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Prevalence of hypertension and associated behavioural risk factors among low income adults in Kiambu County, Kenya

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Abstract

Hypertension is one of the critical risk factors for cardiovascular morbidity and mortality, and a leading risk for cardiovascular disease (CVD) and premature death. This study aimed to determine the prevalence of hypertension and quantify related behavioural risk factors in Kiambu County, Kenya. A cross-sectional study design was used, and data were collected using adapted WHO stepwise questionnaire. A total of 310 participants took part in the study. Majority, (76%) were females and participants' mean age was 45.3 years. Results showed 31% of participants had hypertension (systolic blood pressure ≥140 and/or diastolic blood pressure ≥90 mmHg). Social-demographic characteristics associated with hypertension included male gender (AOR=2.33; 95% CI 1.09-4.99), older age groups (AOR=3.1-11.3 p<0.05) and history of hypertension (AOR=10.59; 95% CI 5.06-22.13). behavioural factors associated with hypertension were, alcohol consumption (AOR=3.3; 95% CI 1.66-6.57), being overweight (AOR=5.4; 95% CI 2.91-10.01) and obese (AOR=13.4; 95% CI 5.21-34.26). Eating fruits daily (AOR=0.5; 95% CI 0.25-0.96), being physically active (AOR=0.51; 95% CI 0.28-0.90) and rarely adding raw salt to cooked food (AOR=0.19; 95% CI 0.07-0.51) were associated with reduced odds of being hypertensive. In conclusion, the prevalence of hypertension was high at 31% and was associated with modifiable behavioural factors. Lifestyle factors associated with increased odds of being hypertensive were alcohol consumption, physical inactivity and being obese. Eating fruits daily and avoiding raw salt were protective dietary practices against hypertension. Targeted intervention measures focused on healthy diet and healthy lifestyle choices for control of blood pressure such physical activity and avoiding alcohol consumption are recommended.

Keywords: Hypertension, prevalence, behavioural factors

Introduction

Hypertension (also known as high blood pressure) is the single most important risk factor for cardiovascular morbidity and mortality in developed countries [1]. The prevalence of hypertension globally is on the increase as a result of combination of factors that include a population that is ageing, an increase in exposure to lifestyle risk factors such as physical inactivity, unhealthy diet, tobacco use and excessive alcohol consumption [2]. It is estimated that 1.13 billion people around the world are living with hypertension, two-thirds of which are in low and medium income countries (LMICs) [3].

Hypertension has been proven to be a major risk factor for cardiovascular disease (CVD), and a key driver of the increasing prevalence of CVD morbidity and mortality in Kenya. The 2015 Kenya STEPwise survey demonstrated that the prevalence of hypertension, overweight and obesity was high among adults aged between 18-69 years and were estimated at 24 percent and 28 percent in that order [4]. Despite the high prevalence recorded, and the prevailing knowledge of association between socio-economic status and hypertension, our understanding of factors that explains inequalities in high blood pressure in different parts of Kenya remains limited [5].

Behavioural risk factors such alcohol consumption and use of tobacco products may be contributing to the increasing hypertension prevalence and CVDs in Kenyait was reported that 13% of Kenyans have smoked some form of tobacco-based product with a bigger propensity for men, 23% and women 4%.

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Further, 24% and 20.9% of people in Kenyan get exposure to second hand smoke at home and work respectively [6]. Similarly, research has shown high prevalence of overweight and obesity in the country. In a study using a national representative sample, about 30 percent of adults in Kenya were either overweight or obese [7]. This has been attributed to dietary habits and low levels of physical activity. In Kenya, two national surveys have reported differing compliance levels, the STEPwise survey reported a higher compliance to physical activity 90.5% [4] while the Kenya demographic and health survey reported a lower compliance at 38 percent among women and 41 percent among men.

Although studies have been conducted on hypertension prevalence and associated frisk actors in Kenya, they are mostly facility based studies, [8,9] which indicate the magnitude of the problem among those seeking care and not those in the community. Hypertension is often called 'the silent killer' since it is a disease that manifests no early symptoms to indicate something is wrong but in the long run causes complications such as stroke, heart failure, chronic kidney disease among others. With such absence of signs and symptoms in the early onset of hypertension, it means the symptomatic cases are the tip of an iceberg in communities, with larger number living with undiagnosed hypertension, which carries the risk of development of CVDs and death. This was a community based study that sought to determine the magnitude of uncontrolled blood pressure at the community level and the associated behavioural factors.

