

Research Paper

HYPERTENSION IN THE ADULT POPULATION OF KAYA HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEM IN BURKINA FASO: PREVALENCE AND ASSOCIATED FACTORS

ABSTRACT

Background: Recent scientific reports have revealed that the prevalence of high blood pressure has reached high levels in urban populations of sub-Saharan African countries. Yet, information on this morbidity in the rural areas is limited.

Objective: to estimate the prevalence of hypertension and to identify associated factors in rural and semi-urban populations in Burkina Faso

Methods: This is a community-based cross-sectional study conducted between September and December 2012 among residents of Kaya Health and Demographic Surveillance System (HDSS). A stratified sample of 1481 residents, at least 18 years of age, was randomly selected and interviewed. Anthropometric measures were obtained. Two blood pressure (BP) measurements were taken after sitting restfully for about 25 to 30 minutes. Hypertension was defined as mean systolic BP of at least 140 mmHg and/or diastolic BP of at least 90mmHg. Those who were on hypertensive medication were also considered hypertensive. Logistic regressions were fitted to identify factors independently associated with hypertension.

Results: The study sample comprised 726 rural residents and 755 semi-urban residents. The weighted overall prevalence of hypertension was 9.4% (95% CI: 7.3%-11.4%); 5.5% (95% CI: 3.8%-7.1%) in the rural areas; and 11.0% (95% CI: 8.8%-13.2%) in the semi-urban areas. In rural areas, older age and higher body mass index were associated positively with hypertension. In semi-urban areas, older age, not being married, familial history of hypertension, physical inactivity, psychological distress, presence of chronic conditions and poor self-assessment of health, were associated with hypertension positively.

Conclusion: Hypertension prevalence was higher in semi-urban than in rural areas of Kaya HDSS, but was still relatively low. However, it is possible to further reduce the prevalence and to prevent its increase because some risk factors had been identified. For example, encouragement to maintain low body weight by traditional diets and increase of physical activity could be beneficial.

Keywords: *hypertension, Kaya, Health and Demographic Surveillance System, urbanization*

1. INTRODUCTION

In 2000, the prevalence of hypertension was estimated at 26.4% among all adults. Of an estimated 972 million people with hypertension, 65.7% lived in developing countries [1].

20 Projections for 2025 suggest a 60% increase and 1.56 billion people could be affected
 21 globally. A higher rate of increase (80%) is projected among those in developing countries.
 22 Empirically, studies in African countries have confirmed this projection. Thirty to forty years
 23 ago, the prevalence of hypertension hardly exceeded 10% among adults in African countries
 24 such as Kenya, Ghana and South Africa [2, 3]. More recent studies have reported
 25 prevalence in adult populations varying between 20 and 35% [4-8]. In Burkina Faso, studies
 26 on the urban adult population of Ouagadougou reported prevalence 23.0% for those aged 18
 27 and older [9], 40.2% for those aged 35 years and older [10], and 21.9% those aged between
 28 25 and 60 years [11]. Most alarming were reports documenting that in a rural community in
 29 Nigeria and some urban areas in Senegal, among people over 40 years of age, more than
 30 45% were hypertensive [12, 13]. These recent studies show that in African countries, the
 31 prevalence of hypertension is generally increasing in urban and in rural areas [14, 15].

32

33 The consequence of high prevalence of hypertension has also emerged. In Sub-Saharan
 34 African countries, while leading disease burdens were still childhood diseases and those
 35 related to poverty [16], an increase of non-communicable diseases related to hypertension
 36 was observed. Therefore, it is important to understand the prevalence and risk factors for
 37 this condition to prevent the development of new epidemics.

38

39 Suspected risk factors have been shown to be associated with urbanization [10] hence it is
 40 particularly important to understand the situation in rural and semi-urban areas in Africa as
 41 they are inevitably undergoing urbanization. Because such information is still lacking, we
 42 conducted a study to estimate the prevalence of hypertension and to identify associated
 43 factors in rural and semi-urban populations in Burkina Faso.

