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Arterial Hypertension-Related Factors within Custodial Settings of Southern Benin in 2023

Mongbo Virginie[1], Kpozehouen Alphonse[2], Achille Kpétékousso[3]

[1]Department of Health Policies and Systems, Regional Institute of Public Health, University of Abomey-Calavi, Abomey-Calavi, Benin
[2]Epidemiology and Biostatistics Department, Regional Institute of Public Health, University of Abomey-Calavi, Abomey-Calavi, Benin
[3]Ministry of the Interior of Benin, Cotonou, Benin
Email: vmongade@yahoo.com

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Abstract

Introduction: Hypertension, a non-communicable disease, is a major public health threat worldwide, accounting for a high level of morbidity and mortality. Although it has been extensively published among the general population, further research is needed to understand the reality of hypertension within the custodial setting. This study aimed to investigate the factors associated with arterial hypertension in custodial settings in southern Benin in 2023. **Methods**: This was a cross-sectional, descriptive, analytical study held in prisons in southern Benin from March to April 2023, involving inmates selected by two-stage random sampling. In the first stage, four prisons out of the six in the southern region of Benin were selected by simple random sampling. In the second stage, the prisoners were selected by systematic random sampling, with the sampling frame being the numbered list of eligible prisoners in each prison selected. Data collected by observation and questionnaire survey were analyzed using Stata 11 software. Hypertension was defined as systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg. Overweight was defined by a body mass index (weight/height^2 (kg/m^2) ≥ 25. Factors associated with hypertension were identified by multiple logistic regression, at a 5% threshold of significance. **Results**: Altogether 336 inmates aged 37.55 ± 1.72 years were surveyed. The prevalence of hypertension in custodial settings in southern Benin in 2023 was 31.32% (95% CI [17.06; 52.57]). Associated factors were inmate age (ORa = 3.36 95% CI: [1.94; 5.85]) and abnormal waist circumference (ORa = 2.61 95% CI [1.27; 5.40]). **Conclusion**: The prevalence of arterial hypertension in prisons of southern Benin (31.32%) is high when compared with the national average (25.9% (22.5 - 29.3)). The ministries of the Interior and Health need to collaborate to in-

volve inmates in preventive strategies for non-communicable diseases, including hypertension.

Keywords

Arterial Hypertension, Associated Factors, Inmates, Custodial Setting, Benin

1. Introduction

Arterial high blood pressure (AHB) is a non-communicable disease (NCD) and a chronic condition of worldwide significance [1]. As a potentially fatal cardiovascular disease, it causes stroke, myocardial infarction, heart failure, kidney damage and many other health disorders [2]. It is also one of the world's leading causes of premature death. According to the World Health Organization (WHO), in 2021, 1.28 billion people aged between 30 and 79 had arterial hypertension worldwide [3], more than three-quarters of whom live in low- and middle-income countries [2].

Factors increasing the risk of hypertension include advanced age, genetic background, overweight, lack of physical activity, high-salt diet, excessive alcohol consumption, sedentary lifestyle and stress [2]. Many of these factors can be observed in prisons, where detention conditions are conducive to chronic diseases such as hypertension [4]. In Burundi, for instance, with a capacity of 4194 places, prisons held 11,464 inmates in 2019 [5]. In Benin, there was also overcrowding, with 14,190 inmates for a capacity of 5620 places, *i.e.*, 252.49% in 2021 [6].

Several studies have reported a high prevalence of hypertension among inmates [7] [8], more so than in the general population [7], and cardiovascular disease (CVD) is one of the leading causes of death among people incarcerated in correctional facilities [2].

Given that almost half of all hypertensives are symptom-free and therefore unaware of their condition, the only effective way to combat hypertension is through early detection and identification of associated factors, including in custodial settings.

While Benin's prevalence of hypertension in the general population was 25.9% in 2015 [9], there are few studies on hypertension in inmates. What is the extent of arterial hypertension in correctional facilities, and what are the associated factors?

To answer these questions, the present study was initiated to investigate the factors associated with hypertension in custodial settings in Benin in 2023.

2. Study Design

2.1. Study Framework

The study covered four prisons in southern Benin. The country of Benin is located in West Africa, with a population of 12.45 million in 2022, spread over an

area of 114,763 km^2. It has 11 civil prisons, located six in the south, two in the center and three in the north of the country.

2.2. Study Type

This was a cross-sectional, descriptive study with a qualitative component.

2.3. Population

Inmates aged 18 or over who had spent at least six months in one of the prisons selected for the study were targeted. Inmates suffering from a medical condition that prevented the administration of a questionnaire were not surveyed.

➢ Inclusion criteria

Included in the study were prisoners aged at least 18 years and having spent at least six months in one of the selected prisons.

➢ Non-inclusion criteria

Not included in our study were any prisoners suffering from a condition that did not allow the administration of a questionnaire or who had not given their free and informed consent.

