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Hypertension, its correlates, and differences in access to healthcare services by gender among rural Zambian residents: a cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055668
Article Type:	Original research
Date Submitted by the Author:	20-Jul-2021

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Keywords:	Hypertension < CARDIOLOGY, PUBLIC HEALTH, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Hypertension, its correlates, and differences in access to healthcare services by gender among rural Zambian residents: a cross-sectional study

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Word Count: 3999 words

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ABSTRACT

Objectives: To examine the prevalence of hypertension and access to related healthcare services among rural residents of Mumbwa district in Zambia.

Design: Cross-sectional study with probability cluster sampling.

Setting: Rural Zambia.

Participants: We recruited 690 residents from Mumbwa district aged 25–64 years who had been living in the study area for ≥6 months and had adopted the lifestyle of the study area. Pregnant women and women who had given birth in the last 6 months were excluded. The data collection - questionnaire survey and anthropometric and biological measurements - was conducted between May and July 2016.

Results: In the overall sample, 39.7% of the men and 33.5% of the women had hypertension (SBP≥140 or DBP≥90 mmHg), respectively. Among the participants without a previous diagnosis of hypertension, 30.3% presented with hypertension at the time of measurement. In the multivariable analysis, alcohol intake and urban residence in men, and older age group, higher education, and body mass index ≥25 in women were significantly associated with hypertension. Among the 21.8% who never had their blood pressure (BP) measured, 83.8% were men; in this group of men, older age (AOR, 0.43; 95% CI, 0.25–0.73) and HIV positive status (AOR, 0.37; 95% CI, 0.14–0.97) were negatively associated while current smoker status (AOR, 2.09; 95%CI, 1.19–3.66) was positively associated with the lack of BP measurements.

Conclusion: We found that hypertension is prevalent in the target rural area. However, many were not aware of their hypertension status and many never had their BP measured, indicating a serious gap in cardiovascular disease prevention services in Zambia. There is an urgent need for health promotion and screening for hypertension, especially in the primary health services of rural Zambia. Particular attention should be paid to issues related to healthcare accessibility in men.

KEY WORDS

Hypertension, blood pressure, rural, cluster sampling, access, health promotion

Strengths and limitations of this study

- This study assessed the prevalence and factors associated with hypertension stratified by gender to understand the current hypertension status among rural residents of Zambia.

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- We employed multi-stage cluster random sampling and obtained a relatively high response rate, which helped ensure that the results are representative of the target population.
- Socially desirable responses due to face-to-face interviews might have affected the results.

INTRODUCTION

Hypertension is a major global health concern; currently, there are 17.9 million cases of mortality each year due to coronary heart disease and stroke worldwide.[1] The burden of hypertension has globally increased during the past quarter century and accounts for 7% of disability-adjusted life years.[2] It has been reported that if no action is taken to control hypertension, economic losses will outstrip public healthcare spending.[3]

It is difficult to be aware of hypertension without assessment during the early stages because it is asymptomatic.[3] To address the increasing prevalence of hypertension, early detection and awareness of hypertension is important, particularly at the primary healthcare level. However, many people with hypertension in sub-Saharan Africa (SSA) may remain undiagnosed, untreated, or uncontrolled because of an inadequate healthcare system.[4] In fact, a systematic review of SSA studies reported that only 22.5% of people with hypertension were aware of their hypertension status.[2] Additionally, a South African study found that among people with hypertension, 51% ever had their blood pressure (BP) measured, of which nearly half had not been told that they had high BP.[5] This indicates a lack of necessary health services for prevention and screening of hypertension, particularly in developing countries.

SSA has been reporting rising rates of hypertension, with the highest prevalence rate in the world (46% of adults aged 25 and older),[6] and the prevalence remains high in Zambia as well (19.0% in 2017).[7] A recent study in Zambia found that the prevalence of hypertension in people aged over 25 in rural settings was 23.1%.[8] However, this information was collected from the clinical visit records at primary healthcare facilities and did not include people without access to health facilities.