44

45 2. METHODS

46

47 2.1. Study Area

48 In Kaya health district, one of the 64th health districts of Burkina Faso, the Kaya Health and
 49 Demographic Surveillance System (Kaya HDSS) has been in operation since 2007 under
 50 the auspice of Institut de Recherche en Sciences de la Santé (IRSS). The system was
 51 established to collect demographic and health information to guide the development of
 52 health policies. It is affiliated with the International Network for the Demographic Evaluation
 53 of Population and their Health (INDEPTH) (www.indepth-network.org). Kaya HDSS, is
 54 situated 100 km from Ouagadougou (Figure 1). Its covers all the seven sectors of the semi-

urban areas and 18 villages situated in the rural areas around the city of Kaya. In 2012, the population was 67 676 inhabitants in 11 083 households, with an average size of 6.1. The population is 70% semi-urban and 30% rural, about 80% are Muslims. The semi-urban areas have cadastral organizations with streets. There are public services such as: tap water, electricity, telephones, and a regional hospital. Parcels of land have been allocated to inhabitants. The rural areas have no cadastral organization. Dwellings are separated by fields. There are no public services; except rarely a primary school or a health centre managed by a nurse. Rural inhabitants are almost all aboriginals, practicing agriculture or animal husbandry.

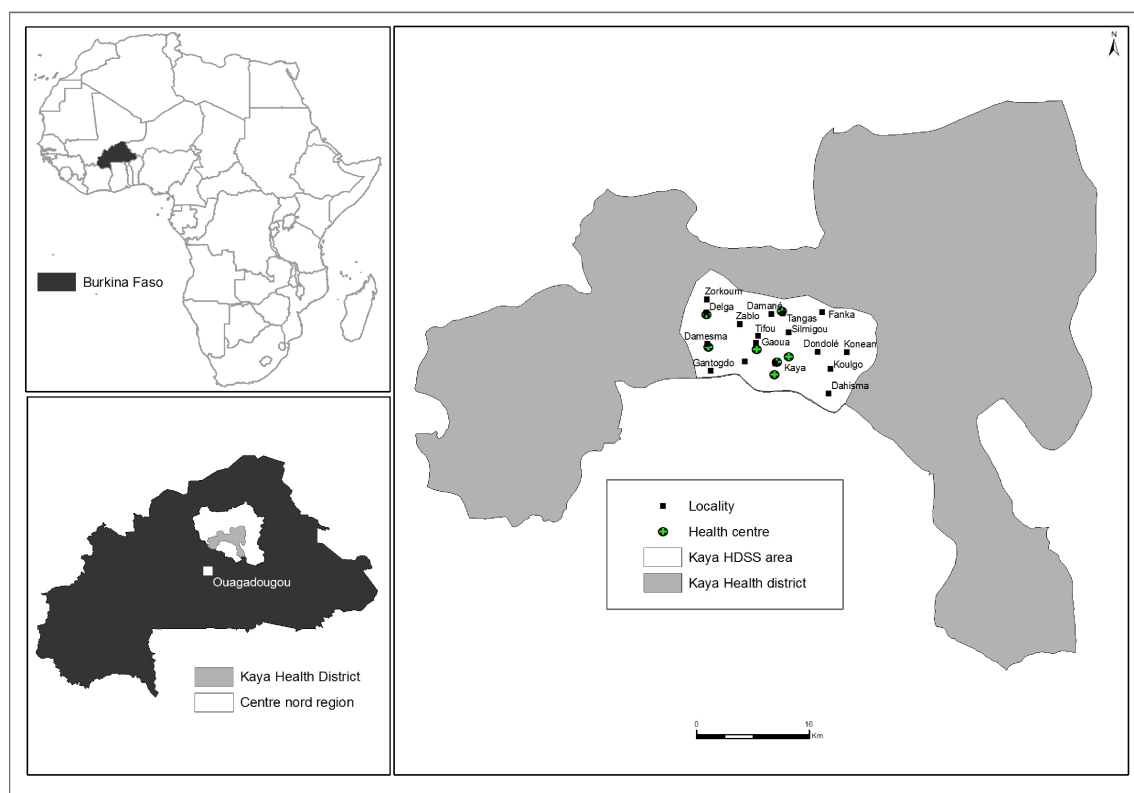


Figure 1 : Kaya HDSS location

2.2. Study design

This is a community-based cross-sectional study. The study population included all residents who were 18 years and older residing in the Kaya HDSS between September and December 2012. Two strata (rural and semi-urban) were sampled; the Kaya HDSS list of households was used as sampling frame. In each household, one person was randomly selected among people who were at least 18 years old.

