3 ± 14.9 b	81.1 ± 14.2 a	0.002
	Waist (cm)	89.2 ± 13.1 a	86.9 ± 12.6 b	85.2 ± 10.5 a	0.0001
	Glycemia (mg/dL)	94.1 ± 26.9 a	89.9 ± 20.1 b	87.3 ± 33.1 b	0.002
	Triglycerides (mg/dL)	87.5 ± 64.6 a	105.8 ± 83.9 b	85.1 ± 64.8 a	0.0001
	Total cholesterol (mg/dL)	142.9 ± 60.3 a	154.6 ± 64.4 b	140.0 ± 56.6 a	0.001
Overall population		N= 3512	N= 1683	N= 459	
	Age (years)	35.9 ± 12.2a	44.1 ± 15.2 b	46.3 ± 17.3 c	0.0001
	BMI (kg/m2)	28.0 ± 6.1a	27.1 ± 5.7 b	24.7 ± 4.7 c	0.0001
	SBP (mmHg)	128.8 ± 22.5a	133.9 ± 22.9 b	130.8 ± 31.4 a	0.0001
	DBP (mmHg)	83.1 ± 14.9 a	85.8 ± 15.6 b	83.4 ± 18.7a	0.0001
	Waist (cm)	89.9 ± 13.9 a	88.7 ± 13.7 b	87.9 ± 12.8 b	0.005

	Glycemia (mg/dL)	93.7 ± 15.2 a	95.5 ± 19.3 a	92.8 ± 21.2 a	0.123
	Triglycerides (mg/dL)	88.0 ± 22.2 a	109.7 ± 22.3 b	94.5 ± 17.0 b	0.0001
	Total cholesterol (mg/dL)	150.9 ± 24.9 a	162.7 ± 24.7 b	141.2 ± 20.0 c	0.0001
	Socio-economic features (%)				
	Jobless	37.2	38.3	30	0.0001
	Civil servant /private sector	47.1	28.5	4.1	0.0001
	Self employment	15.7	33.2	65.9	0.0001
	Positive family history of CVD	53.1	29.5	21.2	0.0001

Table 1: Description of the study population

Results are expressed in terms of mean values ± standard deviation. In the same line, values with the same letter (a, b, c) are not significantly different at $p<0.05$. CVD: cardiovascular diseases

In the present study, from the evaluation of the frequency of individual components of metabolic syndrome or risk factors of cardiovascular diseases, it is observed that HTN and high cholesterol are highly frequent in less urbanized area than in urban (Table 2). Some indicators of nutritional transition such as the consumption of food rich in fibers (fruits and green vegetables); level of physical activities, alcohol and tobacco consumption were also evaluated to better describe lifestyle habits in the study areas.

Risk factors	Urban area	Less Urbanized area	Rural area
	% (N)	% (N)	% (N)
Overweight (25 ≤ BMI ≥ 29.9 kg/m^2)	32.2 (1260) a	33.3 (557) b	26.2 (120) c
Obesity (BMI ≥ 30 kg/m^2)	33.3 (1296) a	26.8 (448) b	14 (64) c
Overweight (BMI ≥ 25 kg/m^2)	65.5 (2549) a	60.2 (1004) b	40 (183) c
Abdominal obesity	49 (1385) a	47.7 (684) b	28.9 (133) c
Elevated SBP (SBP ≥ 130 mmHg)	39.8 (1257) a	52.8 (890) b	41.2 (186) c
Elevated DBP (DBP ≥ 85 mmHg)	43.4 (1601) a	48.1 (811) b	41.8 (189) c
Systolic HTN (SBP ≥ 140 mmHg)	23.5 (741) a	32.2 (543) b	25.5 (115) c
Diastolic HTN (DBP ≥ 90 mmHg)	30.5 (1125) a	34.6 (583) b	34.1 (154) c
Hyperglycemia (glycemia ≥ 100 mg/dL)	26.8 (755) a	24.5 (284) b	19.5 (43) c
Prediabetes (glycemia 110-125 mg/dL)	12.2 (344) a	10.3 (119) b	7.2 (16) c
Diabetes (glycemia ≥ 126 mg/dL)	5.8 (162) a	6.5 (75) b	6.3 (14) c
Total hypercholesterolemia (TC ≥ 200 mg /mL)	19.5 (575) a	24 (282) b	12 (32) c
Hypertriglyceridemia (TG ≥ 150 mg/dL)	12.7 (403) a	24.9 (287) b	16.7 (44) c

Table 2: Frequency of cardiovascular risk factors in different areas

Results are expressed in terms of percentage (sample size). In the same line, values with the same letter were not significantly different at $p<0.05$. DBP: diastolic blood pressure; SBP: systolic blood pressure; T C: total cholesterol; TG: triglycerides, HTN: hypertension.