Material and Methods

Study Location

The study was conducted in Kiambu County, Kenya. The county is located in the Central Kenyan highlands at an altitude of between 1,400m and 1,800m above sea level. Kiambu is situated between latitudes 0°75' and 1°20' south of the equator and longitudes 36°54' and 36°85' east of the prime meridian.

Study Design

This was an analytical cross-sectional study.

Target Population

The low-income adults aged 18 years and above living in peri-urban, high-density neighbourhoods of Kiambu County, Kenya.

Study Population

The study involved 310 low-income adults aged above 18 years, living in Kiambu and were willing to take part in the study.

Inclusion/Exclusion Criteria

Adults residing in low-income neighbourhoods of Kiambu County, who were willing and gave consent to participate in the study. Pregnant women were excluded since approximation of waist circumference was deemed difficult and their blood pressure would have been influenced by their physiological state.

Sample Size Determination

A sample of 310 participants was estimated using fisher's et.al (1998) formula using a prevalence of hypertension of 24% according to the stepwise survey [4], 5% precision, a 95% confidence interval and a 10% adjustment for non-response.

Sampling Technique

Multi-stage sampling technique was used to select sub counties, wards, villages and Community Health Units that were included in the study. Cluster sampling was used to select households to be included in the study. Juja and Ruiru Sub- Counties have total of 13 wards. Four wards (30% of the wards) were selected using simple random sampling for inclusion in the study these were Biashara, Mwihoko, Kalimoni and Juja wards. Cluster sampling was used to selected community health units in the selected wards to be included in the study. The first household was identified by spinning a pen and the household in the direction that the pen pointed was selected as the first household.

Data Collection

WHO STEPwise questionnaire was adapted and used for data collection on demographic characteristics (age, sex, occupation), history of hypertension and participant's actions that can directly affect their health outcomes (use of tobacco and tobacco products, alcohol consumption, diet, and levels of physical activity) of participants. The international physical activity questionnaire (IPAQ) [10] was utilised in collecting data on physical activity. The tools were translated and validated in the local context. The questionnaires were administered by trained interviewers in the data collection process. The participants blood pressure, weight, waist circumference and body mass index were measured using standard procedures as follows; measurement of blood pressure was using a digital blood pressure machine (Omron M1, manufactured by Omron healthcare, Kyoto, Japan) in accordance with guidelines from the American Heart Association. The guidelines emphasized the need for participant to rest in a sitting position for 5 minutes prior to BP measurement, abstaining from alcohol consumption, smoking and physical exercise 30 minutes before measurements of BP is dome, and taking three separate measurements each time the monitor was used and a mean of the three measurements calculated [11]. Anthropometric measures of height, weight and WC were also taken and recorded. Measurement of height was done to the nearest half a centimetre (0.5 cm) using a metallic tape measure, against a wall and a flat headboard placed at right angle to the wall. Measurement of body weight was done to the nearest 100 grammes by use of a digital bathroom scale (Ashton Meyers®, manufactured by Meyer corporation in Guangzhou, China), with participant donned in light clothes and while barefoot. WC was measured with a flexible/fibreglass tape measure placed on a horizontal plane at the level midpoint of the waist and the recording was at the end of normal expiration. BMI was calculated from results of weight and height, and was used as an indicator total body obesity. On the other hand, waist circumference was used as a measure of abdominal obesity.

