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Nutritional and Environmental Contribution as a Determinant of Hypertension Among Adults in Urban-Rural Areas in the Demogratic Republic of Congo

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Abstract: *Background and Aim*: This study was carried out in the port city of Boma and had the aim of evaluating the impact of nutritional and environmental factors on the prevalence of hypertension. *Methods*: a cross-sectional survey using a modified WHO STEP wise questionnaire for data collection during face-to face interviews was conducted from March, 1 to April 15, 2018. We did multi-stage cluster sampling. Was an all-inclusive adult over the age of ≥ 18 years having given informed consent. Information on demographic parameters, lifestyles, anthropometric measurements and blood pressure (BP) were obtained. Hypertension was defined as a mean of two BP ≥ 140/90 mmHg or a self-reported history of antihypertensive drug use. Independent factors associated with hypertension were identified using logistic pressure analysis. P<0.05 defined level of statistical significance. *Results*: The prevalence of hypertension was 35 SES Low (p=0.002), Tabaco (p=0.002), physical Inactivity (p=0.043), Excess consumption of animal fats (p=0.035), and Low frequency consumption fruits and vegetables (p=0.010) have been the nutritional and environmental factors associated with high blood pressure. *Conclusion*: Nutritional and environmental factors play an important role in increasing the prevalence of hypertension in the city of boma, this requires that the population is in full nutritional transition

Keywords: Hypertension, Prevalence, Rick Factors, Boma

1. Introduction

Cardiovascular diseases represent a major public health problem in both developed and developing countries [1]. They cause nearly 80% of deaths in low- and middle-income countries through their complications [2]. It is estimated that around 17 million deaths occur each year worldwide due to cardiovascular disease (CVD) of which 9.4 million die from complications of high blood pressure [3]. In the past decades, hypertension has become the fifth most important risk factor for deficient health in developing countries [4].

The higher relative prevalence of hypertension in Africa is linked not only to the aging of the population but also to the adoption of Western lifestyles and risky behavior including the consumption of tobacco and alcohol [5, 6]. Hypertension is one of the main contributors to morbidity, accounting for 7% of disability life years worldwide. The burden of hypertension continues to increase in sub-Saharan

Africa (SSA) especially in recent decades [2, 7]. The Sub-Saharan Africa (SSA), has experienced in hard-related over the past 10 years when already facing transmitted disease such as tuberculosis and Ebola which is added the burden of hypertension [2, 7].

In 2015, the global number of hypertensive people was estimated at nearly 1.13 billion [8] with a prevalence of HTN between 30 and 45% in adults [9], the global burden of morbidity and mortality due to HTN is becoming one of the major public health problems

There are many risk factors associated with hypertension: socio-demographic factors [10-14], residence [15], obesity, psychosocial stress [16-18]

The combination of unhealthy diet to increase the prevalence of hypertension is no longer to be demonstrated. It is the insufficient consumption of fruits and vegetables [19, 20], consumption of fatty gasoline [21, 22] and fast food [23, 24], as well as the consumption of sugar and soft drinks [25] which are incriminated.

Several studies have reported a positive association between physical inactivity [26, 27], smoking [28] and hypertension. Some studies, for example [29], have shown that a higher frequency of doctor visits is associated with hypertension in addition to psychosocial stress [30].

Considered as rare even inexistent in the early sixties, hypertension prevalence has attained prevalence rates around 30 - 40% in both sex and in urban as well as rural areas of the Democratic Republic of the Congo (DRC) [10-14, 31]. As a consequence, hypertension-related morbidity and mortality has been reported to be very high [32, 33] highlighting thus the need for early detection and management of HBP prior to the development HBP-related complications.

To our knowledge, there are no published studies regarding the association hypertension and environmental factors among adult living in Boma city.

2. Methods

2.1. Study Design

This was a population-based cross-sectional study involving adult population randomly selected.

2.2. Study Setting

The study was conducted in Boma, a port city with a population of 459. 361 inhabitants, located in the province of Kongo Central at about 440 Km southwest of Kinshasa, the Capital City. It has mixed urban and rural communities and comprised of three administrative districts and one rural district.

A multistage sampling strategy was used. The city of Boma includes 3 urban districts and 1 rural district. In all these districts, the lists of existing streets were obtained and 2 streets were selected in each district using simple random sampling strategy. On the streets drawn all the inhabited plots were listed in order to constitute the sampling frame. All the parcels listed with the odd numbers have been selected. In the selected plots, all residents aged 18 or over were invited to participate in the study.

