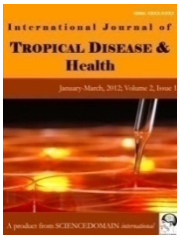

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Hypertension in the Adult Population of Kaya Health and Demographic Surveillance System in Burkina Faso: Prevalence and Associated Factors

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Authors' contributions

This work was carried out in collaboration between all authors. Author BD designed the study, collected and analyzed the data, drafted and reviewed the paper. Author SK designed the study, drafted and reviewed the paper. Authors AB and LN participated to data collection and reviewed the paper. Author MVZ designed the study, supervised data analysis, reviewed the paper. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Background: Recent scientific reports have shown that high blood pressure is a major public health problem 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

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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 measurements were carried out. Two blood pressure (BP) measurements were taken after sitting at rest 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 taking hypertensive medication were also considered hypertensive. Logistic regression was carried out 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 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.

Conclusion: Hypertension prevalence was higher in semi-urban than in rural areas of Kaya HDSS, but was overall relatively low. However, it may be possible to further reduce its prevalence and prevent increasing prevalence by acting on the identified risk factors. Encouragement to maintain low body weight through traditional diets and to increase physical activity could be beneficial.

Keywords: Hypertension; Kaya; health and demographic surveillance system; urbanization.

1. INTRODUCTION

In 2000, the global prevalence of hypertension was estimated at 26.4% among adults. Of an estimated 972 million people with hypertension, 65.7% lived in developing countries [1]. Projections for 2025 suggest a 60% increase and 1.56 billion people could be affected globally. A steeper increase (80%) is projected among populations living in developing countries. Prevalence studies in African countries have confirmed this projection. Four decades ago, prevalence of hypertension hardly exceeded 10% among adults in countries such as Kenya, Ghana and South Africa [2-4]. More recent studies have reported prevalence estimates in adult populations varying between 20 and 35% [5-9]. In Burkina Faso, studies on the urban adult population of Ouagadougou reported prevalence of 23% for those aged 18 years and older [10], 40.2% for those aged 35 years and older [11], and 22% between 25 and 60 years of age [12]. Most alarming reports came from a rural community in Nigeria and some urban areas in Senegal, where more than 45% over 40 years of age were hypertensive [13,14]. These recent studies show that in African countries, the prevalence of hypertension is generally increasing in both urban and rural areas [15,16].

Consequences of high prevalence of hypertension has also emerged. In Sub-Saharan African countries, while leading disease burdens are still childhood diseases and those related to poverty [17], an increase in non-communicable diseases related to hypertension has been observed. Better knowledge of the prevalence and risk factors for this chronic condition is needed to prevent cardiovascular and stroke epidemics.

Most hypertension risk factors have been shown to be associated with urbanization [11]. Hence it is particularly important to understand the situation in rural and semi-urban areas in Africa as they are rapidly undergoing urbanization. Because such information is still lacking,

we conducted a cross-sectional study to estimate the prevalence of hypertension and to identify associated factors in rural and semi-urban populations in Burkina Faso.

2. METHODS

2.1 Study Area

In Kaya health district, one of the 64 health districts of Burkina Faso, the Kaya Health and Demographic Surveillance System (Kaya HDSS) has been in operation since 2007 under the auspice of Institut de Recherche en Sciences de la Santé (IRSS). The system was established to collect demographic and health information to guide the development of health policies. It is affiliated with the International Network for the Demographic Evaluation of Population and their Health (INDEPTH) (www.indepth-network.org). Kaya HDSS, is situated 100 km from Ouagadougou (Fig. 1). It 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% is Muslims. The semi-urban areas have cadastral organizations with streets. There are public services such as: tap water, electricity, telephone, 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 few public services such as a primary school or a health centre managed by a nurse. Rural inhabitants are almost all natives, practicing agriculture or animal husbandry.