The aforementioned evidence underscores the importance of strengthening the assessment and treatment of hypertension. However, research on screening and diagnosis of hypertension has been limited in Zambia.[8-10] Therefore, we aimed to find the prevalence of hypertension including undiagnosed cases to understand the current status and access to healthcare service for hypertension among rural residents in Zambia. We also examined the correlation of demographic, behavioural, and biological factors with hypertension.

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METHODS

Design and settings

This was a cross-sectional study conducted between May and July 2016 in Zambia. We selected Mumbwa district in Central Province as our study area because it is a typical rural area experiencing urbanization and economic growth while maintaining traditional culture. The district is located 150 km west of the capital Lusaka city and is home to approximately 210,847 inhabitants – 15% in urban areas and 85% in rural areas.[11] The target population included residents aged 25–64 years. Since the objective of this study was to investigate lifestyle-related risk factors, we only included residents who had been living in the study area for ≥6 months and had adopted the prevalent lifestyle of the study area. Pregnant women and women who had given birth in the last 6 months were excluded because of potentially different dietary habits and lifestyles and the fact that prepartum and postpartum weight could affect their anthropometric and biological data.

Sampling

We employed a three-stage probability proportional to size (PPS) cluster sampling. The sample size calculation was based on the recommendations of the WHO STEPwise approach to surveillance (STEPS),[12] assuming 95% confidence level, 5% margin of error (e2), and 30% prevalence of hypertension in rural areas.[12] The minimum sample size required was 167 subjects, which was increased to 800 to address design effects (loss of sampling efficiency due to cluster sampling), an assumed 20% non-response rate, and planned subgroup and multivariate analyses.

The Central Statistical Office (CSO) of Zambia provided the list of study sampling clusters and Standard Enumeration Areas (SEAs). In the first stage, we selected 32 SEAs through PPS sampling without replacement using the sampling frame of the Zambia Population and Housing Census 2010.[11] In the second stage, within each selected SEA, field staff consisting of mappers from CSO and research assistants mapped the area and listed all households and their eligible members. A total of 25 households in each SEA were selected through systematic sampling. In the third stage, from each selected household, only one individual was selected using the Kish Household Coversheet based on the WHO STEPS.[12] We scheduled a date and place to administer the questionnaire survey and take anthropometric and biological measurements as per the participants' convenience. We met with all recruited individuals (if absent, their family members or closest neighbours) 1–2 days before testing to request them to

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start fasting at 8:00 pm on the day prior to the biological measurements and to visit the testing venue on the scheduled date.

Data collection

The questionnaire was developed in English and three local languages based on the review of Zambian and international literature[9,13] and the results of an earlier qualitative study. [14] A pilot study was conducted to resolve language discrepancies, to assess the face validity of the questionnaire and test-retest reliability, and confirm the feasibility of anthropometric and biological measurements. Face-to-face interviews were carried out by field staff at venues such as the participant's home, community meeting places, or schools. Additionally, licensed nurses were recruited and trained to collect anthropometric measurements and biological samples.

Measurements

BP was measured using electronic equipment (Omron HEM-7130-HP, Omron Corporation, Kyoto, Japan). Three measurements were taken from the participants at three-minute intervals while they were seated after 15 minutes of rest, and the average of the last two readings was recorded. Weight was measured while the participants were barefoot and wearing light clothing using an electronic scale (Omron HBF-223-G, Omron Corporation, Kyoto, Japan). Glycated haemoglobin (HbA1c) and blood lipids (total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides) were measured using point-of-care testing device (Cobas b 101, Roche Diagnostics K.K., Tokyo, Japan). Other variables used in the analysis included socio-demographic characteristics, food security using the Household Food Insecurity Access Scale,[15] medical history and current medications, psychological distress using the Kessler-6 scale,[16] and lifestyle-related variables (tobacco, alcohol, physical activity, and dietary habits). The results of the measurements were explained by local nurses and given to each participant. Those who had extremely abnormal results were encouraged to visit the nearest health facilities with the reports.

Patient and public involvement

Participants were not involved in the design, conduct, reporting, and dissemination plans of our research.