We included 1178 households in which 3510 adults consented and were examined.

2.3. Eligibility Criteria

Participants were included in the study if they were aged 18 years and above, living in the City for at least 1 year and willing to participate in the study. Non-inclusion criteria included pregnancy or any form of debilitation that makes obtaining past-medical anthropometric and measures difficult.

2.4. Data Collection

Data for demographic and behavioral characteristics were obtained by self-reporting during face-to-face interviews. Demographic variables included items on gender, age, and marital status, level of education, employment status, hypertension duration and average monthly income. The following behavioral variables were obtained by self-reporting: smoking, alcohol use, physical activity, and fruits and vegetables consumption. Smoking and alcohol use were assessed by self-reporting on the use of any tobacco product or alcoholic drink. Participants' levels of physical activity were obtained by self-reported engagement in moderate (yes or no) or vigorous (yes or no) intensity exercise. The questionnaire elicited information on demographic characteristics and health behaviors. The field personnel also took blood pressure and heart rate measurements, and anthropometric measurements (height, weight, and waist circumference). A pilot study was carried out with volunteers from the district of Luzolo in order to assess the tools.

2.5. Measures

The anthropometric measurements (such as body weight, waist circumference, height) blood pressure, and pulse rate were collected by well-trained Medical students. Blood pressure was measured using digital blood pressure meters (OMRON MIT5 Connect, Kyoto, Japan). The average of the two measures was used in the final analysis.

The size was measured, in a standing position, in a participant without shoes, using a flexible measuring tape (Hemostyl, Sulzbach, Germany). Body weight was also measured with individuals wearing light clothing or standing without shoes using adigital weighing scale (Deluxe GBS-721; Seca Deutschland, Hamburg, Germany). Body mass index (BMI) was computed as weight in kilograms divided by height in meters squared (Kg/m^2). A flexible measuring tape was used to measure the size at the level connecting the two iliac crests.

During the survey, questionnaires on eating habits, risky behavior (smoking and smoking, lack of consumption of fruits and vegetables) and physical activities were administered.

2.6. Operational Definitions

Hypertension was defined as a BP ≥140/90 mm Hg [35].

Diabetes was defined as fasting capillary blood glucose, 110 mg/ dl or history of antidiabetic treatment [36]. Fruit/vegetable intake was considered good if fruit and vegetables were consumed on 3 days and more per week and low if fruit and vegetable intake was<3 days per week [21]. Insufficient physical activity was defined as self-reported less than 150 min of moderate intensive activity or less than 75 min vigorous intensive physical activity per week, including walking and cycling [37].

The BMI was further classified into four categories; underweight (BMI<18.5 Kg/m^2), normal (BMI 18.5-24.99 Kg/m^2), overweight (BMI 25 -29.99 Kg/m^2) and obese (BMI ≥30 Kg/m^2 [38]. Waist circumference (WC) was used as surrogate for abdominal obesity: > 94 cm in men and > 80 cm in women [39].

Talking alcohol was defined as consumption of more than 1 standard drink (which is the amount of alcohol you find in a small beer, one glass of wine, or one tot of spirits per day for females and more than 2 standard drinks for males [40]. Smoking was defined as the frequent use of tobacco in all forms (smoked, prized) [41]. The socio-economic level was calculated on the basis of DRC Demographic and Health Survey (DHS) and classified into three degrees: low, middle and high socioeconomic status (SES) [42].

2.7. Data Analyses

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 21 for Windows (SPSS Inc., Chicago, IL, United States). Data were expressed as mean values±standard deviations (SD) for continuous variables. Frequencies (n) and percentages (%) were reported for categorical variables. Counts (frequency=n) and percentages (%) were reported for categorical variables. Percentages were compared using the chi-square test. The logistic regression model analysis adjusted for obesity, physical activity, dietary practices, parity, income and alcohol use. A p-value of<0.05.

2.8. Ethical Approval

Obtained from the Ethical Committee of the Ministry of Health (N°104/CNES/BN/PMMF/2018). Consent was taken from the subjects who volunteered to participate in the study. Identified hypertensive subjects were referred to the nearby clinic for treatment

3. Results

Out of 3840 eligible older adults, 3510 subjects participated in the study making a response rate of 91.4%. Of which 1396 (40%) were males while 2114 (60%) were females. Their mean age was 36,3±15,9 years with 43,4%, 23%, 13,4%, 9,6.% and 10,5% participants aged 18–29 years, 30–39 years, 40–49 years, 50-59 years and ≥60 years, respectively. Most participants (74.2%) were recruited from the residence; the proportion low SES were 63.5%.