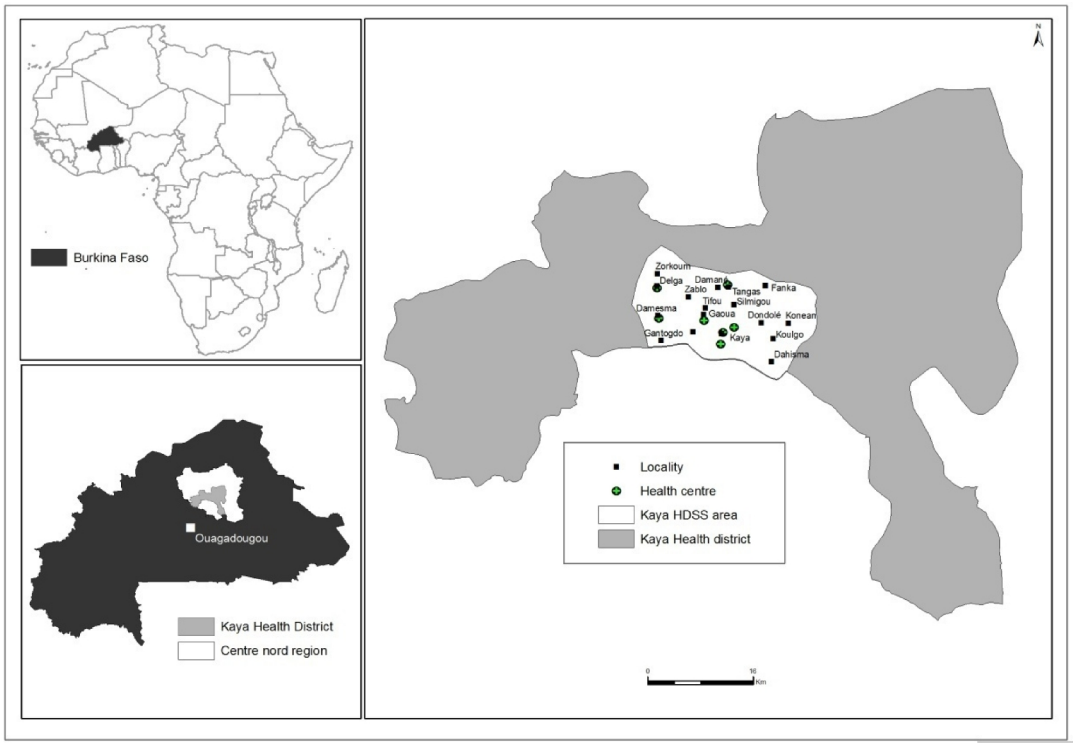

Fig. 1. Kaya HDSS location

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. Before visiting the household, one person was randomly selected among people living at that household 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 William software version 1.5 of MultiSpectra.

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 sitting 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 [18]. 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 or those who reported current use of anti-hypertensive medications were considered hypertensive [19]. All newly screened hypertensive participants were referred to a health facility for diagnosis and possible treatment.

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) by the square of height (m^2). Participants were considered "underweight" when their BMI < 18.5; "normal weight" when 18.5 ≤ BMI < 25; "pre-obese" when 25 ≤ BMI < 30; "obese" when BMI ≥ 30 [20].

Age, sex, marital status, place of residence, education, and occupation were recorded. The World Health Organization Stepwise Approach to Chronic Disease Risk Factor Surveillance (STEPS), an instrument for ascertaining non-communicable disease risk factors, was used to collect information on behavioral factors [18]. 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 (activities that required moderate increase in breathing or heart rate for at least 10 minutes). Furthermore, the participants were asked if in their leisure time, they took part in sports or other intense or moderate activities. Participants who had intense or moderate work or leisure activities were classified as "having vigorous physical

activity"; otherwise as "having non-vigorous physical activity". Brisk walking was coded as vigorous activity.

Psychological distress was evaluated using the 28-item General Health Questionnaire (GHQ). This questionnaire was designed to assess common mental health in general medical practice and in the community [21,22]. It was originally designed in a 60-item format. Many shorter versions have been derived (12-item, 28-item, 30-item) but the 28-item format had been validated prior to this study in African populations [21,23]. It has four subscales, each with seven items: somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression [21]. For each item, there are four answers that ranged from best to worst. We used the binary scoring method [23]. The two best symptomatic answers scored "0" while the two worst symptomatic answers scored "1". The final score had a possible range of "0" to "28". Participants were considered having psychological distress if the total score was "5" or higher [23].

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

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

2.5 Statistical Analysis

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

3. RESULTS

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

Table 1. Characteristics of participants by residence and by sex (N=1481)