Statistical analysis

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We analysed the data using the Complex Sample module in IBM SPSS Statistics version 21 (IBM Corp., Armonk, NY, USA) to adjust for the effects of multistage sampling, clustering, and weighting. Sample weights accounted for different selection probabilities at each sampling stage, non-response rate in each SEA, and post-stratification adjustments to correct for differences between our sample and the district population estimates based on the 2010 census. Total weights were standardised as the final weight. Bivariate analyses were performed to determine statistically significant associations between independent variables and high BP (systolic blood pressure (SBP) ≥140 or diastolic blood pressure (DBP) ≥90 mmHg) using logistic regression. Variables that showed significant associations with high BP ($p < 0.10$) in the bivariate analysis were entered into the multiple logistic regression models stratified by gender.

Ethical considerations

This study was approved by the Ethics Committee of the Graduate School and Faculty of Medicine of Kyoto University, Japan (R0403) and ERES Converge, Zambia (No. 2016-Jan-003) for the pilot phase. The University of Zambia Biomedical Research Ethics Committee, Zambia (No. 011-02-16) and the National Health Research Authority, Zambia (MH/101/23/10-1) granted approval for the main survey. All participants provided written informed consent prior to their participation.

RESULTS

Of the 800 targeted subjects, 712 agreed to participate. We excluded 22 participants from the analyses due to missing interviews or anthropometric/biological data. The final valid response rate was 86.3%. Table 1 shows the weighted characteristics of the study population by gender. The sample consisted of 48.6% of men, and the mean age was 41.9 years (SE 0.6). Most of the participants were married (%), had only primary education (%), and were self-employed (%). Nearly one-half had an income of 50 USD or less (Zambia's minimum wage); one-quarter were living with severe food insecurity. For the self-reported medical history, 10.4% had with human immunodeficiency virus (HIV) and were receiving antiretroviral therapy (ART). Only 8% and 0.7% of participants had been diagnosed with hypertension and diabetes, respectively. More than 50% of both men and women had family members or relatives who had hypertension, and about 20% reported having family members or relatives who had experienced a stroke.

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Table 1. Sociodemographic characteristics and related medical histories among overall participants in the Mumbwa district, Central Province of Zambia, 2016

	Overall n (%)		Male n (%)		Female n (%)	
Number						
Unweighted	690		332		358	
Weighted	689	(100)	335	(48.6)	354	(51.4)
Age, years [SE]						
	41.9	[0.6]	42.7	[0.8]	41.1	[0.7]
Residential area of the district						
Urban area	87	(10.4)	35	(14.7)	52	(12.6)
Rural area	602	(89.6)	300	(85.3)	302	(87.4)
Marital Status						
Not married	27	(3.9)	20	(5.8)	7	(2.0)
Married	557	(80.8)	300	(89.4)	257	(72.6)
Divorced/widow/widower	106	(15.4)	16	(4.8)	90	(25.4)
Education						
Primary	513	(74.3)	229	(68.3)	284	(80.1)
Secondary	127	(18.5)	77	(23.0)	50	(14.2)
Tertiary	49	(7.2)	29	(8.7)	20	(5.7)
Monthly income (USD)						
≤50	326	(47.4)	157	(46.9)	169	(47.8)
>50	362	(52.6)	178	(53.1)	185	(52.2)
Work Status						
Employed	85	(12.4)	58	(17.2)	28	(7.8)
Self-employed	481	(69.7)	255	(76.2)	225	(63.6)
Unemployed/Retired	123	(17.9)	22	(6.6)	101	(28.6)
Food security						
Secure	192	(27.9)	107	(32.1)	85	(23.9)
Mildly insecure	45	(6.6)	25	(7.4)	21	(5.8)
Moderately insecure	261	(37.9)	132	(39.4)	129	(36.4)
Severely insecure	191	(27.7)	71	(21.2)	120	(33.8)
Medical history (Self-reported)						
HIV positive*	71	(10.4)	28	(8.4)	43	(12.2)
Hypertension	55	(8.0)	18	(5.4)	37	(10.4)
Diabetes	5	(0.7)	3	(0.9)	2	(0.6)
Past history within family and relatives (Self-reported)						
Hypertension	381	(55.3)	174	(52.0)	207	(58.5)
Stroke	140	(20.3)	68	(20.4)	71	(20.2)
Heart disease	64	(9.3)	25	(7.5)	39	(11.0)
Diabetes	123	(17.9)	52	(15.5)	71	(20.2)

Data are presented as numbers (%)
SE, standard error
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
*All have been receiving antiretroviral treatment.