2.3. Data collection

Participants were interviewed at home by trained interviewers in the local language (Mooré) using a computer aided questionnaire. The information was directly recorded using laptop computers.

2.4. Variables

Blood pressure (BP) was measured on a single occasion at home by a trained interviewer using a digital automatic sphygmomanometer (Omron 3) with the appropriate cuff size. At the end of the interview, after about 25 to 30 minutes' rest in a seating position, BP and pulse were measured. BP was taken successively on the two arms; on the arm with the higher reading; two other readings were taken one minute apart. The mean of these two readings was used to determine hypertension [17]. In accordance with the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation and Treatment of High Blood Pressure, those who had a systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg were considered hypertensive. Similarly for those who reported current use of anti-hypertensive medications [17].

Weight and height were measured with participants lightly dressed and after removal of shoes and pocket contents. Height was measured using a wooden stadiometer. Body mass index (BMI) was calculated by dividing the weight (kg) with the square of the height (m^2). Participants were considered "underweight" when their BMI < 18.5 ; "normal weight" when $18.5 \leq \text{BMI} < 25$; "overweight" when $25 \leq \text{BMI} < 30$; "obese" when BMI ≥ 30 [18].

Age, sex, marital status, place of residence, education, and occupation were inquired. The World Health Organization STEPS, an instrument for ascertaining non-communicable disease risk factors, was used to collect information on behavioral factors [19]. For smoking, the question "Do you currently smoke tobacco products such as cigarettes, cigars or pipe?" was asked. If the answer was negative, a second question "In the past, did you smoke daily?" was asked to identify ex-smokers. Due to the small number of ex-smokers, smokers and ex-smokers were combined into one single category. For alcohol, the question was: "Have you ever consumed alcoholic beverages such as beer, wine, liquor, dolo (local beer)?" For physical activities, the participants were asked whether they had intensive activities in their current occupation, (activities that required a substantial increase in breathing or heart rate for at least 10 minutes), or moderate activities (activity that required

111 moderate increase in breathing or heart rate for at least 10 minutes). Further, the
112 participants were asked if in their leisure time, they took part in sports or other intense
113 activities or moderate activities. Participants who had intense or moderate work or leisure
114 activities were classified as “having vigorous physical activity”; otherwise as “having non-
115 vigorous physical activity”.

116

117 Psychological distress was evaluated using the 28-item General Health Questionnaire
118 (GHQ). This questionnaire was designed to assess common mental health in general
119 medical practice and in the community [20, 21]. It was originally designed in a 60-item
120 format. Many shorter versions have been derived (12-item, 28-item, 30-item) but the 28-item
121 format had been validated prior to this study in African populations [20, 22]. It has four
122 subscales, each with seven items: somatic symptoms, anxiety and insomnia, social
123 dysfunction, and severe depression.[20] For each item, there are four answers that ranged
124 from best to worst. We used the binary scoring method [22]. The two best symptomatic
125 answers scored “0” while the two worst symptomatic answers scored “1”. The final score
126 had a possible range of “0” to “28”. Participants were considered having psychological
127 distress if the total score was “5” or higher.

128

129 For general health status, the participants were asked to assess their current health as “very
130 good”, “good”, “fair”, “poor”, or “very low”. Answers were then recoded as good (“for very
131 good” and “good”), moderate (for “fair”) and low (for “poor” and “very poor”).

132

133 Chronic conditions were assessed by asking the participants whether they had ever been
134 told by a health professional that they had a chronic disease such as diabetes mellitus,
135 cancer, AIDS, heart problems, or asthma. Family history of hypertension was assessed by
136 asking the participants if one of their grandparents, father, mother, brother or sister had
137 hypertension.

138

139 **2.5. Statistical Analysis**

140

141 Chi square tests were used to assess differences in prevalence of hypertension by levels of
142 categorical risk factors. Logistic regression was used to estimate adjusted odds ratios for
143 each risk factor for hypertension. All statistical tests were two-tailed and were performed
144 using IBM SPSS 20 for Windows.

145

146

147 3. RESULTS

148
149 The stratified random selection resulted in 1645 households, 148 were not found due to
150 inaccuracies in address and another 16 could not be located. From each located household,
151 one member who was at least 18 years old were invited to participate. No one refused. The
152 final sample size was 1481. One stratum with 726 participants was from rural areas and the
153 other stratum, with 755 participants was from semi-urban areas. The proportions of men and
154 women were approximately equal in both strata. Men from semi-urban areas were younger
155 than men from rural areas. Ages of women were similar (Table 1).