Data Analysis

Stata version 18 statistical computing software application was utilised for data entry, cleaning and analysis. Descriptive statistics were used for reporting the proportion of adults with hypertension

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and associated cardiovascular risk factors. Categorical data were analysed and reported in frequencies and percentages. Continuous data were analysed using measures of central tendencies where mean, standard deviation and range for age was reported. Blood pressure categorization was done as either normal BP (Systolic BP<130 and/or diastolic BP<85), pre-hypertensive (systolic BP of between 130 and 139 mmHg and/or diastolic BP of 85 to 89 mmHg) or hypertensive (systolic BP≥140 and/or diastolic BP≥90 mmHg) in accordance with the national guidelines for cardiovascular diseases management in Kenya [12]. Obesity was categorized according to the World Health Organization BMI categories; under-weight (BMI<18), normal weight (BMI 19 to 25), over-weight (BMI 26 to 29) and obese (BMI≥30). Significant WC was considered for measurements greater than 80 centimetres (31.50 inches) for females, and more than 90 centimetres (35.50 inches) for males. Chi square test was used in bivariate analysis of risk factors, as a measure of association between a particular characteristic and hypertension, and the level of statistical significance considered at $p<0.05$. Multiple logistic regression was used to analyse factors associated with being hypertensive, to control for confounding and to examine the series of independent variables, to ascertain those which best predict certain outcomes.

Ethical Considerations

Ethical approval was obtained (vide approval no. JKU/ISERC/02316/1100) from JKUAT Institutional Ethics Committee. A research permit was obtained (License No: NACOSTI/P/23/31797) from the National Commission for Science, Technology and Innovation (NACOSTI) before commencement of the study. Confidentiality and anonymity of patients was guaranteed by excluding unique identifiers from the data collected from participants. Participation in the study was purely on voluntary basis and written informed consent was obtained from participants prior to commencement of administering the questionnaire.

Results

Social Demographic Characteristics of the Study Participants

A total of 310 participants took part in the study. Majority, 235 (76%) of participants were female. The mean age of participants was 45.3 years with standard deviation of 16.4 years and their age ranged from 19 to 90 years. A total of 132 (42.6%) participants had attained primary school education and 184 (59.3%) were married. This was a predominantly low-income population with only 28 (9.2%) earning above Ksh.15 000 (100 USD) per month. Other social demographic characteristics are summarized in Table 1.

Table 1. Socio-demographic characteristics of the participants

Variables		Female n (%) n=235 (76%)	Male n (%) n=75 (24%)	Total n (%) N=310
Age groups	18-30	54 (22.8)	17(22.7)	71 (22.9)
	31-40	67(28.3)	8 (10.7)	75 (24.2)
	41-50	41(17.7)	13 (17.3)	54 (17.4)
	51-60	36 (15.2)	6 (8.0)	42 (13.5)
	>60	37 (16.0)	31 (41.3)	68 (21.9)
Education level	Never been to school	11(4.7)	9 (12.0)	20 (6.4)
	Primary	103 (43.8)	29 (38.7)	132 (42.6)
	Secondary	73 (31.0)	25 (33.3)	98 (31.6)
	Tertiary	48 (20.4)	12 (16.0)	60 (19.4)
Marital status	Single (never been married)	56 (23.8)	23 (30.7)	79 (25.5)
	Married	144 (61.3)	38 (50.6)	182 (58.7)
	Divorced/separated/widowed	35 (14.9)	14 (18.7)	49 (15.8)
Occupation/work status	Employed	58 (24.7)	18 (24.0)	76 (24.5)
	Self- employed	54 (23.0)	10 (13.3)	64 (20.6)
	Homemaker	46 (19.6)	0 (0)	46 (14.8)
	Retired	32 (13.6)	26 (34.7)	58 (18.7)
	Student	3 (1.3)	8 (10.7)	11 (3.6)
	Casual worker	42 (17.9)	13 (17.3	55 (17.7)
Income per month KES (N=306)	<5,000	93 (40.3)	41 (54.3)	134 (43.8)
	5,001-10,000	93 (40.3)	13 (17.8)	106 (34.6)
	>10,000-15,000	26 (11.3)	12 (16.0)	38 (12.4)
	>15,000	19 (8.2)	9 (12.0)	28 (9.2)

KES: Kenya Shillings

Physical Measurements of the Participants and Prevalence of Hypertension

Data in table 2 suggests that there were notable differences in blood pressure, BMI categories, and waist circumference between females and males in the study population. A slightly higher proportion of females (23.0%, n=235) were overweight compared to males (28.0%, n=75) and a significantly higher proportion of males (46.7%) had abdominal obesity compared to females (15.3%).

