Hypertension in the Adult Population in Côte d'Ivoire: Prevalence and Associated Factors

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Authors' contributions

Article Information

Original Research Article

ABSTRACT

Objectives: To estimate the current national prevalence of hypertension and to identify associated factors, in a context of increasing cardiovascular diseases and rampant urbanization in Côte d'Ivoire.
Methodology: This was a secondary analysis of data from the survey on the prevalence and characteristics of diabetes in Côte d'Ivoire. The cross-sectional, descriptive and analytical study was conducted among 3198 adults aged 20 to 79 years, in the twenty health regions of Côte

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d'Ivoire from 23 November to 22 December 2017. Risk factors were identified by binary stepwise logistic regression using Stata version 15 software.

Results: The survey population was predominantly female (55%) and lived in urban areas (55.38%). The prevalence of hypertension in Côte d'Ivoire was 39.92% [95% CI : 37.28 - 42.62]. Independent of other factors, hypertension in adults is associated with age, place of residence, education level, marital status, income and nutritional status. However, the consumption of fruits and vegetables is protective of hypertension.

Conclusion: The prevalence of hypertension in Côte d'Ivoire is very high with a greater burden in the older populations. Interventions targeting the associated modifiable risk factors are needed to correct this alarming epidemiological situation.

Keywords: Hypertension; prevalence; risk factors; Côte d'Ivoire.

ABBREVIATIONS

CI   :   *Confidence Interval*
NCD   :   *Non Communicables diseases*
WHO   :   *World Health Organization*
LMICs   :   *Low and Middle income Countries*
HBP   :   *High Blood Pressure*
FCFA   :   *Franc of African Financial Community*
WHO AFRO: *WHO Regional Office for Africa*

1. INTRODUCTION

Low- and middle-income countries (LMICs) have seen a dramatic increase in non-communicable diseases (NCDs) in recent years, while infectious and parasitic diseases and nutritional deficiencies still persist [1,2]. According to the World Health Organisation (WHO), non-communicable diseases (NCDs) kill 41 million people each year, accounting for 71% of deaths worldwide. Each year, 15 million people, aged 30-69, die from a NCD and more than 85% of these "premature" deaths occur in LMICs. NCD deaths were mainly due to cardiovascular disease (17.9 million per year), cancer (9 million), respiratory disease (3.9 million) and diabetes (1.6 million) [3]. High blood pressure (HBP) is the leading risk factor for cardiovascular disease mortality and one of the leading causes of premature death worldwide. In 2015, one in four men and one in five women had high blood pressure [4]. An estimated 1.13 billion people worldwide have hypertension, and most of them (two-thirds) live in low- and middle-income countries. In 2019, the main attributable global level 2 risk factor for deaths was high systolic blood pressure, which accounted for 10.8 million deaths (95% uncertainty interval [UI] 9.51-12.1) (19.2% [16-9-21-3] of all deaths in 2019) [5].

The African Region has the highest prevalence in the world with 46% of adults with hypertension [6]. However, within this region, the prevalences vary between 16% and 40% [7]. The countries with the highest prevalence of hypertension were Seychelles (40%), Cape Verde (39%), Sao Tome and Principe (39%), Nigeria (38,1%), Ghana (37%) and Niger (36%). In contrast, the countries with the lowest prevalence of high blood pressure were Mali (16%), Eritrea (17%), the Democratic Republic of Congo (Kinshasa, 17%), Cameroon (17%) and Togo (19%) [6,8].

The increase in the prevalence of hypertension is the result of changes in environmental and behavioural determinants. At the behavioural level, these include increased consumption of tobacco, alcohol, refined sugars, fats, salt, decreased physical activity and prolonged periods of exposure to these determinants due to long life expectancy [9,10]. At the environmental level, it is the change over time in the pattern of health and disease, depending on the degree of change in population structure and movements, the pace of economic development and urbanisation. Thus, it is the combination of these different changes that has led to this epidemiological evolution called the epidemiological transition [9].