156
157 The participants were mostly young and had low levels of education. Regular employment
158 was almost non-existent in the rural areas for both men and women and very rare among
159 semi-urban women. Overweight and obesity were rare in the rural areas and only relatively
160 frequent among semi-urban women. Less than thirty five per cent of men, and practically no
161 women, in both rural and in semi-urban areas smoked. "Ever had alcohol intake" was
162 reported by a minority of both men and women, in rural and semi-urban areas. Rural
163 participants were more physically active and reported less frequent family history of
164 hypertension than participants living in semi-urban areas (Table 1).

165
166 **Table 1 : Characteristics of participants by residence and by sex**
167

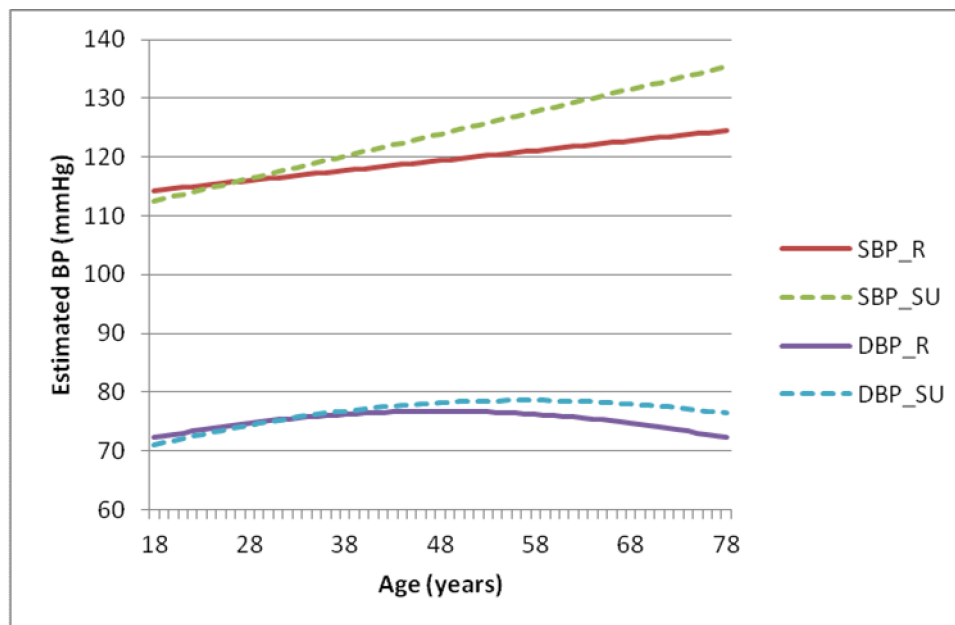
	Men			Women			All		
	Rural (n=329)	Semi- Urban (n=337)	P-value	Rural (n=397)	Semi- urban (418)	P-value	Rural (n=726)	Semi- urban (n=755)	P-value
<u>Age</u>			.001			.351			.453
18-24	7.0	14.8		21.2	21.3		14.7	18.4	
25-34	27.4	33.8		35.0	30.4		31.5	31.9	
35-44	22.2	20.5		17.6	17.5		19.7	18.8	
45-54	18.5	16.0		14.6	13.9		16.4	14.8	
55-64	15.8	8.6		6.8	9.8		10.9	9.3	
65+	9.1	6.2		4.8	7.2		6.7	6.8	
<u>Civil status</u>			.002			.000			.000
Married	88.1	79.2		88.2	75.8		88.2	77.4	
Other	11.9	20.8		11.8	24.2		11.8	22.6	
<u>Education</u>			.000			.000			.000
Illiterate	77.5	58.5		88.4	60.5		83.5	59.6	
Read/Write	22.5	41.5		11.6	39.5		16.5	40.4	
<u>Occupational status</u>			.000			.000			.000
Employed	0.9	15.1		1.0	6.9		1.0	10.6	
Independent	74.5	70.0		42.3	44.5		56.9	55.9	
Unpaid job	24.6	14.8		56.7	48.6		42.1	33.5	
<u>Body Mass Index</u>			.000			.000			.000