	Men		Women		All	
	Rural (n=329) n (%)	Semi-Urban (n=337) n (%)	Rural (n=397) n (%)	Semi-urban (n=418) n (%)	Rural (n=726) n (%)	Semi-urban (n=755) n (%)
Median Age (years)	42.0	35.0	32.0	34.0	36.0	34.0
Civil status						
Married	290 (88.1)	267 (79.2)	350 (88.2)	317 (75.8)	640 (88.2)	584 (77.4)
Other	39 (11.9)	70 (20.8)	47 (11.8)	101 (24.2)	86 (11.8)	171 (22.6)
	P-value=.002		*P*-value = .000		*P*-value = .000	
Education						
Illiterate	255 (77.5)	197 (58.5)	351 (88.4)	253 (60.5)	606 (83.5)	450 (59.6)
Read/Write	74 (22.5)	140 (41.5)	46 (11.6)	165 (39.5)	120 (16.5)	305 (40.4)
	P-value = .000		*P*-value = .000		*P*-value = .000	
Occupational status						
Employed	3 (0.9)	51 (15.1)	4 (1.0)	29 (6.9)	7 (1.0)	80 (10.6)
Independent	245 (74.5)	236 (70.0)	168 (42.3)	186 (44.5)	413 (56.9)	422 (55.9)
Unpaid job	81 (24.6)	50 (14.8)	225 (56.7)	203 (48.6)	306 (42.1)	253 (33.5)
	P-value = .000		*P*-value = .000		*P*-value = .000	
Family history of hypertension						
No						
Yes	286 (86.9)	264 (78.3)	356 (89.7)	309 (73.9)	642 (88.4)	573 (75.9)
	43 (13.1)	73 (21.7)	41 (10.3)	109 (26.1)	84 (11.6)	182 (24.1)
	P-value = .003		*P*-value = .000		*P*-value = .000	
Self-rated health						
Good	246 (74.8)	276 (81.9)	284 (71.5)	322 (77.0)	530 (73.0)	598 (79.2)
Moderate	78 (23.7)	50 (14.8)	105 (26.4)	83 (19.9)	183 (25.2)	133 (17.6)
Low	5 (1.5)	11 (3.3)	8 (2.0)	13 (3.1)	13 (1.8)	24 (3.2)
	P-value = .007		*P*-value = .060		*P*-value = .001	
Chronic conditions						
No	319 (97.0)	325 (96.4)	389 (98.0)	396 (94.7)	708 (97.5)	721 (95.5)
Yes	10 (3.0)	12 (3.6)	8 (2.0)	22 (5.3)	18 (2.5)	34 (4.5)
	P-value = .707		*P*-value = .014		*P*-value = .034	
Psychological distress						
No	180 (54.7)	213 (63.2)	198 (49.9)	225 (53.8)	378 (52.1)	438 (58.0)
Yes	149 (45.3)	124 (36.8)	199 (50.1)	193 (46.2)	348 (47.9)	317 (42.0)
	P-value = .026		*P*-value = .259		*P*-value = .021	

Body Mass Index (Kg/m^2)*						
<18.5	65 (19.8)	27 (8.0)	84 (23.5)	51 (13.0)	149 (21.7)	78 (10.7)
18.5 to 24.99	249 (75.7)	270 (80.1)	244 (68.2)	233 (59.3)	493 (71.8)	503 (68.9)
≥25	15 (4.6)	40 (11.9)	30 (8.4)	109 (27.7)	45 (6.6)	149 (20.4)
	P-value = .000		*P*-value = .000		*P*-value = .000	
Smoking status						
No smoker	215 (65.3)	229 (68.0)	393 (99.0)	415 (99.3)	608 (83.7)	644 (85.3)
Smoker or ex-smoker	114 (34.7)	108 (32.0)	4 (1.0)	3 (0.7)	118 (16.3)	111 (14.7)
	P-value = .476		*P*-value = .719		*P*-value = .409	
Alcohol intake						
Never	236 (71.7)	252 (74.8)	324 (81.6)	332 (79.4)	560 (77.1)	584 (77.4)
Yes	93 (28.3)	85 (25.2)	73 (18.4)	86 (20.6)	166 (22.9)	171 (22.6)
	P-value = .375		*P*-value = .431		*P*-value = .921	
Physicalactivity						
Vigorous	282 (85.7)	193 (57.3)	336 (84.6)	138 (33.0)	618 (85.1)	331 (43.8)
Non vigorous	47 (14.3)	144 (42.7)	61 (15.4)	280 (67.0)	108 (14.9)	424 (56.2)
	P-value = .000		*P*-value = .000		*P*-value = .000	

** excluding pregnant women in rural areas (39) and in semi-urban areas (25);*

The P-value was generated from the χ^2 test and compares rural population to semi-urban population, for each variable among men, women and all sex.

Participants were mostly young and had low levels of education. Regular employment was almost non-existent in the rural areas for both men and women and was very rare among semi-urban women. Overweight (BMI≥25) was uncommon in the rural areas and only relatively frequent among semi-urban women. Less than 35% of men, and practically no women, in both rural and in semi-urban areas smoked. “Ever had alcohol intake” was reported by few men and women, in rural and semi-urban areas.Rural participants were more physically active and reported less frequent family history of hypertension than participants living in semi-urban areas (Table 1). Our study population was comparable to the general population of Burkina Faso with 51.7% of women, 57.0% of people under 20 years old and 70% without any instruction [24].

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

Table 2. Prevalence of hypertension according to socio-demographic characteristics by area of residence (N=1481)