Cöte d'Ivoire is one of the countries in sub-Saharan Africa where non-communicable diseases are currently on the rise. Indeed, the total number of deaths from myocardial infarction and stroke increased by 21.2% and 18.1% respectively between 2009 and 2019 [11]. In this country, cardiovascular disease was the leading cause of death from non-communicable diseases [12]. High blood pressure, with a prevalence of 25.9% in the adult population in 2015 [6], is the fifth largest contributor to death and disability in Côte d'Ivoire [11]. According to a population-based study on hypertension conducted in the Lagunes region, the prevalence was estimated at 21% among 15-64 year olds [13]. This

prevalence is close to that found by Kramoh et al (20.4%) in the opportunistic cross-sectional survey conducted in May 2017 among volunteers aged 18 years and above [14].

In a context of increasing cardiovascular diseases and rampant urbanization in Côte d'Ivoire, it appears necessary to estimate the current national prevalence of hypertension and to identify the associated factors. Hence this study.

2. MATERIALS AND METHODS

2.1 Study Sites

The study took place throughout the national territory, in the twenty health regions that Côte d'Ivoire had in 2017.

2.2 Type of Study

We conducted a secondary analysis of data from the "PREVADIA 2017" survey on the prevalence and characteristics of Diabetes in Côte d'Ivoire [15]. The primary study was a descriptive and analytical cross-sectional study of 3198 individuals. Each participant was subjected to a questionnaire, physical measurements (weight, height, waist circumference, blood pressure) and biological examinations (blood glucose, cholesterol, triglyceride, albuminuria, glycated haemoglobin).

2.3 Study Population and Sampling

The target populations for the primary study were people aged 20 to 79 years, living stably in the national territory of the Republic of Côte d'Ivoire for at least six (06) months. Subjects with major medical conditions other than diabetes (cancer, gastrectomy, serious infectious disease, bedridden) and pregnant women were not included. The survey covered all the districts that made up the 20 health regions. Participants were selected using three-stage stratified random sampling. At the first stage, clusters represented by localities/neighbourhoods were selected in each health district using an unremitted probability proportional to size random sample. In the second stage, 10 households were drawn systematically at random after a complete enumeration of all households in each previously selected cluster. In the third stage, in each selected household, the selection of the subject to be surveyed was done randomly using the KISCH table [16]. In total, 3198 subjects were surveyed.

2.4 Variables

The dependent variable is hypertension. It was constructed from the interview and the measurement of blood pressure. Any participant reporting known hypertension or a mean systolic blood pressure (SBP) > 140 mm Hg and/or diastolic blood pressure (DBP) > 90 mm Hg was considered hypertensive [17]. The independent variables were selected on the basis of scientific knowledge of factors associated with hypertension.

2.5 Data Processing and Analysis

All analyses were carried out with Stata version 15 and weighted to be representative of the entire target population of the country. The descriptive analysis of all selected variables was the first step of our analysis. The numbers and percentages were calculated for each qualitative variable. The univariate analysis consisted in measuring the association between the dependent variable and each of the selected independent variables by performing a simple logistic regression. A variable is retained for the construction of the model when its P-value is less than 0.2. For the multivariate analysis, binary logistic regression was performed using the stepwise ascending method. The successive models were compared using the likelihood ratio test. The Hosmer-Lemeshow test was used to judge the goodness of fit of the final models. The discriminative power of the model was assessed using the value of the area under the ROC curve (Receiver Operating Characteristic). The adjusted Odds ratios were estimated with their P-value and confidence interval. Associations are considered significant when $P < 0.05$.

2.6 Ethical Considerations

The use of the database was authorised by the Coordination Directorate of the National Programme for the Control of Metabolic Diseases / Prevention of Noncommunicable Diseases. The PREVADIA study has been authorised by the National Ethics Committee for Life Sciences.