Table 2 shows the prevalence of hypertension in each stage and the current status of access to health services for hypertension stratified by gender. The prevalence of hypertension (Stage 2 and hypertensive crisis) was 36.6% in the overall sample and was greater in men than in women but without statistical significance (39.7% vs. 33.5%, $p = 0.10$). In contrast, the prevalence of hypertensive crisis, which refers to severe BP elevation, was slightly higher in women than in men (5.1% vs. 3.2%) ($p = 0.32$). Prehypertension (SBP, 120–139 or DBP, 80–89 mmHg [Elevated and Stage 1]), which is the risk of developing future hypertension and cardiovascular disease, was found in 39.9% of the men and 30.6% of the women, and the difference was statistically significant ($p = 0.02$). There was a significant association between the stage of hypertension and age in both men and women (men, $p = 0.02$; women, $p < 0.01$). Area of residence in the district had a significant association with hypertension in men ($p = 0.02$) but not in women ($p = 0.82$). Regarding access to healthcare services for hypertension, the

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prevalence of hypertension was higher among men than among women, and the proportion of men who had “never had their BP measured” was significantly higher than that of women (37.3% [125/335] vs. 6.8% [24/354]) (p < 0.01). The proportion of participants who had a previous diagnosis of hypertension was 5.4% [18/335] for men and 10.5% [37/354] for women, and 2.4% [8/335] of the men and 4.5% [16/354] of the women received antihypertensive treatment (p = 0.09, p = 0.25).

Table 2. Stage of hypertension relative to demographics and access to care and services among all participants in the Mumbwa district, Central Province of Zambia, 2016

Male

				Prehypertension				Hypertension				
	Overall	Normal		Elevated		Stage 1		Stage 2		Hypertensive crisis		*p* value
Total n(%)	335	68	(20.4)	33	(9.8)	101	(30.1)	122	(36.5)	11	(3.2)	
Age												
25-44	203	45	(22.0)	26	(12.7)	62	(30.6)	68	(33.4)	3	(1.3)	0.02
45-64	132	24	(17.9)	7	(5.4)	39	(29.2)	54	(41.2)	8	(6.2)	
Residential area of the district												
Urban area	35	5	(13.2)	1	(2.9)	8	(22.1)	17	(48.5)	5	(13.2)	0.02
Rural area	300	64	(21.2)	32	(10.6)	93	(31.0)	105	(35.1)	6	(2.1)	
Access to hypertension care and services												
Have never blood pressure measured	125	27	(21.3)	8	(6.1)	35	(27.9)	55	(43.9)	1	(0.8)	0.11
Diagnosed as hypertensive	18	2	(11.4)	0	(0.0)	2	(11.4)	8	(45.7)	6	(31.4)	<0.01
On treatment	8	0	(0.0)	0	(0.0)	1	(13.3)	2	(26.7)	5	(60.0)	<0.01
Medical history (Self-reported)												
HIV positive	28	8	(29.1)	2	(7.3)	9	(30.9)	9	(32.7)	0	(0.0)	0.69
Diabetic	3	0	(0.0)	0	(0.0)	1	(33.3)	2	(66.7)	0	(0.0)	0.80