In the present study, we evaluated the frequency of green vegetable sauce consumption not vegetables alone because, this class of food is usually eaten in form of porridge or sauce. The results shown in Table 3 revealed a relative abandon of green vegetables sauce and fruits consumption by the population of all areas, particularly those of urban area and less urbanized areas with more than 45% of them, who ate green vegetables sauce at most once a week. The rural area remains the place where the high frequency of fruits and green vegetable consumption was observed (more than 4 times a week) ($p<0.05$). For fruit intake, the high frequency of low consumption was observed in less urbanized area and rural area (62.5% and 65% respectively; $p<0.05$). The high level of physical activity was observed in rural areas;

meanwhile the urban populations were more exposed to tobacco and alcohol consumption.

As far as the prevalence of metabolic syndrome is concerned, it is observed that it increased with age in the three areas of study. However, in urban populations, (urban area and less urbanized area), the prevalence were two times higher as from the age of 30-39 years. The highest prevalence was observed among those between 50 to 69 years (Table 4).

Factors	Urban Area	Less Urbanized Area % (N)	Rural Area
	% (N)		% (N)
Green vegetable sauce consumption	N=1259	N=1041	N=217
Rare (0-1 time/week)	45.9 (578) a	47.8 (498) b	37.8 (82) c
Moderate (2-3 times/week)	38.6 (486) a	36.9 (384) b	42.4 (92) c
High (4 ≤ times/week)	15.5 (195) a	15.3 (159) a	19.8 (43) c
Fresh fruit consumption	N=1258	N=1042	N=217
Rare (0-1 time/week)	46.1 (580) a	62.5 (651) b	65 (141) c
Moderate (2-3 times/week)	33.1 (416) a	26.6 (277) b	25.8 (56) c
High (≥ 4 times/week)	20.8 (262) a	10.6 (114) b	9.2 (20) c
Level of physical activities	N=2088	N=1509	N=299
Low	31.7 (661) a	31.3 (472) b	20.1 (60) c
Moderate	50.7 (1058) a	41.2 (621) b	18.1 (54) c
High	17.7 (369) a	27.6 (416) a	61.9 (185) c
Tobacco consumption	N=2006	N=1515	N=308
Smokers	18 (362) a	7.9 (120) b	4.2 (13) c
Alcohol consumption	N=1891	N=1537	N=308
Never	7.3 (138) a	35.4 (544) b	50 (154) c
Occasionnal (0-1 time/week)	61.2 (1157) a	31.3 (481) b	12.7 (39) c
Moderate (2-3 times/week)	24.4 (461) a	22.3 (342) b	26.3 (81) c
High (≥ 4 times/week)	7.1 (135) a	11.1 (170) b	11 (34) c

Table 3: Frequency of lifestyle habits in different study areas

In the same line, values with the same letter were not significantly different at $p<0.05$. Results are expressed in terms of percentage (sample size)

From the results obtained from regression analyses, the risk of developing metabolic syndrome in the urban area was increased with low fruit consumption (OR=1.06); low level of physical activities (OR=1.63; $p<0.05$) and heavy alcohol consumption (OR=1.70; $p<0.05$) meanwhile, in less urbanized areas, low green vegetables sauce consumption (OR=1.28), low fruit consumption (OR=1.19) and low physical activities (OR=1.72; $p<0.05$) were the main risk factors of metabolic syndrome. On the contrary, in rural area, only the low fruit consumption was associated with increased risk of metabolic syndrome (OR=1.96).

	Urban area	Less urbanized	Rural area
	% (N)	Area % (N)	% (N)
Overall population	12.7 (424) a	17.4 (265) b	7 (30) c
Gender			
Female	13 (257) a	20.7 (176) b	9.9 (27) c
Male	5.9 (91)* a	5.8 (42)* b	1.4 (2)* c
Age			
≤ 29 years	3.2 (39) a	2.7 (9) b	0 (0) c
30-39 years	11.4 (78) a	13.2 (36) b	3.8 (2) c
40-49 years	18.7 (121) a	22.3 (78) b	7.8(7) c
50-59 years	29.2 (109) a	26.5 (84) a	10.4 (8) c
≥ 60 years	33.1(46) a	22.9 (57) a	11.2(11) c

Table 4: Prevalence of metabolic syndrome according to IDF definition (slightly modified)

Results are expressed in terms of percentage (sample size). *significantly different from female in the same area at p <0.05. In the same line, values with the same letter were not significantly different at p < 0.05.