	Rural (n=726)		**Semi-Urban (n=755)**	
	n (%)	**95% CI**	**n (%)**	**95% CI**
All	40/726 (5.5)	3.8-7.1	83/755 (11.0)	8.8-13.2
Sex				
Female	17/397 (4.3)	2.3-6.3	48/418 (11.5)	8.4-14.6
Male	23/329 (7.0)	4.2-9.8	35/337 (10.4)	7.1-13.7
	P-value = .111		*P*-value = .632	
Age, (years)				
18 to 24	2/107 (1.9)	0.0-4.5	3/139 (2.2)	0.0-4.6
25 to 34	6/229 (2.6)	0.5-4.7	6/241 (2.5)	0.5-4.5
35 to 44	8/143 (5.6)	1.8-9.4	14/142 (9.9)	4.9-14.8
45 to 54	10/119 (8.4)	3.4-13.5	22/112 (19.6)	12.2-27.1
55 to 64	8/79 (10.1)	3.3-16.9	16/70 (22.9)	12.8-32.9
65+	6/49 (12.2)	2.7-21.8	22/51 (43.1)	29.1-57.2
	P-value = .000		*P*-value = .000	
Civil status				
Married	36/640 (5.6)	3.8-7.4	55/584 (9.4)	7.0-11.8
Other	4/86 (4.7)	0.1-9.2	28/171 (16.4)	10.8-22.0
	P-value = .476		*P*-value = .011	
Education				
Illiterate	34/606 (5.6)	3.8-7.5	53/450 (11.8)	8.8-14.8
Read/write	6/120 (5.0)	1.0-9.0	30/305 (9.8)	6.5-13.2
	P-value = .789		*P*-value = .403	
Occupational status				
Employed	0/7 (-)	-	8/80 (10.0)	3.3-16.7
Independent	23/413 (5.6)	3.4-7.8	38/422 (9.0)	6.3-11.8
Unpaid job	17/306 (5.6)	3.0-8.1	37/253 (14.6)	10.2-19.0
	P-value = .814		*P*-value = .074	

For categorical variables, the P-value was generated from the χ^2 test. For the age groups, the p-value is based on the χ^2 test for trends.

Fig. 2 shows that the association between age and hypertension is linear. After age 30, hypertension prevalence increased faster in semi-urban compared to rural areas. High levels of hypertension > 15% were only observed in semi-urban populations 45 years and older.

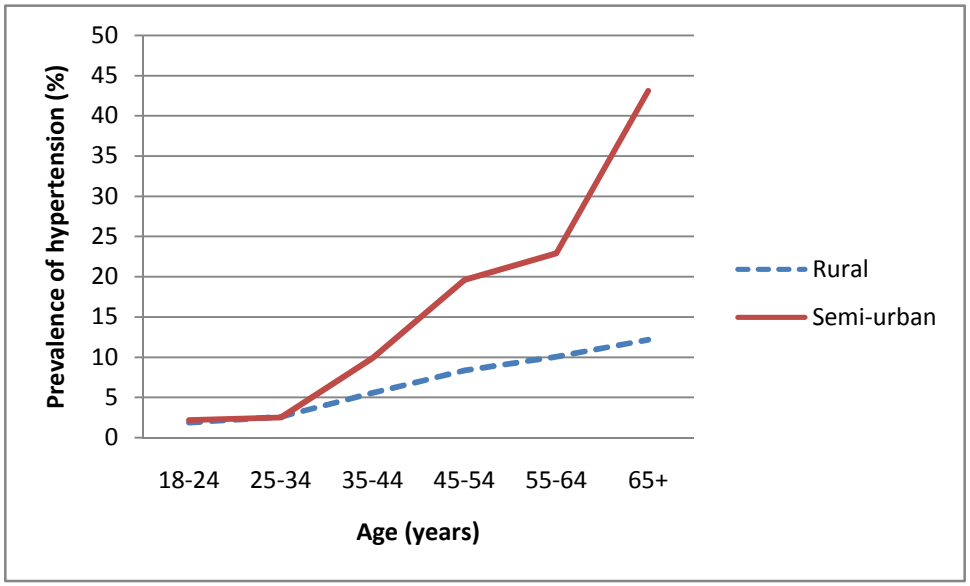

Fig. 2. Prevalence of hypertensionby age and place of residence (rural and semi-urban) among Kaya HDSS adults

The prevalence of hypertension according to behavioral risk factors and chronic conditions is shown in Table 3. Both smoking and alcohol intake were not associated with hypertension. Rural and semi-urban areas appeared to be quite different with respect to possible risk factors. In the rural areas, only body mass index was associated with prevalence of hypertension (*P* = .02). In the semi-urban areas, body mass index had no effect (*P* = .56) but "having non-vigorous physical activities", "having psychological distress", "having a chronic health condition" and "self-reported poor health" were associated with higher prevalence of the condition (all with *P* = .00).

Unadjusted and adjusted odds ratios for risk factors were estimated using logistic regressions (Table 4). In the unadjusted 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 older age, semi-urban areas and presence of family history of hypertension remained significantly associated with hypertension. Interaction terms of residence with physical activity was tested but they did not reach statistical significance (*P*=.103; 95% CI: 0.84-7.12).