2.4. Sampling

2.4.1. Size of the Sample

Our sample size was calculated using the Schwartz formula, with the prevalence of hypertension in the general population of Benin in 2021 (25.9%) [10] and a precision of 5%. This sample size, increased by 10% in anticipation of refusals and missing data, was distributed proportionally to the number of prison inmates.

This size was distributed in proportion to the number of inmates held inside correctional facilities.

2.4.2. Sampling Methods and Techniques

Four of the six prisons in the southern region of Benin were selected by simple random selection.

In each prison, inmates were chosen by systematic random sampling, using the institution's numbered list of eligible inmates as the sampling frame.

2.5. Variables

The study variables were of two types: the dependent variable and the independent variables.

The dependent variable was arterial hypertension in prisoners, defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

The independent variables were divided into five groups relating to:

- Socio-demographic features (age, gender, level of instruction, marital status, socio-economic level)
- Behavioral factors (alcohol consumption, smoking)
- Custodial environment features (motive for detention, sentence, length of

incarceration, stress, promiscuity, sedentary lifestyle, diet)
- Individual predispositions (family history of hypertension, personal history of diabetes, knowledge of hypertension and menopause in women)
- Anthropometric measurements (weight, height, waist circumference)

Qualitative data collected through interviews with primary targets focused on their knowledge of hypertension, its consequences and the factors influencing its onset.

2.6. Data Gathering Techniques and Tools

Data were collected by questionnaire survey, observation and individual interview.

Stress was measured using the Perceived Stress Scale (PSS), a 10-item form [11].

Measurements were taken during observation using a well-calibrated SECA brand bathroom scale, a measuring cup with a sliding board and a tape measure.

Blood pressure was taken twice at three-minute intervals on a bare arm using an OMRON brand electronic blood pressure monitor in a subject who had been resting seated for at least five minutes, at least thirty minutes after a meal, alcohol or tobacco intake, and no urge to urinate, then the second BP value was considered.

2.7. Data Analysis

Data were processed in two stages using Stata 11 software.

For the description, central tendency and dispersion characteristics were used. A waist circumference ≥ 88 cm was considered abnormal.

Body mass index was calculated by BMI = Weight/height^2 (kg/m^2) and assessed as below [12].
- BMI < 18.5: Lean
- 18.5 ≥ BMI < 25: Normal
- 25 ≥ BMI < 30: Overweight
- BMI ≥ 30 : Obese

In the analytical phase, bivariate analysis and multiple logistic regression were used to identify associated factors. The bivariate analysis used Pearson's khi^2 test or Fisher's exact test when one of the expected numbers was less than or equal to 5. Variables with a p-value greater than 20% were included in the initial multiple logistic regression model. Elimination was stepwise, at the 5% significance level. The adequacy of the final model was tested using the Hosmer Lemeshow adequacy test. According to this test, the model is said to be adequate when the p-value is greater than 5%.

Qualitative data were subjected to content analysis.

2.8. Ethical Concerns

The Ministry of the Interior, which has jurisdiction over the prisons, authorized

the study. Prisoners were provided with a briefing note prior to obtaining their consent. Anonymity was respected during data collection and analysis.

3. Results

3.1. Sample Description

A total of 336 inmates were surveyed, aged between 18 and 90, with an average age of 37.55 ± 1.72 years, and a male/female sex ratio of 2.90. Table 1 below presents some of the inmates' characteristics.

3.2. Prevalence of Arterial Hypertension

The overall prevalence of hypertension in prisons was 32.31% (95% CI [17.06; 52.57]), 21.44% (95% CI [16.25; 27.74]) in men and 10.87% (95% CI [2.76; 34.37]) in women.

3.3. Identification of Arterial Hypertension Related Factors

❖ **Bivariate analysis results**

The factors associated with hypertension in prisons according to the bivariate analysis are summarized in Table 2.

Table 2 shows that five variables are associated with hypertension in prisons after bivariate analysis.

❖ **Multivariate analysis results**

The final logistic regression model, presented in Table 3, shows that the joint action of age and waist circumference was likely to lead to arterial hypertension in custodial settings of southern Benin, 2023.

4. Discussion

The prevalence of AH in prisons of southern Benin in 2023 (32.31%) according to the present study is higher than the prevalence of AH in the general population of Benin, 25.9% according to the STEP survey of 2015 [9], lower than the 39.6% found by Tiodoung and al. in the central prison of Yaoundé in 2019 [13].

The difference with the STEP survey data can be justified by the eight-year time lag between the two studies (2015-2023); in fact, our results are close to the prevalence of hypertension in Benin according to world health statistics (31.8%) [14].

That the prevalence of hypertension in prison is equivalent to that of the general population indicates the multiplicity of risk factors. Indeed, the prison environment requires a sedentary lifestyle, often limited activity, imposed diet and stress. However, the data collected in the present study do not provide information on the effect of these different factors on prisoners or known hypertensives before incarceration.