Female

				Prehypertension				Hypertension				
	Overall	Normal		Elevated		Stage 1		Stage 2		Hypertensive crisis		*p* value
Total n(%)	354	127	(35.8)	12	(3.3)	97	(27.3)	101	(28.4)	18	(5.1)	
Age												
25-44	226	105	(46.4)	5	(2.3)	63	(27.7)	50	(22.0)	4	(1.6)	<0.01
45-64	128	22	(17.3)	7	(5.2)	34	(26.5)	51	(39.8)	14	(11.2)	
Residential area of the district												
Urban area	52	16	(31.7)	2	(3.0)	17	(32.7)	15	(28.7)	2	(4.0)	0.82
Rural area	302	111	(36.6)	10	(3.4)	80	(26.4)	86	(28.4)	16	(5.3)	
Access to hypertension care and services												
Have never blood pressure measured	24	8	(31.9)	1	(2.1)	9	(38.3)	7	(27.7)	0	(0.0)	0.53
Diagnosed as hypertensive	37	2	(4.2)	0	(0.0)	7	(19.4)	15	(40.3)	13	(36.1)	0.00
On treatment	16	0	(0.0)	0	(0.0)	3	(18.8)	6	(34.4)	8	(46.9)	0.00
Medical history (Self-reported)												
HIV positive	43	19	(44.0)	3	(6.0)	11	(26.2)	10	(23.8)	0	(0.0)	0.36
Diabetic	2	1	(50.0)	0	(0.0)	0	(0.0)	1	(50.0)	0	(0.0)	0.90

Data are number (%)HIV, human immunodeficiency virus
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
Blood pressure category: Normal (SBP<120 and DBP<80), Elevated (SBP 120-129 and DBP < 80), Stage 1 (SBP 130-139 or DBP 80-89), Stage 2 (SBP≥140 or DBP≥90), Hypertensive crisis (SBP>180 and/or DBP>120)

The present status of hypertension screening and diagnosis is shown in Figure 1. We see that 21.8% (150/689) never had their BP measured, and the main reasons given were ‘do not know where to obtain the service’ (41.6%), ‘do not have the time or opportunity to check’ (24.8%), and ‘I think it is not important or I am healthy’ (18.8%). Among the participants who never had their BP measured, 41.9% (63/150) presented with hypertension at the time of measurement in this study. Among participants who had their BP measured previously, 89.8%

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(485/539) had not been diagnosed with hypertension but 30.3% (147/485) presented with hypertension. Among the participants already diagnosed with hypertension, 56.4% (31/55) were not taking antihypertensive medication, of which 71.0% (22/31) presented with hypertension. Furthermore, most participants taking antihypertensive medication (20/24) presented with hypertension, indicating poor BP control.

Figure 1. Status of screening and diagnosis of hypertension among all participants in the Mumbwa district, Central Province of Zambia, 2016 (weighted)

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Table 3 shows the proportion of hypertension in relation to each covariate and the association of each covariate with hypertension by multivariable analysis (adjusted for the variables that showed an association of $p < 0.10$ in the bivariate analysis) in the overall sample analysis and the analysis stratified by gender. In the overall sample, older age group (45–64 years) (adjusted odds ratio [AOR] = 1.95, 95%CI, 1.35–2.80), higher education (≥college) (2.00, 95%CI, 1.04–3.82), alcohol intake (a few times/week or everyday) (2.14, 95%CI, 1.28–3.58), and BMI ≥25 (1.83, 95%CI, 1.24–2.71) were positively associated, while the presence of HIV infection was negatively associated with hypertension (0.53, 95%CI, 0.29–0.96). Gender, marital status, food insecurity, smoking, physical activity, cooking oil intake, sugar intake, and HbA1c were not associated with hypertension. There was a significant association between hypertension and alcohol intake in both genders (men ≥a few times/week or everyday: 2.28, 95%CI, 1.24–4.17; women ≤a few times/month: 1.79, 95%CI, 1.01–3.19), but the association with urban residence was significant only in men (2.46, 95%CI, 1.09–5.56). Older age (45–64 years) (2.68, 95%CI, 1.56–4.63), higher education (≥college) (3.39, 95%CI, 1.19–9.64), low-level alcohol intake (≤a few times/month) (1.79, 95%CI, 1.01–3.19), and BMI ≥25 (1.98, 95%CI, 1.18–3.29) showed significant association with hypertension only in women.