<u>(Kg/m²)*</u>								
<18.5	19.8	8.0		23.5	13.0		21.7	10.7
18.5 to 24.99	75.7	80.1		68.2	59.3		71.8	68.9
≥25	4.6	11.9		8.4	27.7		6.6	20.4
<u>Smoking status</u>			.476			.719		.409
No smoker	65.3	68.0		99.0	99.3		83.7	85.3
Smoker or ex-smoker	34.7	32.0		1.0	0.7		16.3	14.7
<u>Alcohol intake</u>			.375			.431		.921
Never	71.7	74.8		81.6	79.4		77.1	77.4
Yes	28.3	25.2		18.4	20.6		22.9	22.6
<u>Physical activity</u>			.000			.000		.000
Vigorous	85.7	57.3		84.6	33.0		85.1	43.8
Non vigorous	14.3	42.7		15.4	67.0		14.9	56.2
<u>Chronic conditions</u>			.707			.014		.034
No	97.0	96.4		98.0	94.7		97.5	95.5
Yes	3.0	3.6		2.0	5.3		2.5	4.5
<u>Psychological distress</u>			.026			.259		.021
No	54.7	63.2		49.9	53.8		52.1	58.0
Yes	45.3	36.8		50.1	46.2		47.9	42.0
<u>Self-rated health</u>			.007			.060		.001
Good	74.8	81.9		71.5	77.0		73.0	79.2
Moderate	23.7	14.8		26.4	19.9		25.2	17.6
Low	1.5	3.3		2.0	3.1		1.8	3.2
<u>Family history of hypertension</u>			.003			.000		.000
No	86.9	78.3		89.7	73.9		88.4	75.9
Yes	13.1	21.7		10.3	26.1		11.6	24.1

168

169 Association between BP and age is illustrated in Figure 2. Systolic BP increased slightly with
 170 age. The slope of the regression line for the semi-urban participants was statistically different
 171 from zero ($b = 0.38$; $se(b) = 0.03$; $P = .000$) and from the slope for the rural participants ($b =$
 172 0.17 ; $se(b) = 0.03$, $P = .000$ in test of differences in slopes). A cubic polynomial was fitted to
 173 the data to illustrate the relationship between diastolic BP and age. Diastolic BP increased
 174 before age 50 and apparently decreased after that. The difference between slopes for the
 175 semi-urban and rural areas was not statistically significant.

176



177
178

179 **Figure 2 : Estimated systolic (SBP) and diastolic (DBP) blood pressures by age and**
180 **place of residence (R=rural and SU=semi-urban) among Kaya HDSS adults**

181

182 The overall weighted prevalence of hypertension was 9.4% (95% CI: 7.3%-11.4%); lower in
183 rural areas (5.5%; 95% CI: 3.8%-7.1%) than in the semi-urban areas (11.0%; 95% CI: 8.8%-
184 13.2%) (Table 2). In both rural and semi-urban areas, prevalence of hypertension increased
185 with age. In rural areas, there was no significant difference in hypertension between married
186 and unmarried people (5.6% vs. 4.7%; $P = .48$), whereas in the semi-urban areas, that
187 difference was statistically significant (9.4% vs. 16.4%; $P = .01$).

188

189 **Table 2: Prevalence of hypertension according to socio-demographic characteristics**
190 **by area of residence**

191

	Rural			Semi-Urban		
	%	P-value	95% CI	%	P-value	95% CI
All	5.5		3.8-7.1	11.0		8.8-13.2
Sex		.111			.632	
Female	4.3		2.3-6.3	11.5		8.4-4.6
male	7.0		4.2-9.8	10.4		7.1-13.7
Age, (years)		.007			.000	
18 to 24	1.9		0.0-4.5	2.2		0.0-4.6
25 to 34	2.6		0.5-4.7	2.5		0.5-4.5
35 to 44	5.6		1.8-9.4	9.9		4.9-14.8
45 to 54	8.4		3.4-13.5	19.6		12.2-27.1