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Ninety-seven (31%) of the participants had high blood pressure (systolic blood pressure ≥140 and/or diastolic blood pressure ≥90 mmHg) with more females (62%) recording normal blood pressure compared to 28% for males.

Table 2. Physical measurements of the participants and prevalence of hypertension

Variables		Females n=235 n (%)	Males n=75 n (%)	Total N=310
Blood pressure	Normal BP (systolic BP<130mmHg and/or diastolic BP<85mmHg)	146 (62.1)	21 (28.0)	167 (53.9)
	Pre-hypertensive (systolic BP of 130 to 139 mmHg and/or diastolic BP of 85to 89 mmHg)	31 (13.2)	15 (20.0)	46 (14.8)
	Hypertensive (systolic BP≥140mmHg and/or diastolic BP≥90 mmHg)	58 (24.7)	39 (52.0)	97 (31.3)
BMI categories	Normal (BMI range 18.5 to 24.9)	162 (68.9)	43 (57.3)	205 (66.1)
	Underweight (BMI≤18.4)	2 (0.9)	0 (0)	2 (0.7)
	Overweight (BMI range 25 to 30)	54 (23.0)	21 (28.0)	75 (24.2)
	Obese (BMI greater than 30)	17 (7.2)	11 (14.7)	28 (9.0)
WC	Abdominal obesity=(WC≥90cm for male and ≥80 cm for females	36 (15.3)	35 (46.7)	71 (22.9)
	No abdominal obesity (WC<90cm for male and <80 cm for females	199 (84.7)	40 (53.3)	329 (77.1)

cm: centimetres, BMI: body mass index, ratio: mmHg- millilitres of mercury, WC: waist circumference

Social Demographic Factors Associated With Hypertension

Table 3 shows that sex ($\chi2$=19.7, df=1, p=<0.001), age ($\chi2$=36.0, df=4, p=<0.001), marital status ($\chi2$=8.5, df=2, p=0.014), occupation ($\chi2$=25.9, df=5, p=<0.001), and history of hypertension in the family ($\chi2$=66.1, df=1, p=<0.001) were significantly associated with hypertension in unadjusted bivariate analyses. Level of education ($\chi2$=6.9, df=3, p=<0.072), and monthly income ($\chi2$=3.7, df=3, p=<0.292), were not associated with hypertension.

Table 3. Chi-square analysis of social demographic factors associated with hypertension

	Characteristic	Normal BP n=213	High BP n=97	χ2	df	P value
Sex	Female	176 (83.1)	58 (59.8)	19.7	1	<0.001
	Male	36 (16.9)	37 (40.2)			
Age	18-30	65 (30.5)	6 (6.2)	36.0	4	<0.001
	31-40	56 (26.3)	19 (19.6)			
	41-50	36 (16.9)	18 (18.6)			
	51-60	24 (11.3)	18 (18.6)			
	>60	32 (15.0)	36 (37.11)			
Education level	Never been to school	12 (5.6)	8 (8.3)	6.9	3	0.072
	Primary	82 (38.5)	50 (51.5)			
	Secondary	72 (33.8)	26 (26.8)			
	Tertiary	47 (22.1)	13 (13.4)			
Marital status	Single	58 (27.2)	21 (21.7)	8.5	2	0.014
	Married	130 (61.0)	52 (53.6)			
	Divorced/separated/widowed	25 (11.7)	24 (24.7)			
Occupation/work status	Employed	49 (23.0)	27 (27.8)	25.9	5	<0.001
	Self- employed	49 (23.0)	15 (15.5)			
	Homemaker	38 (17.8)	8 (8.3)			
	Retired	27 (12.7)	31 (32)			
	Student	11 (5.2)	1 (1)			
	Casual worker	39 (18.3)	15 (15.5)			
Income per month KES N=306	<5000	88 (42.1)	46 (47.4)	3.7	3	0.292
	5001-10000	76 (36.3)	30 (30.9)			
	>10000-15,000	29 (13.9)	9 (9.3)			
	>15,000	16 (7.7)	12 (12.4)			
Family history of hypertension	Yes	22 (10.3)	51 (52.6)	66.1	1	<0.001
	No	191 (89.7)	46 (47.4)			