Factors	Urban area	Less urbanized area	Rural area
Residence area (urban/ rural)	1,93 (1,31 - 2,83) **	2,78 (1,88 - 4,12) **	1
Gender (Female/ Male)	1.51 (1.21 - 1.87) **	4.15 (2.3 - 5.74) **	/
Age (vs 20- 29 years)			
30-39 years	3.86 (2.59 - 5.74) **	5.401 (2.55 - 11.43) **	/
40-49 years	6.92 (4.75 - 10.07) **	10.12 (5.02 - 20.71) **	/
50-59 years	12.44 (8.43 - 18.36) **	12.36 (6.3 - 26.06) **	/
≥ 60 years	14.90 (9.26 - 23.99) **	10.56 (5.11 - 21.84) **	/
Green vegetable sauce consumption (Low / regular)	0.69 (0.52-0.92) **	1.28 (0.96-1.71)*	0.97 (0.43-2.17)
Fruit consumption (Low/Regular)	1.06 (0.80-1.41)	1.19 (0.89-1.61)	1.96 (0.80-4.82)
level of physical activities (Low/ Regular)	1.63 (1.27 - 2.09) **	1.72 (1.30 - 2.27) **	0.63 (0.21 - 1.89)
Smoker (Yes/No)	0.32 (0.21 - 0.49) **	0.50 (0.27 - 0.91) **	0.67 (0.08 - 5.33)
Alcohol consumption (Yes/ no)	0.94 (0.58 - 1.53)	0.53 (0.41 - 0.70) **	0.56 (0.26 -1.24)
Level of alcohol intake (heavy/ light)	1.71 (1.39 - 2.20) **	0.71 (0.53 - 0.96) **	0.38 (0.15 - 0.98) **

Table 5: Risk of metabolic syndrome in relation to gender, age and lifestyle habit

* P< 0.1; ** P<0.05. Results are expressed as odd ratio (95% confidence Interval) adjusted for age

Discussion

The present study revealed that the prevalence of metabolic syndrome varied from 7% in rural areas to 12.7% in urban area then, 17.4% in less urbanized areas. Fezeu et al., 2007 [11] and Assah et al., 2011 [12] (NCEP ATP III definition) had previously mentioned an increase of this prevalence from rural to urban milieu in Cameroonian population. They justified the increase by a general westernization of lifestyle habits of urban population. These results, particularly in urban area (Yaoundé, political capital) were higher than 7.5% obtained by Tachang et al. [13] using IDF 2005 definition among the hospital personnel of Douala city (the economic capital of the country) and for those obtained by Fezeu et al. [11] among urban and rural Cameroonian populations. Moreover, these prevalences were slightly lower compared to those obtained by Assah et al. [12] showing a prevalence of 17.7% in urban area and more higher than prevalences found by Fezeu et al. in rural area (3.5%) (NCEP definition). This high prevalence of metabolic syndrome among urban populations can partly be due to an increase of physical inactivity which has been previously reported by other authors like Sobngwi et al. [17] ; Assah et al. [18] ; Assah et al. [12] . The low fruits and vegetables consumption, added to the higher consumption of foods rich in starch and sugar which characterizes mainly Cameroonian eating habits [19] can also be pointed as causes of the increase of the prevalence of MetS. In fact, the typical African diet (with regional diversity) is composite in nature, with whole grains or tubers usually being the staple, accompanied with legumes, leafy and non-leafy vegetables, meat or fish and vegetable fat. Such a composition appears to carry a low risk for obesity, though recently, studies suggested that Africans, especially in the urban areas are gradually departing from this traditional dietary pattern towards a western diet high in saturated fats, sugars, refined carbohydrates and low in fibers thereby significantly raising this risk [5].

One of the most important findings of this work is the evidence that the populations of less urbanized /semi-urban areas were more affected by metabolic syndrome than their urban counterparts (Table 4). This difference can be explained by the fact that, urban area population becomes more and more aware of the consequences of the adoption of an urban lifestyle through the multiplication of preventive health campaign and mass media communication [20]; meanwhile in many less urbanized areas (Dschang, Nkongsamba), fatness is still being considered as expression of well-being. This situation allows us to think that populations of urban area are aware of preventive measures against risk factors of cardiovascular diseases and are really implementing them, while those of less urbanized areas may still to be more sensitized against the risk factors of non-communicable diseases as described by Popkin [21,22]. For instance, 53.1% of urban dwellers reported on positive family history of CVD risk factors while only 29.5% and 21.2% were reported in less urbanized and rural areas respectively (Table 1). A particular attention has to be paid to female in particular, given that this study revealed that they were up to 4 times more exposed to MetS in semi urban then in urban area (Table 5). The high exposure of women compared to men has also been noted in Nigeria [23,10], Kenya [24] and South Africa [25]. Each individual component of metabolic syndrome was represented in high frequency (Table 2) in all the areas, but especially among urban populations than their rural counterpart. 60% of urban population were overweight (BMI ≥ 25 kg/m^2) with an OR=2.84 and 2.68 p<0.05 respectively in urban area and less urbanized area compared to rural population (40%). Similarly high prevalence of overweight or obesity (64.9%) was observed among female Ghanaian living in Accra in 2012 by Benkeser et al. [26] and by Bita et al. [27] in the working milieu of Douala in Cameroon.