Table 3. Prevalence of hypertension according to behavioral risk factors and chronic conditions (N=1481)

	Rural (n=726)		Semi-Urban (n=755)	
	n (%)	95% CI	n (%)	95% CI
Family history of hypertension				
No	33/642 (5.1)	3.4-6.9	56/573 (9.8)	7.3-12.2
Yes	7/84 (8.3)	2.3-14.4	27/182 (14.8)	9.6-20.1
	P-value = .228		*P*-value = .057	
Self-rated health				
Good	25/530 (4.7)	2.9-6.5	54/598 (9.0)	6.7-11.3
Moderate	13/183 (7.1)	3.4-10.9	22/133 (16.5)	10.1-22.9
low	2/13 (15.4)	0.0-38.1	7/24 (29.2)	9.6-48.8
	P-value = .138		*P*-value = .001	
Chronic conditions				
No	38/708 (5.4)	3.7-7.1	72/721 (10.0)	7.8-12.2
Yes	2/18 (11.1)	0.0-27.2	11/34 (32.4)	15.8-49.0
	P-value = .261		*P*-value = .000	
Psychological distress				
No	16/378 (4.2)	2.2-6.5	33/438 (7.5)	5.1-10.0
Yes	24/348 (6.9)	4.2-9.6	50/317 (15.8)	11.7-19.8
	P-value = .116		*P*-value = .000	
Body Mass Index (Kg/m^2)*				
<18.5	7/149 (4.7)	1.3-8.1	11/78 (14.1)	6.2-22.0
18.5 to 24.99	26/493 (5.3)	3.3-7.3	52/503 (10.3)	7.7-13.0
≥ 25	7/45 (15.6)	4.5-26.6	18/149 (12.1)	6.8-17.4
	P-value = .015		*P*-value = .562	
Smoking status				
No smoker	35/608 (5.8)	3.9-7.6	70/644 (10.9)	8.5-13.3
Smoker or ex-smoker	5/118 (4.2)	0.6-7.9	13/111 (11.7)	5.6-17.8
	P-value = .508		*P*-value = .793	
Alcohol intake				
Never	31/560 (5.5)	3.6-7.5	63/584 (10.8)	8.3-13.3
Yes	9/166 (5.4)	1.9-8.9	20/171 (11.7)	6.8-16.7
	P-value = .955		*P*-value = .738	
Physical activity				
No-vigorous	6/108 (5.6)	1.2-10.0	59/424 (13.9)	10.6-17.2
Vigorous	34/618 (5.5)	3.7-7.3	24/331 (7.3)	4.4-10.1
	P-value = .982		*P*-value = .004	

**excluding pregnant women in rural areas (39) and in semi-urban areas (25);*

The P-value was generated from the χ^2 test

Table 4. Associations of selected risk factors with prevalence of hypertension (N=1481)

Characteristics	**Hypertensive**	**Unadjusted**	**Adjusted**
	n (%)	Odds ratio (95% CI)	Odds ratio (95% CI)
Age, years			
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]
Sex			
Female	65 (8.0)	1	1
Male	58 (8.7)	1.10 (0.76-1.59)	0.96 (0.61-1.52)
Residence			
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]
Family history of hypertension			
No	89 (7.3)	1	1
Yes	34 (12.8)	1.85 (1.22-2.82)[b]	1.97 (1.24-3.13)[b]
Chronic conditions			
No	110 (7.7)	1	1
Yes	13 (25.0)	4.00 (2.07-7.71)[d]	1.71 (0.82-3.56)
Psychological distress			
No	49 (6.0)	1	1
Yes	74 (11.1)	1.96 (1.35-2.86)[d]	1.15 (0.73-1.81)
Body Mass Index (Kg/m^2)*			
<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)
Smoking status			
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)
Alcohol intake			
Never	94 (8.2)	1	1
Yes	29 (8.6)	1.05 (0.68-1.63)	0.94 (0.59-1.48)
Physicalactivity			
Vigorous	58 (6.1)	1	1
Non-vigorous	65 (12.2)	2.14 (1.48-3.10)[d]	1.27 (0.81-1.99)

**excluding pregnant women; [a]P = .02; [b]P = .006; [c]P = .004; [d]P = .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

reported a similarly low prevalence. Those with ages between 18 and 64, had a prevalence of hypertension of 7.6%, similar to that reported in Ethiopia (8.2%) among 25-64 years olds [25]. Overall, we found generally lower prevalence of hypertension than what has been previously reported.

Our prevalence estimate in rural areas (5.5%) is lower than those of other studies in rural regions of Africa. They found prevalences between 12.5% and 32.2% among populations 18 years and older [5,15,26-28]. Also, studies conducted in rural and urban populations aged 15 years and older in West African countries reported higher hypertension prevalence estimates, between 21% and 30%[5,29-32].

Prevalence estimate in semi-urban areas (11%) is lower in our study than results previously reported in Africa, including those from Ouagadougou, that ranged from 21 to 31% among population aged 16 years and older [5,10,33]. Our estimate is also lower than the prevalence found in urban areas of Africa with similar but slightly older participants (25 years and older) [11,12,34,35].

Taking these findings together, we conclude that the prevalence of hypertension remains low in rural areas, and significantly high in semi-urban areas but still remains below that of urban areas. Among participants from semi-urban areas, the prevalence of hypertension increases with age, although at a lower rate than in European populations.