BP: blood pressure, KES: Kenya Shilling

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After adjusting for all the social-demographic characteristics studied, the results of adjusted logistic regression model showed that sex, age, and history of hypertension in the family were all significantly associated with hypertension (Table 4). Males were 2.3 times more likely to be hypertensive (AOR=2.33; 95% CI 1.09-4.99) compared to females. Participants in older age groups had between 3.1 and 11.3 times increased odds of being hypertensive compared to those aged 18-30 years. Having a family history of hypertension was associated with 10.6 times (AOR: 10.59, 95% CI 5.06-22.13) increased odds of hypertension compared to those who did not report history of hypertension in the family.

Table 4. Multiple logistic regression model for social-demographic factors associated with hypertension

Variables		AOR	SE	95% CI	P value
Sex	**Female**	Ref			
	Male	2.33	0.91	1.08-4.99	0.030
Age	**18-30**	Ref			
	31-40	3.05	1.82	0.95-9.82	0.06
	41-50	5.00	3.11	1.47-16.94	0.01
	51-60	11.3	7.4	3.14-40.6	<0.001
	>60	7.6	6.7	1.36-42.6	0.021
Education level	**Never been to school**	Ref			
	Primary	1.48	0.94	0.43- 5.19	0.532
	Secondary	1.08	0.76	0.27-4.29	0.902
	Tertiary	0.76	0.57	0.17-3.31	0.707
Marital status	**Single**	Ref			
	Married	1.47	0.58	0.67-3.21	0.329
	Divorced/separated/windowed	1.21	0.62	0.44-3.32	0.707
Income per month KES N=306	**<5000**	Ref			
	5001-10000	0.68	0.28	0.29-1.53	0.348
	>10000-15,000	0.54	0.31	0.17-1.72	0.297
	>15,000	1.30	0.84	0.36- 4.62	0.685
Work status	**Employed**	Ref			
	Self-employed	0.31	0.16	0.11-0.89	0.030
	Homemaker	0.44	0.31	0.11-1.74	0.245
	Retired	0.61	0.53	0.11-3.41	0.582
	Casual worker	0.74	0.39	0.26-2.11	0.584
Family history of hypertension	**Yes**	Ref			
	No	10.59	3.98	5.06-22.13	<0.001

AOR: adjusted odds ratio, SE: standard error, KES: Kenya Shillings

Lifestyle Factors Associated With Hypertension

Table 5 shows that alcohol consumption ($\chi2=27.2$, df=1, p=<0.001), being physically active ($\chi2=8.15$, df=1, p=0.004) and being obese ($\chi2=62.46$, df=3, p=0.001) were significantly associated with being hypertensive in bivariate analyses. Tobacco use ($\chi2=0.63$, df=1, p=0.429) was not associated with hypertension.

Table 5. Chi-square analysis Participants' lifestyle factors associated with hypertension

Characteristic		Normal BP n=213 n (%)	High BP n=97 n (%)	χ2	df	P value
Alcohol consumption	**No**	188 (88.3)	61 (62.9)	27.2	1	<0.001
	Yes	25 (11.7)	36 (37.1)			
Tobacco use	**No**	206 (96.7)	92 (94.8)	0.63	1	0.429
	Yes	7 (3.3)	5 (5.2)			
Physical Activity (Adherence to at least 150 min of moderate activity or 75 min of vigorous exercise weekly)	**No**	88 (41.3)	57 (58.7)	8.15	1	0.004
	Yes	125 (58.7)	40 (41.2)			
Obesity	**Normal (BMI range 18.5 to 24.9)**	170 (79.8)	35 (36.1)	62.46	3	<0.001
	Underweight (BMI ≤18.4)	2 (0.94)	0 (0.0)			
	Overweight (BMI range 25 to 30)	33 (15.5)	42 (42.3)			
	Obesity (BMI greater than 30)	8 (3.76)	20 (20.6)			

BP: blood pressure, BMI: body mass index

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After adjusting for all the lifestyle factors studied, the adjusted logistic regression model shows that alcohol consumption, being physically active and being overweight/obese were significantly associated with hypertension (Table 6). Participants who consumed alcohol were 3.3 times more likely to be hypertensive (AOR=3.3; 95% CI 1.66-6.57) compared to those who did not. Participants who were physically active were 0.51 times likely to be hypertensive (AOR=0.51; 95% CI 0.28-0.90) compared to those who were not physically active. Those who were overweight (AOR=5.4; 95% CI 2.91-10.01) and obese (AOR=13.4; 95% CI 5.21-34.26) had 5.4 and 13.4 times increased odds of being hypertensive compared to those who had normal BMI.