Description of behavioral, clinical, biological and risk factors of the participants.

Concerning the lifestyle behavior, 515 (14.7%) of them reported that had smoked, 1590 (45.3%) had drunk alcohol. Concerning dietary practice, 1981 (56.4%) of the participants ate fruit less than 3 days a week, 2117 (60.3%) have excessive consumption of animal fats and 2050 (58.4%) of drunk excess sugary drink (Table 2) Average levels of SBP, DBP, BMI, WC, and capillary blood glucose were 122.2±21.9 mmHg, 80.7±14.9 mmHg, 23.1±5.7 Kg/m^2, 81,7±11,9 cm and 118,1±31,1 mg/dl, respectively (Table 1). Their mean age was 44.0±17.0 years and average levels for BMI, WC, SBP, DBP, and blood glucose were 24.1±5.9 Kg/m^2, 85.4±13.2 cm, 149.1±25.8 mmHg, 93.1±15.7 mmHg and 117.9±29.7 mg/dL, respectively. The proportion of participants with low SES was 60.6%. Compared to normotensive participants, those with hypertension were in average significantly older (44.0±17.0 vs 44.0±17.0 years; p<0.001) and had higher levels for BMI (24.1±5.9 vs 23.1±5.7 Kg/m^2; p<0.001), WC (85.4±13.2 vs 81.7±11.9 cm; p<0.001) With reference to cardiovascular risk profile (Table 1), physical inactivity (62.2%), central obesity (49.6%), obesity (11.8%), and alcohol intake (46.6%) were cardiovascular risk factors more frequently observed among hypertensive participants. Compared to normotensive participants, hypertensive ones had a significantly higher proportion of smokers (18.8 vs 12.4%; p<0.001) and those with physical inactivity (62.2 vs 55.0%; p<0.001), central obesity (49.6 vs 38.1%), overweight (23.0 vs 12.2%; p<0.001), and obesity (11.8 vs 8.0%; p<0.001) (Table 1).

Prevalence and of hypertension

Hypertension was observed in 1245 (35.5%) participants of whom 790 (63.5%), 620 (50.5%) and 916 (73.6%) were women and living in rural area, respectively (Table 1).

Factors associate with Hypertension

Out of all independents variables entered into univariate logistic regression, Age, BMI (Kg/m^2), WC (cm), Consumption of animal fats, Low Frequency consumption fruits and vegetables, Frequency consumption of sugary drink were found to be significantly associated with hypertension. In multivariate analysis (Table 4), the strength of the associations observed in univariate analysis with hypertension persisted for all the risk factors.

Certain rick factors such Old age, SES Low, Tabaco physical Inactivity, Excess consumption of animal fats and Low frequency consumption fruits and vegetables non only the were associated with HPN but also have emerged as a significant determinant. Older age, (aOR 4,14; 95%CI: 3.47-4.95; p=0.000)], SES Low (aOR 1,54; 95%CI: 1.18-2.01; p=0.002), Tabaco (aOR 1.50; 95%CI 1.13-1.74; p=0.002), physical Inactivity (aOR 1.70; 95%CI: 1.01-2.36; p=0.043), Excess consumption of animal fats (aOR 1.17; 95%CI: 0.99-1.38; p=0.035), and Low frequency consumption fruits and vegetables (aOR 1.65; 95%CI: 1,07-2,59; p=0.010).

4. Discussion and Conclusion

This study was conducted following the STEPS of the WHO on the assessment rick for non-communicable

diseases and associated factors in rural population. The study on hypertension, like the other studies carried out in the RDC, showed a high prevalence in the general population 35.5%. The majority of previous studies report a higher prevalence of HNT in urban areas than in rural areas, because rural Congolese like African populations have a traditional lifestyle associating cultural and dietary habits allowing prevention against of HNT, (38% in rural areas vs 41% in urban areas) A similar prevalence has been reported from HTN in Nigeria, South Africa, Tanzania, Uganda and Ghana [43-47]. This prevalence will be explained by the progressive aging of the population and the increase in life expectancy in African countries. The few differences noted in the prevalence of hypertension could explain by sample size and methodology used as well as in geographical distribution of traditional and emerging cardiovascular risk factors. Added to this the speed of the epidemiological transition between the countries of sub-Saharan African [48].