55 to 64	10.1		3.3-16.9	22.9		12.8-32.9
65+	12.2		2.7-21.8	43.1		29.1-57.2
<u>Civil status</u>		.476			.011	
Married	5.6		3.8-7.4	9.4		7.0-11.8
Other	4.7		0.1-9.2	16.4		10.8-22.0
<u>Education</u>		.789			.403	
Illiterate	5.6		3.8-7.5	11.8		8.8-14.8
Read/write	5.0		1.0-9.0	9.8		6.5-13.2
<u>Occupational status</u>		.814			.074	
Employed	0.0		-	10.0		3.3-16.7
Independent	5.6		3.4-7.8	9.0		6.3-11.8
Unpaid job	5.6		3.0-8.1	14.6		10.2-19.0

192

193 The prevalence of hypertension according to behavioral risk factors and chronic conditions is
 194 shown in Table 3. Both smoking and alcohol intake were not associated with hypertension.
 195 Other than that, the rural and semi-urban areas appeared to be quite different with respect to
 196 these possible risk factors. In the rural areas, only body mass index was associated with
 197 prevalence of hypertension ($P = .02$). In the semi-urban areas, body mass index had no
 198 effect ($P = .56$) but “having non-vigorous physical activities”, “having psychological stress”,
 199 “having a chronic health condition” and “self-reported poor health” were associated with
 200 higher prevalence of the condition (all with $P = .00$). “Having a family history of hypertension”
 201 might also be associated with hypertension in the participants ($P = .06$).

202

203 **Table 3: Prevalence of hypertension according to behavioral risk factors and chronic**
 204 **conditions**

205

	Rural			Semi-Urban		
	%	<i>P</i> -value	95% CI	%	<i>P</i> -value	95% CI
<u>Physical activity</u>		.982			.004	
No-vigorous	5.6		1.2-10.0	13.9		10.6-17.2
Vigorous	5.5		3.7-7.3	7.3		4.4-10.1
<u>Body Mass Index</u>		.015			.562	
(Kg/m²)*						
<18.5	4.7		1.3-8.1	14.1		6.2-22.0
18.5 to 24.99	5.3		3.3-7.3	10.3		7.7-13.0
≥ 25	15.6		4.5-26.6	12.2		6.8-17.4
<u>Smoking status</u>		.508			.793	
No smoker	5.8		3.9-7.6	10.9		8.5-13.3
Smoker or ex-smoker	4.2		0.6-7.9	11.7		5.6-17.8
<u>Alcohol intake</u>		.955			.738	
Never	5.5		3.6-7.5	10.8		8.3-13.3
Yes	5.4		1.9-8.9	11.7		6.8-16.7
<u>Psychological distress</u>		.116			.000	

No	4.2		2.2-6.5	7.5		5.1-10.0
Yes	6.9		4.2-9.6	15.8		11.7-19.8
<u>Family history of hypertension</u>		.228			.057	
No	5.1		3.4-6.9	9.8		7.3-12.2
Yes	8.3		2.3-14.4	14.8		9.6-20.1
<u>Chronic conditions</u>		.261			.000	
No	5.4		3.7-7.1	10.0		7.8-12.2
Yes	11.1		0.0-27.2	32.4		15.8-49.0
<u>Self-rated health</u>		.138			.001	
Good	4.7		2.9-6.5	9.0		6.7-11.3
Moderate	7.1		3.4-10.9	16.5		10.1-22.9
low	15.4		0.0-38.1	29.2		9.6-48.8

*excluding pregnant women

With logistic analyses, unadjusted and adjusted odds ratios for risk factors were estimated (Table 4). In unadjusted separate analysis, the odds of hypertension increased significantly with age, presence of chronic conditions (OR = 4.00; 95% CI: 2.07-7.71), presence of family history of hypertension (OR = 1.85; 95% CI: 1.22-2.82), presence of psychological distress (OR = 1.96; 95% CI: 1.35-2.86), having non-vigorous activity (OR = 2.14; 95% CI: 1.48-3.10) overweight (OR= 1.70; 95% CI: 1.06-2.73); and living in a semi-urban area (OR = 2.12; 95% CI: 1.43-3.14). After adjustment for all covariates, only age, semi-urban area and presence of family history of hypertension remained significantly associated with the odds of hypertension.