3. RESULTS

3.1 Socio-demographic Characteristics of the Survey Population

The surveyed population were women and lived in urban areas (55%). The vast majority of participants were under 50 years of age (more

than 60%), living with a partner (61%) and not attending school (47.81%). Just over half of this population had a professional occupation (51%). However, 50% had no income and almost all (93%) had no health insurance (Table 1).

3.2 Prevalence of Hypertension According to the Socio-demographic Characteristics of the Surveyed Population

The overall prevalence of hypertension in the surveyed population was 39.92% with a 95% confidence interval [37.28 - 42.62]. The prevalence of hypertension increased with the age of the subjects and reached almost the same level in women (39.80%) with a 95% CI [36.61 -

43.66] as in men (40.08%), 95% CI [36.89 - 42.77] (Table 2). However, when we look at this prevalence by age group, we see that women are younger overall than men (Table 2).

3.3 Risk Factors Associated with Hypertension in the Surveyed Population

Independently of other factors, hypertension in adults is associated with socio-demographic factors such as age, place of residence, education level, marital status and income. As for behavioural factors, it is the consumption of fruit and vegetables and nutritional status that are associated with hypertension.

Table 1. Socio-demographic characteristics of the surveyed population (n=3,198)

	Sample	
	n	%
Genre		
Male	1 386	43,34
Female	1 812	56,66
Age group		
[20-29]	543	16,98
[30-39]	730	22,83
[40-49]	621	19,42
[50-59]	620	19,38
[60-69]	461	14,42
[70-79]	223	6,97
Marital status		
Married	337	10,54
Common-law (cohabitation)	1 975	61,76
Single	624	19,51
Widow(er)	252	7,88
Divorced	10	0,31
Level of education		
No	1 529	47,81
Primary	722	22,58
Secondary	710	22,20
University	237	7,41
Profession		
With profession	1 633	51,06
No profession	1 558	48,72
Rejected	7	0,22
Place of residence		
Urban	1 771	55,38
Rural	1 427	44,62
Do you have an income		
Yes	1 578	49,34
No	1 620	50,66
Do you have health insurance		
Yes	193	6,04
No	3 005	93,96

Table 2. Prevalence of high blood pressure by socio-demographic characteristics of the survey population (n=1274)

	Total hypertension (n=1274)	
	%	[IC 95% CI]
Together	39.92	[37.28 - 42.62]
Gender		
Male	40.08	[36.61 - 43.66]
Female	39.80	[36.89 - 42.77]
Age group		
[20-29]	19.13	[14.85 - 24.30]
[30-39]	25.86	[22.69 - 29.30]
[40-49]	38.53	[34.20 - 43.06]
[50-59]	52.60	[47.92 - 57.23]
[60-69]	61.30	[55.73 - 66.58]
[70-79]	64.82	[58.08 - 71.01]

The prevalence of hypertension increases with age and this association is quite strong. Indeed, the positive correlation between hypertension and age can be seen in the prevalence, which gradually increases from 18.78% in subjects aged 20-29 years to 25.61% (30-39 years), 38.32% (40-49 years), 52.25% (50-59 years), 60.52% (60-69 years) and 64.57% in the 70-79 years age group. The risk of developing hypertension increases with age.

As for the place of residence, subjects living in urban areas have a 41.33% higher risk of hypertension than those living in rural areas. As for the level of education, people with at least primary education have a 42% lower risk of hypertension than those without schooling.

With regard to marital status, marriage or common-law unions are protective against high blood pressure, unlike divorced or widowed status, which doubles the risk of high blood pressure compared to single people.

In terms of income, respondents with a monthly income of more than 200,000 CFA francs had a 44.12% higher risk of hypertension than those with a monthly income of less than this amount.
At the behavioural level, subjects who ate fruit and vegetables every day of the week were more protected than those who ate them only a few days or not at all. Finally, respondents who are overweight have a 48.10% higher risk of hypertension than those who are underweight (Table 3).