Hypertension was more common in women than in men in the present study. Our results corroborate those reported by several studies considered in sub-Saharan African countries [43-47] but contrast with that of previous studies in the Democratic Republic of Congo [11-14] which reported a higher prevalence of hypertension in men than women. The high prevalence of hypertension among women in the present study could probably be due to the inclusion of more women than men.

This high prevalence of hypertension could probably be due to the larger number of women in this study, but also to female obesity which is increasingly frequent in SSA, not to mention the menopause with subsequent loss of cardiovascular protection by estrogen [49, 50].

Age, BMI, sedentary lifestyle, smoking and alcohol consumption are the factors generally associated with hypertension Most of them have already been identified as important risk factors for hypertension in different studies conducted in SSA [51-52]. Older age as non-modifiable and BMI, WC, Number of meals per day, Consumption of animal fats, consumption fruits and vegetables risk factors were independent factors associated with hypertension as modifiable.

Advanced age has been reported to be one of the most potent cardiovascular risk factors due to oxidative stress responsible for endothelial dysfunction [53], subsequent vascular remodeling as well as the coexistence of multiple cardiovascular risk factors acting by via insulin resistance [54].

Overweight or obesity are well-known traditional risk factors based on insulin resistance, activation of the sympathetic nervous system (SNS) and the renin angiotensin aldosterone system (RAAS) [55]. This study also reports a positive relationship between a low consumption fruits and vegetables and on one side and high consumption of animal fats on the other. This observation is similar to that reported by several authors [56].

Indeed, the arterial pressure evolves so with advancement in age because of endothelial dysfunction and atherosclerosis [53]. SES, is inversely linked to hypertension; suggesting that the risk conferred by the low level and its importance on the weight of major factors risk present in the population [56]. Diet is believe to be a critical determinant of health and affects all the major CVD risk factors. Consumption of saturated fat increases cholesterol levels the prevalence of hypertension

Some limits must be taken into account in the interpretation of the results of this study first, the transversal character which requires the establishment of any relation between the variables of interest, second, the single measurement of the variables of interest could underestimate or overestimate their actual values and thirdly, not taking into account other factors such as the dosage of blood lipids.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

All the authors participated in the development of this study.

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Appendix

Table 1. *General characteristics of the study population as a whole and by hypertension status.*

Variables	Over All n=3510	Normotension n=2265	Hypertension n=1245	P
Age, years	36.3±15.9	31.7±12.8	44.7±17.6	<0.001
Age categories, n (%)				<0.001
<30 years	1524 (43.4)	1239 (54.7)	285 (22.9)	
30-39 years	809 (23.0)	530 (23.4)	279 (22.4)	
40-49 years	469 (13.4)	258 (11.4)	211 (16.9)	
50-59 years	338 (9.6)	133 (5.9)	205 (16.5)	
≥60 years	370 (10.5)	105 (4.6)	265 (21.3)	
Gender, n (%)				0.002
Male	1396 (39.8)	941 (41.5)	455 (36.5)	
Female	2114 (60.2)	1324 (58.5)	790 (63.5)	
Residence, n (%)				0.263
Urban	904 (25.8)	575 (25.4)	329 (26.4)	

Variables	Over All n=3510	Normotension n=2265	Hypertension n=1245	P
Rural	2606 (74.2)	1690 (74.6)	916 (73.6)	
SES, n (%)				0.018
Low	2229 (63.5)	1475 (65.1)	754 (60.6)	
Middle	988 (28.1)	616 (27.2)	372 (29.9)	
High	293 (8.3)	174 (7.7)	119 (9.6)	
Smoking, n (%)	515 (14,7)	281 (12,4)	234 (18,8)	<0.001
Alcohol intake, n (%)	1590 (45,3)	1010 (44,6)	580 (46,6)	0.136
Physical inactivity, n (%)	2020 (57,5)	1245 (55,0)	775 (62,2)	<0.001
Obesity	282 (8,0)	135 (6,0)	147 (11,8)	<0.001
Central obesity, n (%)	1337 (38,1)	720 (31,8)	617 (49,6)	<0.001
BMI, Kg/m^2	23.1±5.7	22.5±5.4	24.1±5.9	<0.001
WC, cm	81.7±11.9	79.7±10.7	85.4±13.2	<0.001
SBP, mmHg	122.2±21.9	112.9±11.7	149.1±25.8	<0.001
DBP, mmHg	80.7±14.9	73.8±8.6	93.1±15.7	<0.001
MAP, mmHg	94.5±16.2	86.9±8.6	108.4±17.4	<0.001
PP, mmHg	41.6±14.3	39.2±9.9	45.9±19.3	<0.001
Blood glucose, mg/dl	118.1±31.1	117.9±29.7	118.2±31.9	0.929