Table 4 : Associations of selected risk factors with prevalence of hypertension

Characteristics	Prevalence of hypertension	Unadjusted	Adjusted
	n(%)	Odds ratio (95% CI)	Odds ratio (95% CI)
<u>Age, years</u>			
Continuous		1.05 (1.04-1.07)^d	1.06 (1.05-1.07)^d
18 to 24	5 (2.0)	1	1
25 to 34	12 (2.6)	1.26 (0.44-3.64)	1.21 (0.42-3.51)
35 to 44	22 (7.7)	4.03 (1.50-10.81)^c	4.13 (1.52-11.23)^c
45 to 54	32 (13.9)	7.75 (2.96-20.26)^d	8.80 (3.32-23.35)^d
55 to 64	24 (16.1)	9.25 (3.45-24.84)^d	10.50 (3.84-28.71)^d
65+	28 (28.0)	18.74 (6.98-50.31)^d	22.43 (8.08-62.03)^d
<u>Sex</u>			
Female	65(8.0)	1	1
Male	58(8.7)	1.10 (0.76-1.59)	0.96 (0.61-1.52)
<u>Residence</u>			
Rural	40 (5.5)	1	1
Semi-urban	83 (11.0)	2.12 (1.43-3.14)^d	1.69 (1.07-2.69)^a
<u>Chronic conditions</u>			
No	110 (7.7)	1	1

Yes	13 (25.0)	4.00 (2.07-7.71)^d	1.71 (0.82-3.56)
<u>Family history of hypertension</u>			
No	89 (7.3)	1	1
Yes	34 (12.8)	1.85 (1.22-2.82)^b	1.97 (1.24-3.13)^b
<u>Psychological distress</u>			
No	49 (6.0)	1	1
Yes	74 (11.1)	1.96 (1.35-2.86)^d	1.15 (0.73-1.81)
<u>Physical activity</u>			
Vigorous	58 (6.1)	1	1
Non-vigorous	65 (12.2)	2.14 (1.48-3.10)^d	1.27 (0.81-1.99)
<u>Body Mass Index (Kg/m²)*</u>			
<18.5	18 (7.9)	1.01 (0.59-1.73)	0.65 (0.35-1.18)
18.5 to 24.99	78 (7.8)	1	1
≥25	25 (12.9)	1.74 (1.08-2.81)^a	1.29 (0.76-2.20)
<u>Smoking status</u>			
No smoker	105 (8.4)	1	1
Smoker or ex-smoker	18 (7.9)	0.93 (0.55-1.57)	1.17 (0.64-1.14)
<u>Alcohol intake</u>			
Never	94 (8.2)	1	1
Yes	29 (8.6)	1.05 (0.68-1.63)	0.94 (0.59-1.48)

*excluding pregnant women; ^aP = .02; ^bP = .006; ^cP = .004; ^dP = .000

4. DISCUSSION

We found low prevalence of hypertension among participants from Kaya HDSS as a whole; with higher prevalence in semi-urban areas compared to that of the rural areas. This is not an isolated observation; a study conducted in Ethiopia, another sub-Saharan country also reported similarly low prevalence. Our group with age interval 18 to 64, had a prevalence of hypertension (7.6%) similar to that reported for Ethiopia (8.2%) among 25-64 years olds [23]. Other than that, we found generally lower prevalence than previously reported.

Our result in rural areas (5.5%) is lower than those of other studies in rural regions of Africa. They found between 12.5% and 32.2% among population 18 years and older [4, 14, 24, 25]. Also, studies conducted in rural and urban populations aged 15 years and older in West African countries reported higher prevalence, between 21% and 30%. [4, 26-29]

Our result in semi-urban areas (11%) is lower than results reported by previous studies in Africa, including those carried out in Ouagadougou, which ranged from 21 to 31% among population aged 16 years and older [4, 9, 30]. It is also lower than that found in urban areas of Africa with similar but slightly older participants (25 years and older) [10, 11, 31, 32].

241 As anticipated, prevalence of hypertension rose with age in our participants. However,
 242 mean systolic blood pressure did not reach the threshold of hypertension (140 mmHg) even
 243 at 65 years and older. The rate of increase is similar to that estimated in a Ghana rural
 244 community [14]. It is lower than what was observed in European populations, where
 245 increases with age were steeper and exceeding 140mmHg at ages 65-69 years [33]. The
 246 average diastolic pressure in our participants, seemed to increase slowly with age up to 80
 247 mmHg during the fifties, then declined. This pattern has been reported in other areas in
 248 Africa [14].