Less urbanized area population was at a higher risk of hypertension than the rural one and weight gain can be one of the major causes of this situation. It has been clearly stated that being overweight or obese increases the risk of metabolic anomalies such as hypertension in the population [28,29]. This study also revealed an increase of HTN prevalence in rural milieu compared to urban area. This observation can be explained by aging and also by the fact that less attention has been given to rural population in term of health care services leading to an increase in the number of undiagnosed patients in villages or patients whose diagnosis come for the first time at an advanced stage of the disease. The same explanation can be given for diabetes in rural milieu where similar results have been observed in this study and even previously by Mbanya et al.1997 [30] when working on the same population.

The direct consequence of urbanization of a society is the modification of lifestyle habits which in the case of this study have been appreciated in term of frequency of consumption of high fiber diet such as fruits and green vegetable, level of physical activities and consumption of alcohol and tobacco. These results clearly indicated an abandon/reduced consumption of diets rich in fibers by all the population. Twenty percent or less eats fruits and green vegetables more than four times a week (Table 3). This low fruit consumption has already been observed in some African countries from infancy throughout adulthood [31,32] suggesting an under-utilization of the potential protective effect of this group of foods. In fact, the trends in fruit and vegetable consumption here was a bit paradoxical. Fruits are produced in rural areas and transported to cities (Douala, Yaounde) for commercialization. As a matter of fact, urban populations are those who consume the most, given the availability of fruits in variety in urban markets compare to rural areas. In contrast, rural farmers who are producers can only consume fruits from time to time depending on the harvesting season. Similar observations were made in the North-West province of South Africa by Vorster et al. [33] during the Transition and Health during Urbanization of South Africans (THUSA) study. Because of farm works that constitute the main activity of inhabitants in the rural area (65.9% of self-employed) and the long trekking at which they are permanently exposed, their physical activity level was higher than that of their homologues in urban zone (Table 5). In cities inhabitants have engaged themselves in activities that require just small energy loss; be it in the practice of their common activity (47.1% civil servants/private sector (Table 1)) or in leisure and distractions [34].

The study of the influence of lifestyle habits on the risk of developing metabolic syndrome revealed that a high consumption of green vegetable in urban area was associated with high risk of disease and this is probably due to the fact that those green vegetable soups are generally cooked with larger amounts of oil added to important quantities of protein sources (meat or fish, groundnut) which are also sources of fats [35,36]. All this results at the end to a high fat green vegetable sauce in which the higher amount of fats may probably interfere with the known beneficial effect of fibers on the health prevention and management of nutritional related diseases.

Limitations of the Study

This study was cross sectional in design and was limited by poor response rate in rural area. This affects the power of statistical test as well as the construction of a model to better explain interactions in the study population. Another limitation of this study includes the use of slightly modified IDF criteria taking into consideration total cholesterol instead of HDL-Cholesterol. Missing data on Education level, income and published data on the nutritional value of foods consumed in Cameroon limited interpretation of the results.

Conclusion

At the end of the present study, the main findings were as follows: a) the prevalence of metabolic syndrome increased from rural to urban milieu in Cameroon population; b) population of less urbanized areas were more affected by the metabolic anomalies and metabolic syndrome than their urban counterpart; c) the risk factors of metabolic anomalies varied from one zone to another. In urban area, low fruit consumption, consumption of high fat green vegetables sauce, low physical activities and heavy alcohol consumption were the principal risk factors of metabolic syndrome meanwhile in rural population, it was only the low fruit consumption which contributed significantly to the development of the metabolic syndrome. Based on the above observations, intervention should be elaborated taking into consideration specific risk factors prevalent in each specific ecological zone.

Authors' contributions

NFR and NJL contributed to conception and design of the protocol; NFR, DHT, MAM-A, AKBG, SEV, CNRM, NSB and ZH contributed in sampling and Performed the experiments. NFR, NJL and AKBG performed the statistical analysis and drafted the manuscript. OEJ supervised the study and revised critically the manuscript. All authors read and approved the final manuscript.

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