Our observation that the prevalence of hypertension was significantly higher in semi-urban areas than in rural areas points to risk factors inherent in semi-urban living. This is also supported by our finding that after adjusting for rural/semi-urban living, most of the remaining risk factors became insignificant. Tesfaye compared three sites in three countries with different levels of development (Ethiopia, Vietnam and Indonesia) and found that the more developed the country, the higher the hypertension prevalence [25]. Moreover, previous studies have shown that hypertension increases with urbanization in African populations [25,34,36-38]. These findings suggest that the increase in hypertension may be the result of urbanization. Possible causes include stress, reduced physical activity, diet changes, and smoking [39] (Table 5).

In Kaya HDSS, the rural population is predominantly agricultural with strenuous physical efforts in daily work and transport (by foot or bike). The finding that hypertension was associated with being overweight in rural areas may be explained by rapid changes in the occupational activities of some individuals; for example, the transition from doing mostly physical activity in the past (farming) to adopting less active jobs (vendors and merchants). In semi-urban areas, informal trade is predominant. Much of the personal transport is done by motorized means (motorcycle, car, taxi). Dietary changes may also be a factor in urbanization. A study in Benin found that diet in the more urbanized area was less preventive against chronic diseases after controlling for income [41]. Future studies on dietary differences in Burkina Faso would be useful in identifying specific dietary risk factors. In semi-urban areas, married people were less likely to be hypertensive than those who were unmarried. This is consistent with previous studies that found that married individuals tend to experience better health outcomes than those who were not married [42,43]. Marriage could confer more protection in semi-urban than in rural areas by preserving traditional healthy dietary behaviors.

Table 5. Risk factors associated with hypertension in some previous studies in sub-Saharan Africa

First author (Year of publication)	Country	Population type	Size	Age range	Risk factors
Niakara (2007)[11]	Burkina Faso	Urban	2087	>35	Older age, Duration of residence in the city > 20 years, BMI≥25, Physical inactivity.
Sodjinou (2008)[35]	Benin	Urban	200	25-60	Long duration (≥21years) of urban residence
Macia (2011)[13]	Senegal	urban	500	≥50	Older age, BMI≥25
Agyemang (2006)[37]	Ghana	Urban and rural	1431	≥16	Older age, Urban area, overweight, obesity, Alcohol intake
Addo (2006)[15]	Ghana	Rural	362	≥18	Older age, Overweight, obesity
Cappuccio (2004)[34]	Ghana	Semi-urban and rural	1013	40-75	Older age, semi-urban areas
Van de vijver (2013)[33]	Kenya	Urban	5190	≥18	Older age, current drinking, waist circumference ≥94cm(men)/≥80cm(women)
Tesfaye (2007)[25]	Ethiopia	Urban and rural	4050	25-64	Older age, male sex, urban areas, BMI≥25
De Ramirez (2010)[26]	Malawi, Rwanda, Tanzania	Rural	1485	≥18	Older age, Television owner, BMI≥25, Physical inactivity, Less fruit/vegetable intake,
Musinguzi (2013)[38]	Uganda	Rural and urban	4563	≥15	Older age, urban areas, overweight, obesity
Wamala (2009)[27]	Uganda	Urban and rural	842	≥20	Older age, Female sex, Tertiary education level, Overweight, obesity, Past and present alcohol use
Damasceno (2009)[6]	Mozambique	National	3323	25-64	Older age, Urban area
Malaza (2012)[28]	South Africa	Rural	11786	≥15	Older age, Female sex, HIV-uninfected status,
Pick (1990)[40]	South Africa	Urban	1046	≥15	family history of hypertension, Poor education, Obesity

Furthermore, we found that psychological distress was associated with a high prevalence of hypertension in semi-urban areas; a likely product of urbanization [44]. In the urban population of South Africa, this association was found especially among men [23]. A meta-analysis in western populations reported that, depression, one of the manifestation of psychological distress, was probably an independent risk factor for hypertension [45].

Family history was identified as a risk factor for hypertension. A South African study also reported such an association [40]. However, the rural population is poorly served by health

services and most people did not know whether their parents or siblings had been diagnosed with hypertension. This lack of recognition may explain why it is only a risk factor among semi-urban participants. A similar conclusion could be drawn regarding self-recognized chronic diseases.

4.1 Strengths and Limitations of the Study

The study sample was randomly selected and participation was 100% among those we could locate even though participation was voluntary and no payment was given to participants. This enables us to infer our findings confidently to the target population as a whole. Nevertheless, we are aware of some limitations of this study. Blood pressure was based on a single visit, which might have overestimated the prevalence [46] but an adequate rest period could minimize such an effect. Also, psychological distress measured by GHQ and administered by an interviewer, instead of self-administration, may result in misclassification. This phenomenon could have occurred because participants might tend to produce socially acceptable responses. Such misclassifications could dilute the association between psychological distress and hypertension. Furthermore, self-reporting of family history and chronic diseases could lead to underestimation of their prevalence due to lack of diagnosis and low education.