249

250 Taking all these findings together, we conclude that prevalence of hypertension remains low
 251 in rural areas, increased significantly in semi-urban areas but still below that of urban areas.
 252 Among participants from semi-urban areas, it also increased with age, although at a lower
 253 rate than in European populations.

254

255 Our observation that the prevalence of hypertension was significantly higher in semi-urban
 256 areas than in rural areas points to risk factors inherent in semi-urban living. This is also
 257 supported by our finding that after adjusting for rural/semi-urban living, most of the other risk
 258 factors became insignificant. Tesfaye compared three sites in three countries with different
 259 levels of development (Ethiopia, Vietnam, Indonesia) and found that the more developed the
 260 country, the higher the hypertension prevalence [23]. Moreover, previous studies have
 261 shown that hypertension increases with urbanization in African populations [23, 31, 34, 35].
 262 These findings suggest that the increase in hypertension may be the result of urban life.
 263 Possible causes include stress, reduced physical activity, diet changes, and smoking[36].

264

265 In Kaya HDSS, the rural population is predominantly agricultural with strenuous physical
 266 efforts in daily work and transport (by foot or bike). In semi-urban areas, informal trade is
 267 predominant. Much transportation is done by motorized means (motorcycle, car, taxi). The
 268 change in diet may also be a factor in urbanization. A study in Benin found that diet in the
 269 more urbanized area was less preventive against chronic diseases after controlling for
 270 income [37]. Future studies on dietary differences in Burkina Faso would be useful in
 271 identifying specific dietary risk factors.

272

273 Furthermore, we found that psychological distress was associated with a high prevalence of
 274 hypertension in semi-urban areas; a likely product of urbanization [38]. In the urban
 275 population of South Africa, this association was found especially among men [22]. A meta-

276 analysis in the western population reported that, depression, one manifestation of
277 psychological distress, was probably an independent risk factor for hypertension[39].

278

279 Family history was identified as a risk factor of hypertension. A South African study reported
280 such an association [40]. However, the rural population is poorly served by health services
281 and most people did not know whether their parents or siblings had been diagnosed with
282 hypertension. This lack of recognition may explain why it is only a risk factor among semi-
283 urban participants. Similar conclusion could be drawn regarding self-recognized chronic
284 diseases.

285

286 **Strengths and limitations of the study:** The study sample was randomly selected and
287 participation is 100% among those we could locate. This enables us to infer our findings
288 confidently to the target population as a whole. Nevertheless, we are aware of some
289 limitations of this study. Blood pressure was based on a single visit, which might have
290 overestimated the prevalence [41] but an adequate rest period could minimize such an
291 effect. Psychological stress measured by GHQ administered by an interviewer instead of
292 self-administration may result in misclassification. This phenomenon could have occurred
293 because participants might tend to produce responses perceived to be expected by the
294 interviewers. Such misclassifications could dilute the association between GHQ and
295 hypertension. Furthermore, self-reporting of family history and chronic diseases likely had
296 led to underestimation of their prevalence due to lack of health services and low education of
297 the participants.

298

299 5. CONCLUSION

300 Our findings suggest that while prevalence of hypertension remains relatively low in the rural
301 areas of Kaya, the semi-rural areas exhibit a trend towards higher prevalence. Moreover,
302 almost all the risk factors associated with urbanization were confirmed in the semi-rural
303 sample of our study. Consequently, preventive measures related to urbanization are needed
304 to curb the development of hypertension in rural and semi-urban areas. Possible actions
305 include: keeping healthy features of traditional diets to maintain healthy body weight,
306 increase in physical activity, and maintaining mental health. In parallel, because
307 hypertension is a known risk factor of heart disease, measures to control other heart disease
308 risk factors such as smoking and high fat diets should be taken to prevent an epidemic of
309 heart diseases and stroke in developing countries such as Burkina Faso.

310

311

312 **COMPETING INTERESTS**

313 The authors declare that they have no competing interests

314

315 **AUTHORS' CONTRIBUTIONS**

316 BD designed the study, collected and analyzed the data, drafted and reviewed the paper. SK
317 designed the study, drafted and reviewed the paper. AB and LN participated to data
318 collection and reviewed the paper. MVZ designed the study, supervised data analysis,
319 drafted and reviewed the paper. All authors read and approved the final manuscript.

320

321 **CONSENT**

322 Informed consent was signed by all the participants.

323

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