Table 3. Risk factors most significantly associated with high blood pressure among respondents

	Number of people (N)	HBP (%)	Odds Ratio	P>z	[95% Conf.	Interval]
TOTAL	3198	39.92				
Gender						
Male	1386	40.11	1			
Female	1812	39.62	.8561067	0.078	.7203054	1.017511
Age group						
20-29	543	18.78	1			
30-39	730	25.61	1.424054	0.014	1.073119	1.889752
40-49	621	38.32	2.494271	0.000	1.879341	3.31041
50-59	620	52.25	4.486644	0.000	3.38418	5.948257
60-69	461	60.52	5.954378	0.000	4.39831	8.060964
70-79	223	64.57	6.340283	0.000	4.360353	9.21925
Place of residence						
Rural	1,427	37.98	1			
Urban	1,771	41.33	1.21515	0.022	1.027956	1.436434
Level of education						
No	1,529	46.43	1			

	Number of people (N)	HBP (%)	Odds Ratio	P>z	[95% Conf.	Interval]
Primary	722	32.40	.6264182	0.000	.5101941	.7691187
Secondary	710	35.63	.7503062	0.008	.6075867	.9265499
University	237	32.48	.687474	0.038	.482095	.9803472
Marital status						
Never married	624	29.80	1			
Married or common-law	2,312	39.18	1.036502	0.741	.8382562	1.281633
Divorced or widowed	262	69.46	2.674698	0.000	1.885418	3.79439
Income						
No income	770	39.87	1			
≤ 100.000	392	38.09	1.201015	0.053	.9976816	1.44579
100,001 to 200,000	108	39.90	1.371297	0.059	.9880399	1.903218
> 200.000	157	44.12	1.484981	0.005	1.124904	1.960317
Physical activity						
High	491	38.69	1			
Medium	1,235	34.25	.8605202	0.208	.6810875	1.087225
Limit	1,472	44.90	1.211022	0.109	.958004	1.530863
Sedentary lifestyle						
≤ 8 hours	2,917	38.94	1			
8> hours	281	49.11	1.281952	0.074	.9757853	1.684182
Fruit and Vegetable Consumption						
Never	1,839	41.97	1			
A few days / week	137	40.87	1.23064	0.292	.836442	1.810615
The whole week	1,222	36.49	.8231032	0.023	.6962431	.9730781
Nutritional status						
Normal weight	1,701	34.74	1			
Underweight	229	31.87	.7311783	0.055	.5310355	1.006753
Overweight	1,268	48.10	1.782959	0.000	1.505352	2.11176

4. DISCUSSION

In our study, the overall prevalence of hypertension in the population aged 20 to 79 years was 39.92%. This very high prevalence confirms the trend of a sharp increase in hypertension in Ivory Coast. Indeed, in a report on risk factors for NCDs in 2015, WHO AFRO estimated the prevalence of hypertension at 25.9% in adult populations. And this prevalence ranked the country among those with a moderately high prevalence in the African sub-region [6]. In its global health statistics published in 2021 on hypertension in subjects aged 18 and over in 2015, the WHO mentioned in several African countries, hypertension prevalence of between 23.7% in Ghana and 33.4% in Niger. Côte d'Ivoire was in the middle range with a prevalence of 27.2% [18].

In a review of the literature on the epidemiology of hypertension in Africa south of the Sahara, carried out in the PubMed database over a 10-year period by Houehanou et al., the prevalence of hypertension among 18-year-old adults and more varied between 16% and 40%. These prevalences exceeded 60% in people aged 65 and over in some studies [7]. The prevalence of hypertension from our study is at the upper limit of this interval determined by this author, ie 40%. Thus, the current prevalence of hypertension in Côte d'Ivoire gives this country one of the highest prevalence in Africa.