5. CONCLUSION

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

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CONSENT

Informed consent was signed by all the participants.

ETHICAL APPROVAL

The study protocol was approved by the Ethics Committee of Health Research at the University of Montreal in Canada and the Ethics Committee on Health Research in Burkina Faso.

COMPETING INTERESTS

The authors declare that they have no competing interests

REFERENCES

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365(9455):217-23.
2. Pobee JO, Larbi EB, Belcher DW, Wurapa FK, Dodu SR. Blood pressure distribution in a rural Ghanaian population. Trans R Soc Trop Med Hyg. 1977;71(1):66-72.
3. Shaper AG, Wright DH, Kyobe J. Blood pressure and body build in three nomadic tribes of northern Kenya. East Afr. Med. J. 1969;46(5):273-81.
4. Seedat YK, Hackland DB, Mpontshane J. The prevalence of hypertension in rural Zulus. A preliminary study. S. Afr. Med. J. 1981;60(1):7-10.
5. Agyemang C. Rural and urban differences in blood pressure and hypertension in Ghana, West Africa. Public Health. 2006; 120(6):525-33.
6. Damasceno A, Azevedo A, Silva-Matos C, Prista A, Diogo D, Lunet N. Hypertension prevalence, awareness, treatment, and control in mozambique: urban/rural gap during epidemiological transition. Hypertension. 2009;54(1):77-83.
7. Edwards R, Unwin N, Mugusi F, Whiting D, Rashid S, Kissima J, et al. Hypertension prevalence and care in an urban and rural area of Tanzania. J. Hypertens. 2000;18(2):145-52.
8. Ibrahim MM, Rizk H, Appel LJ, el Aroussy W, Helmy S, Sharaf Y et al. Hypertension prevalence, awareness, treatment, and control in Egypt. Results from the Egyptian National Hypertension Project (NHP). NHP Investigative Team. Hypertension. 1995;26(6 Pt 1):886-90.
9. Steyn K, Gaziano TA, Bradshaw D, Laubscher R, Fourie J. Hypertension in South African adults: results from the Demographic and Health Survey, 1998. J. Hypertens. 2001;19(10):1717-25.
10. Niakara A, Nebie LV, Zagre NM, Ouedraogo NA, Megnigbeto AC. [Knowledge of an urban population about arterial hypertension: prospective study carried out in Ouagadougou, Burkina Faso]. Bull. Soc. Pathol. Exot. 2003;96(3):219-22.
11. Niakara A, Fournet F, Gary J, Harang M, Nebie LV, Salem G. Hypertension, urbanization, social and spatial disparities: a cross-sectional population-based survey in a West African urban environment (Ouagadougou, Burkina Faso). Trans R Soc Trop Med Hyg. 2007;101(11):1136-42.
12. Zeba AN, Delisle HF, Renier G, Savadogo B, Baya B. The double burden of malnutrition and cardiometabolic risk widens the gender and socio-economic health gap: a study among adults in Burkina Faso (West Africa). Public Health Nutr. 2012;15(12):2210-9.
13. Macia E, Duboz P, Gueye L. Prevalence, awareness, treatment and control of hypertension among adults 50 years and older in Dakar, Senegal. Cardiovascular journal of Africa. 2011;22:1-5.