Data are expressed as mean±standard deviation, median (interquartile range) absolute (n) and relative (in percent) frequency. Abbreviations: M, male F, female SES, socioeconomic status BMI, body mass index WC, waist circumference SBP, systolic blood pressure DBP, diastolic blood pressure MAP, mean arterial blood pressure PP, pulse pressure

Table 2. *Food characteristic accondig to the status of de HPN.*

Variables	Over All n=3510	Normotension n=2265	Hypertension n=1245	p
Number of meals per day				0,096
Low	2968 (84,6)	2103 (70,1)	865 (69,5)	
Excessive	542 (15,4)	162 (29,9)	380 (30,5)	
Consumption of aminal fats				<0,001
Low	1393 (39,7)	980 (43,3)	413 (33,2)	
Excessive	2117 (60,3)	1285 (56,7)	832 (66,8)	
Frequence consumtion fruits and vegetables				<0,001
Low	1529 (43,6)	1085 (47,9)	444 (35,7)	
Excessive	1981 (56,4)	1180 (52,1)	801 (64,3)	
Frequency consumption of sugary drink				<0.001
Low	1460 (41,6)	1011 (44,6)	449 (36,1)	
Excessive	2050 (58,4)	1254 (55,4)	796 (63,9)	
Number of meals per day	2,8±0,8	2,7±0,8	2,7±0,8	0,560
Consumption of aminal fats	4,2±1,9	4,3±1,9	4,6±1,9	<0,001
Frequence consumtion fruits and vegetables	2,3±0,9	2,1±1,1	2,2±1,0	<0,001
Frequency consumption of sugary drink	3,5±1,5	3,6±1,5	3,8±1,5	0,001

Table 3. *Simple linear correlation between SBP and DBP with independent variables.*

Independent Variables	SBP (mmHg)		DBP (mmHg)	
	r	p	r	p
Age (years)	0,198	<0,001	0,207	<0,001
BMI (Kg/m^2)	0,269	<0,001	0,308	<0,001
WC (cm)	0,440	<0,001	0,347	<0,001
Number of meals per day	-0,032	0,061	-0,007	0,683
Consumption of animal fats	0,086	<0,001	0,100	<0,001
Frequency consumption fruits and vegetables	-0,090	<0,001	-0,101	<0,001
Frequency consumption of sugary drink	0,116	<0,001	0,096	<0,001

Table 4. *Multiple linear correlation between SBP and DBP with independent variables.*

Independent Variables	SBP			DBP		
	β	ES	p	β	ES	p
(Constante)	70,159	2,771	<0,001	40,691	1,935	<0,001
Age	0,526	0,022	<0,001	0,251	0,015	<0,001
BMI	0,315	0,067	<0,001	0,176	0,047	<0,001
WC	0,227	0,033	<0,001	0,250	0,023	<0,001
Number of meals per day	0,746	0,428	0,082	0,679	0,299	0,023
Consumption of animal fats	-0,090	0,186	0,627	0,255	0,130	0,050
Frequency consumption fruits and vegetables	-0,992	0,328	0,002	-1,000	0,229	<0,001
Frequency consumption of sugary drink	0,599	0,237	0,011	0,284	0,165	0,086
	R^2=0.476			R^2=0.428		

Table 5. *Determinants of HPN.*

Independent Variables	β	p	ORa (IC95%)
Age≥60 ans			
No			1
Yes	1,422	0,000	4,14 (3.47-4.95)
Residence			
Rural			1
Urban	0,053	0,547	1,05 (0.89-1.25)
SES			
High			1
Middle	-0,064	0,457	0,94 (0.79-1.11)
Low	0,430	0,002	1,54 (1.18-2.01)
Tobaco			
No			1
Yes	0,339	0,002	1,50 (1.13-1.74)
Alcohol			
No			1
Yes	0,031	0,701	1,03 (0.88-1.21)
Physical inactivity, n (%)			
No			1
Yes	0,157	0,043	1,70 (1.01-2.36)
Number of meals per day			
Low			1
Excess Consumption of animal fats	0,108	0,310	1,11 (0.90-1.37)
Low			1
Excès	0,154	0,075	1,17 (0.99-1.38)
Frequence consumtion fruits and vegetables			
Excess			1
Low	0,263	0,010	1,65 (1,07-2,59)
Frequency consumption of sugary drink			
Low			1
Excess	0,118	0,163	1,13 (0,95-1,33)

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