This high prevalence of hypertension could be explained by rapid and uncontrolled urbanization, even if within urban areas, pockets of rurality can be observed through precarious settlements and slums [9,19]. Indeed, according to our study, more than 55% of the Ivorian population lives in urban areas. This observation is confirmed by the high prevalence of 41.33% found in urban areas during this survey. Numerous health studies around the world also show a higher prevalence of hypertension in urban areas than in rural areas (20–24). Urbanization is causing lifestyle changes such as a sedentary lifestyle, increased consumption of ready-to-eat processed foods high in salt and fat. The urban environment would also expose populations to

several risk factors such as stress resulting from the loss of support and social cohesion [25–27]. However, rampant urbanization alone cannot justify this level of prevalence. Rather, it is the combination of a number of environmental and behavioral determinants that is believed to be at the origin of the high prevalence in LMICs such as Ivory Coast. Globally, there are trends in the structure and movements of populations, changes in lifestyles, pathological profiles which seem to explain the increasing burden of hypertension. These include, among others, the epidemiological transition, urbanization and the aging of the population [9].

Our study also shows that age was associated with hypertension through a positive correlation, with a prevalence going from 18.78% among 20-39 year olds to 64.57% among 70-79 year olds. Numerous studies establish a positive relationship between age and blood pressure in most populations, regardless of their geographic, cultural and socioeconomic characteristics [28–31]. The risk of hypertension increases with age due to increased sensitivity to sodium with age, endothelial dysfunction altering the ability of arteries to dilate, and increased vascular stiffness, although aging of these arteries increases. These can be slowed down by adopting healthy lifestyles, including a balanced diet and reduced salt intake [28–32].

The prevalence of hypertension has been associated with social determinants such as education level and income. The less educated populations are more at risk of hypertension in our study. In countries that are in the post-transitional phase of economic and epidemiological change, lower social-economic groups have consistently higher blood pressure figures and hypertension prevalence [33]. However, in societies in a transitional or pre-transitional phase, the reverse is true. In most societies, there is a reversal of affected social groups as the epidemic progresses [3,34]. While Côte d'Ivoire is in a transitional phase with a double burden, we note instead that there is no reversal in the prevalence of hypertension in education. The high prevalence of hypertension in the less educated social strata is rather similar to what has been observed in industrialized countries [33]. However, we cannot assume that Côte d'Ivoire is an exception in this case among low- and middle-income countries. In fact, in developing countries, hypertension, which mainly affected the well-to-do classes of society, those who adopted a Western way of life in the last century, is now found in all strata of society and especially in level of extreme social categories: the poorest and the richest [34]. It cannot therefore be claimed that Côte d'Ivoire is a low- and middle-income country where the most educated populations have become aware of and made the changes that justify their lower level of prevalence than that of the less educated. The high prevalence among the less educated could be linked to insufficient information and limited access to health services for this segment of the population [3].

When we consider the income of the populations, the prevalence of hypertension is higher among the more affluent. Here we find the classic association of high prevalence of hypertension with the wealthier social classes in the LMICs. Thus, the situation in Côte d'Ivoire is well in line with the results of Antignac et al. who showed that hypertension increased progressively with the decreasing level of individual wealth of patients [35]. One explanation for this is that in sub-Saharan Africa, the collapse of the economies resulting from the biased rules of the market economy, the restrictive measures of structural adjustment programmes and the many problems of governance, has led to the advent of a new social order and above all the impoverishment of the middle classes. These economic and social upheavals have widened the gap between the different strata of society [36].

Marital status has been associated with hypertension. Marriage or common-law status is protective against hypertension, unlike divorce, widowhood and bachelorhood. This high prevalence among the latter may be explained by the fact that divorce and widowhood are highly exposed to instability and precariousness, which are often sources of stress [37]. This observation is in line with the results of studies carried out in Burkina Faso which establish a protective effect of marriage in relation to hypertension [37,38]. Other studies elsewhere confirm that never being married was a significant risk factor for hypertension [39,40]. Marriage or cohabitation preserves traditional healthy eating behaviours in contrast to celibacy [37]. However, our results differ from those of Tuoyire and Ayetey in Ghana who showed significantly higher odds of hypertension in married, cohabiting and divorced women [41].