Sex

Our sample was predominantly male, with a male/female sex ratio of 2.90. This result reflects the gender distribution of the target prison population. Indeed,

Table 1. Individual characteristics of surveyed inmates in southern Benin in 2023 (n = 336).

Variables	Headcounts	Percentages
Level of instruction		
Out of school	119	34.95
Primary	83	24.76
Secondary	101	30.43
University	33	9.86
Marital status		
Married	241	70.85
Divorced	35	11.16
Single	45	13.64
Widowed	15	4.34
AH familial background		
Yes	169	50.02
No	167	49.98
Personal diabetes background		
Yes	20	6.33
No	316	93.67
Menopause (n = 86)		
Yes	21	24.83
No	65	75.17
Waist circumference (cm)		
Normal	263	76.57
Abnormal	73	23.43
Body mass index (kg/m²)		
Lean	16	23.75
Normal	241	71.59
Overweight	79	4.66
Length of incarceration		
<2 years	196	56.41
≥2 years	140	43.59
Stress		
Can manage stress or generally cope with stress PSS (PSS* ≤ 26)	39	10.56
Under constant threat (of rejection, illness or even suicide (PSS* ≥ 27)	297	89.43

*: PSS = Perceived Stress Scale.

Table 2. Factors associated with arterial hypertension in custodial settings of southern Benin, 2023 (n = 336).

Variables	Arterial Hypertension		OR_{raw}	CI 95%	p
	Yes (n = 102)	No (n = 234)			
Age					
<40 years	41	169	1		-
≥40 years	61	65	3.63	[1.02; 1.09]	**0.003**
Marital status					
Married	76	165	2.45	[1.32; 4.58]	**0.019**
Divorced	11	24	2.66	[0.50; 14.04]	0.157
Single	7	38	1		-
Widowed	8	7	5.68	[2.15; 14.99]	**0.011**
Socio-economic level					
Lower class	37	137	1		-
Lower-middle class	32	57	2.06	[1.40; 3.06]	**0.010**
Middle class	17	19	3.04	[0.87; 13.35]	0.065
Upper-middle class	11	15	3.07	[0.99; 9.52]	0.050
Upper class	5	6	2.57	[0.55; 12.12]	0.147
Length of incarceration					
<2 years	49	147	1		-
≥2 years	53	87	1.81	[1.54; 2.13]	**0.001**
Visits per month					
None	58	136	0.94	[0.47; 1.87]	0.796
1 or 2 visits	34	69	1		-
≥3 visits	10	29	0.73	[0.45; 1.18]	0.131
Stress					
Can generally cope with stress	8	31	1		-
Under constant stress	94	203	1.87	[0.69; 5.04]	0.138

Table 3. Factors associated with arterial hypertension in custodial settings of southern Benin in 2023 (n = 336).

Variable	OR Adjusted	CI95%	p
Age ≥ 40 years	3.36	[1.94; 5.85]	0.006
Abnormal waist circumference	2.61	[1.27; 5.40]	0.024

the high representation of men could be explained by their characteristics, which expose them to punishable acts. This male predominance was also found by Tiodoung and al. in Cameroon, with a male/female sex ratio of 3.5 (n = 437) [13]. Beyond the mere male predominance of the sample, even if gender is not retained as an associated factor in the present study, the male sex is recognized by several studies as favoring arterial hypertension [13] [15] [16].

Associated factors with arterial hypertension within custodial settings

Age

The mean age of this study population was 37.55 ± 1.72 years. This average age is very close to those found by several other authors. Indeed, a study carried out by Tiodoung and al. in 2019 in Yaoundé, Cameroon, reported an average age of 37.01 ± 13.2 years [13]. Also, two-thirds of the sample in this survey were aged between 29 to 43, just as in the study carried out in 2019 by Tiodoung and al. who showed that two-thirds of respondents were aged between 20 and 39 [13]. In Brazil, the work of da Silva and al. reported that inmates had an average age of 38.10 ± 8.52 years, with a predominance of the 31 - 49 age bracket in 2015 [17]. Older age has been identified as associated with hypertension in prisons [13] than in the general population [15] [16]. This may be justified by the comorbidities, including diabetes, that lurk in this age group.

Waist circumference

The abnormal waist circumference as a factor associated with hypertension in our study reflects obesity, a well-known associated factor in arterial hypertension. Indeed, it is well established that obesity is associated with activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system, contributing to the development of hypertension in prisoners [18]. This finding is consistent with those of several other studies on hypertension in prisons and in the general population [13] [15] [16] [17].

5. Conclusion

Arterial hypertension is a major health concern requiring a multi-sectoral approach. Prevention strategies need to be extended to prisons, given the additional risk linked to the custodial environment and the higher prevalence of hypertension among inmates.

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Conflicts of Interest

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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