Table 6. Multiple logistic regression model for lifestyle factors associated with hypertension

Variables		AOR	SE	95% CI	P-value
Alcohol consumption	**No**	Ref			
	Yes	3.31	1.16	1.66-6.57	0.001
Tobacco use	**No**	Ref			
	Yes	1.86	1.27	0.49-7.15	0.361
Physical Active (Adherence to at least 150 min of moderate activity or 75 min of vigorous exercise per week)	**No**	Ref			
	Yes	0.51	0.15	0.29-0.91	0.022
Obese	**Normal (BMI range 18.5 to 24.9)**	Ref			
	Underweight (BMI ≤18.4)	-			
	Overweight (BMI range 25 to 30)	5.39	1.70	2.90-10.01	<0.001
	Obesity (BMI greater than 30)	13.36	6.42	5.21-34.26	<0.001

AOR: adjusted odds ratio, SE: standard error, BMI: body mass index

Dietary Factors Associated With Hypertension

At bivariate analysis, the study shows that frequency of eating fruits in week ($\chi2$=7.43, df=2, p=0.024) and adding salt to food while eating ($\chi2$=40.8, df=3, p=<0.001) were significantly associated with being hypertensive (Table 7). Frequency of eating vegetables in a week ($\chi2$=2.47, df=2, p=0.29), eating deep fried foods ($\chi2$=1.16, df=2, p=0.559) and the type cooking oil/fat used in the household ($\chi2$=0.97, df=3 p=0.807) were not associated with hypertension.

Table 7. Chi-square analysis of participants' dietary factors associated with hypertension

Characteristic		Normal BP n=213 n (%)	High BP n=97 n (%)	$\chi2$	df	P value
Days one eats fruits in a week	**0-3 days**	50 (23.5)	37 (38.1)	7.43	2	0.024
	4-6 days	78 (36.6)	26 (26.8)			
	Daily	85 (39.9)	34 (35.1)			
Days one eats vegetables in a week	**0-3**	10 (4.7)	6 (6.2)	2.47	2	0.29
	4-6	64 (30.1)	21 (21.7)			
	Daily	139 (65.3)	70 (72.2)			
Fat or oil used for cooking used in the household	**Vegetable oil**	182 (85.5)	86 (88.7)	0.97	3	0.807
	Butter or ghee	1 (0.5)	0 (0)			
	Cooking fat	28 (13.2)	10 (10.3)			
	Other	2 (0.94)	1 (1.0)			
Frequency of eating deep fried foods	**More than 2 times a week**	52 (24.4)	19 (19.6)	1.16	2	0.559
	1-3 times a month	27 (12.7)	11 (11.3)			
	Rarely	134 (62.9)	67 (69.1)			
Frequency of adding salt in cooked food	**Usually**	7 (3.3)	13 (13.4)	40.8	3	<0.001
	Sometimes	19 (8.9)	30 (30.9)			
	Rarely	155 (72.8)	48 (49.5)			
	Never	32 (15)	6 (12.3)			

BP: blood pressure, df: degrees of freedom

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After adjusting for all the dietary characteristics studied the adjusted logistic regression model shows that frequency of eating fruits and adding salt to food while eating were significantly associated with hypertension (Table 8). Participants who eat fruits daily were 0.5 times likely to be hypertensive (AOR=0.5; 95% CI 0.25-0.96) compared to those who eat 0-3 days in a week. Similarly, participants who rarely or never added salt to cooked food were 0.19 and 0.11 respectively times likely to be hypertensive (AOR=0.19; 95% CI 0.07-0.51; AOR=0.11; 95% CI 0.03-0.41) compared to those who had a habit of adding salt to food while eating.