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Table 3. Multivariate correlates of hypertension among all participants in the Mumbwa district, Central Province of Zambia, 2016

	Overall						Male						Female					
	Total	Hypertension n(%)		Adjusted OR (95%CI)		*p* value	Total	Hypertension n (%)		Adjusted OR (95%CI)		*p* value	Total	Hypertension n(%)		Adjusted OR (95%CI)		*p* value
Socio-demographic characteristics																		
Gender																		
Male	335	133	(39.7)	–			–	–		N/A			–	–		N/A		
Female	354	119	(33.5)	–			–	–					–	–				
Age																		
25-44	429	124	(28.9)	1	(Reference)		203	70	(34.7)	1	(Reference)		226	53	(23.6)	1	(Reference)	
45-64	260	128	(49.2)	1.95	(1.35-2.80)	0.00	132	63	(47.5)	1.57	(0.95-2.58)	0.07	128	65	(51.0)	2.68	(1.56-4.63)	0.00
Marital Status																		
Not married	27	8	(30.8)	1	(Reference)		20	7	(34.2)	–			7	2	(21.4)	–		
Married	557	200	(36.0)	1.57	(0.63-3.90)	0.33	300	120	(40.0)	–			257	81	(31.4)	–		
Divorced/Widow/Widowed	106	43	(40.8)	1.83	(0.68-4.97)	0.23	16	7	(41.9)	–			90	36	(40.6)	–		
Education																		
≤primary	513	185	(36.1)	1	(Reference)		229	90	(39.6)	–			284	95	(33.3)	1	(Reference)	
Secondary	127	44	(34.7)	1.03	(0.66-1.61)	0.89	77	32	(41.3)	–			50	12	(24.5)	0.68	(0.32-1.45)	0.32
≥college	49	23	(45.8)	2.00	(1.04-3.82)	0.04	29	11	(36.8)	–			20	12	(59.0)	3.39	(1.19-9.64)	0.02
Work Status																		
Employed	85	29	(33.7)	–			58	19	(33.0)	1	(Reference)		28	10	(35.2)	–		
Self-employed	481	178	(37.1)	–			255	102	(39.8)	1.43	(0.74-2.78)	0.29	225	77	(34.0)	–		
Unemployed/Retired	123	45	(36.3)	–			22	12	(55.8)	1.95	(0.66-5.75)	0.22	101	32	(32.0)	–		
Monthly income (USD)																		
≤50	326	112	(34.3)	–			157	61	(38.9)	–			169	51	(30.1)	–		
>50	363	140	(38.5)	–			178	72	(40.5)	–			185	68	(36.7)	–		
Residential area **of the district**																		
Urban area	87	39	(44.4)	–			35	22	(61.8)	2.46	(1.09-5.56)	0.03	52	17	(32.7)	–		
Rural area	602	213	(35.4)	–			300	112	(37.2)	1	(Reference)		302	102	(33.7)	–		
Food security																		
Secure	192	58	(30.2)	1	(Reference)		107	33	(31.1)	–			85	25	(29.1)	–		
Insecure	497	194	(39.0)	1.46	(0.99-2.16)	0.06	228	100	(43.8)	–			269	94	(34.9)	–		
Family planning																		
Not used	–	–		–			–	–		–			249	96	(38.6)	1	(Reference)	
Used	–	–		–			–	–		–			101	96	(21.8)	0.61	(0.32-1.153)	0.13
No data	–	–		–			–	–		–			4	1	(14.3)	–		
Behavioral and psychological characteristics																		
Smoking																		
Never	525	179	(34.1)	1	(Reference)		185	66	(35.8)	–			340	113	(33.1)	–		
Ex-smoker	86	37	(43.1)	1.26	(0.73-2.18)	0.41	74	33	(44.4)	–			12	4	(34.8)	–		
Current smoker	79	36	(45.8)	1.27	(0.71-2.29)	0.42	76	34	(44.6)	–			3	2	(80.0)	–		
Alcohol																		
Never	354	106	(30.0)	1	(Reference)		102	30	(29.3)	1	(Reference)		252	77	(30.3)	1	(Reference)	
≤a few times/month	206	80	(39.0)	1.49	(0.98-2.27)	0.06	123	49	(39.6)	1.43	(0.78-2.59)	0.24	82	31	(38.1)	1.79	(1.01-3.19)	0.046
≥a few times/week or everyday	130	65	(50.4)	2.14	(1.28-3.58)	0.00	110	54	(49.5)	2.28	(1.24-4.17)	0.01	20	11	(55.3)	1.61	(0.58-4.49)	0.37
Physical activity (activities of daily life and sports ≥once a week)																		
Neither	54	25	(46.2)	1	(Reference)		16	8	(46.9)	–			38	17	(45.9)	1	(Reference)	
Either	497	182	(36.6)	0.62	(0.34-1.15)	0.13	215	96	(44.7)	–			282	86	(30.4)	0.51	(0.24-1.08)	0.08
Both	138	45	(32.5)	0.66	(0.32-1.35)	0.25	104	29	(28.2)	–			34	15	(45.5)	1.60	(0.54-4.71)	0.40
Cooking oil intake																		
Low <20.83ml	510	198	(38.8)	1	(Reference)		244	103	(42.2)	–			266	95	(35.7)	–		