14. Onwubere BJ, Ejim EC, Okafor CI, Emehel A, Mbah AU, Onyia U et al. Pattern of Blood Pressure Indices among the Residents of a Rural Community in South East Nigeria. International journal of hypertension. 2011;2011:621074.
15. Addo J, Amoah AGB, Koram KA. The changing patterns of hypertension in Ghana: A study of four rural communities in the Ga District. Ethn. Dis. 2006;16:894-899.
16. Fezeu L, Kengne AP, Balkau B, Awah PK, Mbanya JC. Ten-year change in blood pressure levels and prevalence of hypertension in urban and rural Cameroon. J. Epidemiol. Community Health. 2010;64(4):360-5.
17. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012; 380(9859):2224-60.
18. World Health Organization. The STEPS Instrument and Support Materials. Geneva: World Health Organization; 2006. [Accessed 24 March 2012]; Available: http://www.who.int/chp/steps/instrument/en/index.html#.
19. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jr. et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003;289(19):2560-72.
20. World Health Organization. Obesity: Preventing and managing the global epidemic. WHO Technical Report Series 894. Geneva: World Health Organization; 2000.
21. Aderibigbe YA and Gureje O. The validity of the 28-item General Health Questionnaire in a Nigerian antenatal clinic. Soc. Psychiatry Psychiatr. Epidemiol. 1992; 27(6):280-3.
22. Goldberg D and Williams P. A user's guide to the General Health Questionnaire. Windsor: NFER-Nelson; 1989.
23. Mashele N, Van Rooyen JM, Malan L, Potgieter JC. Cardiovascular function and psychological distress in urbanised black South Africans: the SABPA study. Cardiovascular journal of Africa. 2010;21(4):206-11.
24. National Institute of Statistics and Demography Burkina Faso. General Census of Population and Housing 2006-definitive results. Ouagadougou: Institut National de la Statistique et de la Démographie; 2008. [Accessed 20 March 2012]; Available: http://www.insd.bf/fr/IMG/pdf/Resultats_definitifs_RGPH_2006.pdf.
25. Tesfaye F, Nawi NG, Van Minh H, Byass P, Berhane Y, Bonita R et al. Association between body mass index and blood pressure across three populations in Africa and Asia. J. Hum. Hypertens. 2007;21(1):28-37.
26. De Ramirez SS, Enquobahrie DA, Nyadzi G, Mjungu D, Magombo F, Ramirez M et al. Prevalence and correlates of hypertension: a cross-sectional study among rural populations in sub-Saharan Africa. J. Hum. Hypertens. 2010;24(12):786-95.
27. Wamala JF, Karyabakabo Z, Ndungutse D, Guwatudde D. Prevalence factors associated with Hypertension in Rukungiri District, Uganda- A Community-Based Study. African Healh Sciences. 2009;9(3):153-60.
28. Malaza A, Mossong J, Barnighausen T, Newell ML. Hypertension and obesity in adults living in a high HIV prevalence rural area in South Africa. PLoS ONE. 2012;7(10):e47761.
29. Amoah AG. Hypertension in Ghana: a cross-sectional community prevalence study in greater Accra. Ethn. Dis. 2003;13(3):310-5.
30. Ministry of Health and Public Hygiene of Côte d'Ivoire. Investigation of risk factors for noncommunicable diseases. Abidjan: Ministère de la santé et de l'hygiène publique; 2005.

31. Ministry of Public Health of Niger. Measurement of risk factors for noncommunicable diseases in Niger (Approche Step"Wise" de l'OMS). Niamey: Ministère de la santé publique; 2008.
32. van der Sande MA, Bailey R, Faal H, Banya WA, Dolin P, Nyan OA et al. Nationwide prevalence study of hypertension and related non-communicable diseases in The Gambia. Trop. Med. Int. Health. 1997;2(11):1039-48.
33. van de Vijver SJ, Oti SO, Agyemang C, Gomez GB, Kyobutungi C. Prevalence, awareness, treatment and control of hypertension among slum dwellers in Nairobi, Kenya. J. Hypertens. 2013; 31(5):1018-24.
34. Cappuccio FP, Micah FB, Emmett L, Kerry SM, Antwi S, Martin-Peprah R et al. Prevalence, detection, management, and control of hypertension in Ashanti, West Africa. Hypertension. 2004;43(5):1017-22.
35. Sodjinou R, Agueh V, Fayomi B, Delisle H. Obesity and cardio-metabolic risk factors in urban adults of Benin: relationship with socio-economic status, urbanisation, and lifestyle patterns. BMC Public Health. 2008;8:84.
36. Addo J, Smeeth L, Leon DA. Hypertension in sub-saharan Africa: a systematic review. Hypertension. 2007;50(6):1012-8.
37. Agyemang C, Bruijnzeels MA, Owusu-Dabo E. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. J. Hum. Hypertens. 2006;20(1):67-71.
38. Musinguzi G and Nuwaha F. Prevalence, awareness and control of hypertension in Uganda. PLoS ONE. 2013;8(4):e62236.
39. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. Am. J. Clin. Nutr. 2006;84(2):289-98.
40. Pick WM, Myers JE, Sayed AR, Dhansay J, George RL, Barday AW. The epidemiology of hypertension in family practice in Cape Town. S. Afr. Med. J. 1990;78(1):7-10.
41. Delisle H, Ntandou-Bouzitou G, Agueh V, Sodjinou R, Fayomi B. Urbanisation, nutrition transition and cardiometabolic risk: the Benin study. Br. J. Nutr. 2012;107(10):1534-44.
42. Robles TF and Kiecolt-Glaser JK. The physiology of marriage: pathways to health. Physiol. Behav. 2003;79(3):409-16.
43. Spruill TM. Chronic psychosocial stress and hypertension. Curr. Hypertens. Rep. 2010;12(1):10-6.
44. Godfrey R and Julien M. Urbanisation and health. Clin. Med. 2005;5(2):137-41.
45. Meng L, Chen D, Yang Y, Zheng Y, Hui R. Depression increases the risk of hypertension incidence: a meta-analysis of prospective cohort studies. J. Hypertens. 2012;30(5):842-51.
46. Bovet P, Gervasoni JP, Mkamba M, Balampama M, Lengeler C, Paccaud F. Low utilization of health care services following screening for hypertension in Dar es Salaam (Tanzania): a prospective population-based study. BMC Public Health. 2008;8:407.

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