Table 8. Multiple logistic regression model for dietary factors associated with hypertension

Variables		AOR	SE	95% CI	P value
Days one eats fruits in a week	**0-3 days**	Ref			
	4-6 days	0.52	0.17	0.26-1.101	0.055
	Daily	0.50	0.16	0.25-0.96	0.038
Days one eats vegetables in a week	**0-3**	Ref			
	4-6	0.87	0.56	0.24-3.13	0.834
	Daily	1.41	0.87	0.41-4.74	0.578
Fat or oil used for cooking	**Vegetable oil**	Ref			
	Cooking fat	0.76	0.57	0.34-1.84	0.596
	Other	1.95	0.87	0.16-23.8	0.600
Frequency of eating deep fried foods	**More than 2 times a week**	Ref			
	1-3 times a month	0.98	0.48	0.37-2.57	0.964
	Rarely	1.45	0.49	0.75-2.81	0.266
Frequency of adding salt to food while eating	**Usually**	Ref			
	Sometimes	0.97	0.55	0.32-2.97	0.956
	Rarely	0.19	0.09	0.07-0.51	0.001
	Never	0.11	0.08	0.03-0.41	0.001

AOR: adjusted odds ratio, SE: standard error

Discussion

Majority of the participants in the study were females. The imbalance could be attributed to the fact that the interviews were conducted during the day. During this time, women who stayed in their homes and ran small businesses were available while men went out to seek opportunities mainly as day labourers in neighbouring medium income environments. Women were also more receptive and interested to have their blood pressure taken and as a result, more women took part in this study compared to men. The higher response rate among females in this study is consistent with other studies [13,14] that showed that females were more likely to take part in surveys compared to their male counterparts.

This study found that a third (31%) of participants had hypertension. The finding is consistent with previous studies and reflects the substantial burden of hypertension in the Kenyan population. This prevalence compares to that of a community based study conducted in Kirinyaga county among study participants who were aged between 18 and 65 years which estimated the prevalence of hypertension in the county at 29% [15]. Similarly, the findings compare to other studies done in countries across sub Saharan Africa, such Ghana with a prevalence of 36.8% [16], South Africa national prevalence of 30.4% [17], Tanzania 29.2% [18], Botswana 30% [19], and Nigeria with pooled prevalence of 30.6% [20]. However, the prevalence is higher than that of the 2015 Stepwise national survey that estimated a national prevalence of 24.5% [4,21] and that of a population based household survey in a low income informal settlement in Nairobi which showed a prevalence of 22.8% [22]. The discrepancy in the findings in the different studies could be attributed the time of the study, the age groups of the population studied, and differences in the study settings as well as the diagnosis criteria for hypertension.

Results of this study demonstrated significant association between sex and hypertension with males having a two times increased odds of being hypertensive compared to females. The findings are consistent to other studies done in Kenya [23,24], Ethiopia [25,26], Botswana [19] that show greater risk of hypertension among males. The findings are contrary to other studies from Kenya [27], Ghana [20], South Africa [28], and Tanzania [18] which showed no significant difference of the risk of hypertension between males and females. Research has indicated that disparities in gender are associated with several forms of hypertension, such as hypertensive diseases of pregnancy, white coat hypertension, masked hypertension, and postmenopausal hypertension [29,30]. Body composition differences also play an important role, with young men tending

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to have higher muscle mass and lower body fat compared to women while post menopause women experience changes in body composition that contribute to increased hypertension risk, such as increased visceral fat. In addition, behavioural differences in lifestyles between genders, such as smoking habits, alcohol consumption, physical activity levels, and dietary preferences, can influence blood pressure. Excessive alcohol intake and higher rates of smoking are more prevalent among men, which may contribute to their higher hypertension risk.

In this study, increasing age was significantly associated with hypertension, with older age groups having between 3.1 and 11.3 times increased odds of being hypertensive compared to the participants aged 18 to 30 years. The findings were found to be consistent with other studies carried out in Kenya ($p<0.001$) [21,27], as well as those from Ethiopia [25,26], Tanzania [18], Uganda [31], and Botswana [19] that showed older age groups were associated with hypertension. The observed association is consistent with existing body of knowledge which suggests that as people get older [32], they are more likely to have high blood pressure, due to the stiffening of blood vessels with age resulting in blood pressure increase.