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High ≥20.83ml	177	54	(30.5)	0.71	(0.48-1.07)	0.10	92	30	(33.1)	–			85	24	(27.7)	–		
Don't know	1	0	(0.0)	–			–	–		–			1	0	(0.0)	–		
No data	2	0	(0.0)	–			–	–		–			2	0	(0.0)	–		
Sugar intake																		
Low <28.0g	353	136	(38.6)	1	(Reference)		168	70	(42.0)	–			185	66	(35.6)	–		
High ≥28.0g	335	114	(33.9)	0.79	(0.56-1.12)	0.18	167	62	(37.0)	–			168	52	(30.9)	–		
No data	2	2	(100.0)	–			1	1	(100.0)	–			1	1	(100.0)	–		
Clinical characteristics																		
Body mass index (kg/m^2)																		
Normal (<25)	505	167	(33.1)	1	(Reference)		281	106	(37.9)	1	(Reference)		224	61	(27.1)	1	(Reference)	
Overweight/Obese (≥25)	185	85	(46.0)	1.83	(1.24-2.71)	0.00	54	27	(49.1)	1.73	(0.91-3.29)	0.09	130	58	(44.7)	1.98	(1.18-3.29)	0.01
HbA1c																		
Normal (<5.7)	404	144	(35.6)	1	(Reference)		222	89	(40.1)	–			182	55	(30.1)	1	(Reference)	
High risk (5.7-6.4)	266	96	(36.1)	1.05	(0.73-1.50)	0.80	111	42	(38.1)	–			156	54	(34.7)	1.02	(0.61-1.71)	0.93
Diabetes (≥6.5)	18	12	(65.7)	2.69	(0.91-7.96)	0.07	3	2	(66.7)	–			15	10	(65.5)	2.33	(0.68-7.96)	0.18
No data	1	0	(0.00)	–			0	0	(0.0)				1	0	(0.0)	–		
Medical history (self-reported)																		
HIV infection (Self-reported)																		
No	618	232	(37.6)	1	(Reference)		307	124	(40.4)	–			311	108	(34.9)	1	(Reference)	
Yes	71	20	(27.3)	0.53	(0.29-0.96)	0.04	28	9.25	(32.7)	–			43	10	(23.8)	0.54	(0.24-1.24)	0.15

Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
"No data" and "Don't know" were excluded from statistical test.
Hypertension is defined as SBP 140 ≥ mmHg or DBP ≥90 mmHg.

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Table 4 shows factors associated with 'never had BP measured' among men, as 83.8% (125/150) of participants who never had their BP measured were men. In the multivariable analysis, older age (0.43, 95%CI, 0.25–0.73) and HIV positive status (0.37, 95%CI, 0.14–0.97) were negatively associated, while being current smoker status was positively associated with 'never had BP measured' (2.09, 95%CI, 1.19–3.66). In contrast, in women, though not shown in the table, older age was positively associated with 'never had BP measured' (4.53, 95%CI, 1.81–11.4).