Dietary behaviour was associated with hypertension in our study. Indeed, consumption

of fruit and vegetables every seven days of the week conferred greater protection than those who consumed them only a few days a week or not at all. This observation is similar to the findings of Houeanou et al. in their study on the epidemiology of hypertension in sub-Saharan Africa in 2018 and in Sossa in south-west Benin. These authors showed that the onset of hypertension was often linked to modifiable nutritional (particularly fruit and vegetables) and environmental factors [7,42]. This recent work and our results support the conclusions of the African Union Ministers of Health in 2013 and previous work which noted that insufficient consumption of fruit and vegetables was associated with the onset of hypertension. Indeed, some previous work, notably that of Antchouey et al. showed that certain types of diet, notably the DASH (Dietary Approaches to Stop Hypertension) diet rich in fruit, vegetables and low-fat dairy products, which is particularly effective in the African group, would also be beneficial for blood pressure [9,36,43,44].

The association between nutritional status and hypertension was also observed in our study. Overweight and obese individuals had a high prevalence of hypertension of 48.10%. These results confirm the findings of the WHO Regional Office for Africa report and work in some countries in the region in 2015, which showed that nutritional status has a positive linear relationship with blood pressure [6,37,42,45]. Our results are also similar to those from work in Morocco [46,47] and Canada [48]. In these studies, the association between overweight and hypertension was explained by the fact that increased body mass index leads to metabolic and endocrine disorders that increase the risk of developing hypertension [49]. Recent work by Matteo et al. suggests that hypertension in obesity is related to problems in the endothelial cells that line the small arteries. This is because the TRPV4 (Transient Receptor Potential Vanilloid 4) protein in the membranes surrounding the endothelial cells allows calcium to enter the cells and thus maintain normal blood pressure. However, in obesity, the levels of peroxynitrite-producing enzymes in the microdomains containing TRPV4 increase. And it is this peroxynitrite that deactivates TRPV4 and reduces calcium entry into the cells. Thus, without the right amount of calcium, blood pressure increases [50].

This study reports the results of the second population-based study on the prevalence of hypertension and its associated risk factors. In fact, this study is the first ever nationwide survey. The first large-scale population-based study in 2005 only covered the Lagunes 1 and 2 health regions, including the Abidjan metropolis.

The sample was random and representative of the population aged 20 to 79, with a loss rate of 1.02%.

In the literature, physical activity is associated with the prevention of hypertension when practised and its insufficiency or absence is a risk factor for hypertension. However, the cross-sectional nature of the present study did not allow us to highlight the links between hypertension and this "physical activity" variable. The same is true for certain variables such as fat consumption, salt consumption and other metabolic disorders (diabetes, dyslipidemia).

Furthermore, the survey did not collect data on psycho-social factors such as stress, sleep conditions and depression, which can also influence the occurrence of hypertension.

5. CONCLUSION

The aim of this article was to estimate the prevalence of hypertension and to identify associated risk factors. The results of our study show a high prevalence of hypertension with a higher burden in older populations. In determining the high prevalence of hypertension, the most important factors are age, socio-economic status through low education and high income, marital instability (divorce and widowhood) and obesity.

Interventions targeting these modifiable risk factors can help to correct this alarming epidemiological situation. Similarly, information, education and awareness-raising actions aimed at younger populations, supported by immediate and massive care for the elderly, are necessary. In addition, actions targeting the populations of the educated and wealthy social classes are also necessary if we want to slow down, or even reverse the upward trend observed for hypertension in Ivory Coast.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The PREVADIA study has been approved by the Ministry of Health and Public Hygiene and the National Ethics Committee for Life Sciences in Côte d'Ivoire.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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