Having a history of hypertension in the family was associated with 10.6 times increased odds of hypertension compared to those who did not report history of hypertension in the family. The findings are consistent with those of study done in Ethiopia that showed those with family history had four folds increased odds of being hypertensive [26].

The analysis showed that those who consumed alcohol were 3.3 times more likely to have hypertension. The findings are consistent to those of previous studies done in Kenya [21,27], Nigeria [33] and Ethiopia [26]. The direct association between alcohol use and blood pressure remains significant from previous research, suggesting that limiting alcohol consumption would be advisable for patients with hypertension [34-37]. However, the mechanism behind the observed relationship between alcohol intake and blood pressure is not clear [35]. Studies postulate that the observed relationship may be due to mediating behaviours that negatively affect blood pressure control and at the same time are promoted by alcohol use [34]. Alcohol consumption has been associated with behaviours such as physical inactivity, obesity, smoking and unhealthy diet [36,38] which known risk factors for high blood pressure. Similarly, studies have shown that alcohol consumption negatively affects adherence to antihypertensive medication [34,36]. Persons who consume alcohol may intentionally decide to skip taking their medication to avoid toxic interactions or may forget to take the medications as prescribed due to alcohol intoxication, thereby leading to uncontrolled blood pressure due to non-adherence to the medication. Since medication adherence is a critical intervention for control of blood pressure, lack of adherence may contribute to the higher odds of uncontrolled blood pressure among alcohol consumers.

The analysis further showed that participants who were physically active were 49% (aOR=0.51; 95% CI 0.28-0.90) less likely to be hypertensive compared to those physically inactive. This finding was corroborated by other studies that reported lack of regular exercises increased the risk of hypertension [28,33] while engaging in physical activity helps in maintaining healthy blood pressure levels. Further being overweight and obese had 5.4 and 13.4 times respectively, increased odds of being hypertensive compared to those who had normal BMI. The findings are in agreement with those of studies done from Kenya [27], Ethiopia [25,26,39], Tanzania [18], Botswana [19], Uganda [31], and South Africa [28].

The analysis showed that frequency of eating fruits was significantly associated with hypertension. Our findings are contrary to those of studies done using a nationally representative in Botswana [26], and Kenya [27] which showed that frequency of eating fruits had no association with hypertension [19]. Adding raw salt was significantly associated with being hypertensive. The results are similar to those of a previous study carried out in Tanzania that showed that consuming raw salt was a significant predictor of hypertension [18]. However, in their study Tapela, Clifton [19] found that salt intake was not associated with hypertension.

Strengths and Limitations

The strength of this study is that it was community based, therefore able to capture individuals not visiting health facilities. It also studied persons of low social economic status, and was able to demonstrate that hypertension is not a condition affecting only persons in higher social and economic hierarchy. However, the study has some limitations because the data on behavioural factors were self-reported, collected retrospectively and thus liable to reporting, and recall bias. On the other hand, the studies which our findings are compared to used similar approaches and methodologies. Similarly, the study utilised cross-sectional design and therefore a causal relationship between the outcome and predictor variables cannot be inferred. Nevertheless, we believe our estimates represent the epidemiology of hypertension among the low-income adults in Kiambu County and provides basis for targeted interventions to address the high prevalence among urban poor and future studies.

Conclusion

The prevalence of hypertension among the participants was high at 31%. The male sex, increasing age and having family history of hypertension, alcohol consumption, and physical inactivity and being obese were associated with increased odds of being hypertensive. Eating fruits daily and avoiding raw salt were protective dietary practices against hypertension. Targeted interventions measures focused on healthy diet and healthy lifestyle choices for control of blood pressure such physical activity and avoiding alcohol consumption are recommended.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

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Ethical Approval
Ethical approval was obtained (vide approval no. JKU/ISERC/02316/1100) from JKUAT Institutional Ethics Committee. A research permit was obtained (License No: NACOSTI/P/23/31797) from the National Commission for Science, Technology and Innovation (NACOSTI) before commencement of the study.

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