Table 4. Bivariate and multivariate correlates of "never had blood pressure measured"（Men only）

	Male (n=335)	Never had blood pressure measured (n=125)							
	Total	n of total (%)		Crude OR (95%CI)		*p* value	Adjusted OR (95%CI)		*p* value
Age									
25-44	203	83	(41.0)	1	(reference)		1	(reference)	
45-64	132	42	(31.9)	0.48	(0.30-0.77)	0.00	0.43	(0.25-0.73)	0.00
Residential area of the district									
Urban area	35	6	(16.2)	1	(reference)		1	(reference)	
Rural area	300	120	(39.9)	3.60	(1.35-9.61)	0.01	2.79	(0.98-7.93)	0.06
Education									
Primary	229	96	(42.0)	1	(reference)		1	(reference)	
≥Secondary	106	29	(27.5)	0.62	(0.38-1.01)	0.05	0.84	(0.48-1.45)	0.53
Work Status									
Employed	58	13	(23.2)	1	(reference)		1	(reference)	
Unemployed/Retired	278	112	(40.4)	2.04	(1.08-3.83)	0.03	1.86	(0.92-3.76)	0.09
HIV infection									
No	307	119	(38.7)	1	(reference)		1	(reference)	
Yes	28	7	(23.6)	0.40	(0.16-1.02)	0.06	0.37	(0.14-0.97)	0.04
Smoking									
Never, Ex-smoker	259	87	(33.7)	1	(reference)		1	(reference)	
Current smoker	76	38	(50.0)	2.01	(1.19-3.38)	0.01	2.09	(1.19-3.66)	0.01
Alcohol									
Never or a few times/month	225	85	(37.9)	1	(reference)		–		
≥a few times/week or everyday	110	40	(36.4)	1.03	(0.64-1.66)	0.91	–		
Body mass index (kg/m²) [c]									
Normal (<25)	281	111	(39.6)	1	(reference)		1	(reference)	
Overweight/Obese (≥25)	54	14	(26.4)	0.43	(0.22-0.85)	0.02	0.66	(0.32-1.40)	0.28

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

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DISCUSSION

This study assessed the prevalence and the risk factors of hypertension among the genders to understand the current situation of hypertension among rural residents in Zambia. We also explored the status of screening and diagnosis of hypertension and their correlates to evaluate the situation of access to healthcare services for hypertension.

In this study, we found that more than 35% of the participants had hypertension, and the profile of hypertension correlates was different between men and women. More than 80% of the people with high BP measurements had never been previously diagnosed with hypertension, and over 40% of them had never had their BP measured, suggesting the lack of access to or availability of healthcare services for BP control among the studied population.

The prevalence of hypertension in rural areas

The prevalence of hypertension among the targeted rural residents of this study in 2016 was 39.7% in men and 33.5% in women, respectively, both being much higher than the national averages found in the Zambia STEPS Survey of 2017 (20.5% in men and 17.6% in women).[7] Previous research has reported mixed findings regarding the prevalence of hypertension in rural areas of Zambia. While similar prevalence of hypertension (46.9%) was reported among people attending health check-up in other rural area of Zambia,[17] it was only 23.1% in a primary healthcare-based study conducted in several rural districts between 2011–2014.[18] Comparing our results with those of previous studies is, however, difficult due to methodological differences. For example, previous studies were based on convenient samples with potential selection bias, while our study was based on probability sample of the whole area. Studies using probability sampling are needed for documenting the accurate status of blood pressure among Zambian rural populations. The prevalence of prehypertension and hypertension was slightly higher in men than in women in our study, a tendency that has been observed throughout the African region.[6]

Gender differences in factors associated with hypertension

In this study, a difference in gender was found not only in the prevalence of hypertension, but also in the profile of the correlates of hypertension. In men, residence in the urban area of the district and high frequency of alcohol intake were significantly associated with hypertension. While in women, older age, higher education level, low frequency of alcohol intake, and BMI ≥25 were associated with hypertension, suggesting the different mechanism(s) involved in the development of high blood pressure between the genders. This implies that different pathways

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for hypertension including behavioural and socio-cultural factors exist in men and women, which could affect prevention strategies [19]

Alcohol consumption was the only factor moderately associated with hypertension in both genders, which is in line with well-established findings worldwide.[20] Although the exact mechanism is unclear, it can be caused directly through the chronic effect of alcohol and/or indirectly through related socioeconomic status and lifestyles among the study population.[20] Regardless of the mechanism, however, it is important to follow the trend of alcohol intake over time with special attention to the type, amount, and pattern since it may rapidly change in both quantity and quality with future economic growth.

Living in the urban area of the district was significantly associated with hypertension only in men. Although the study region was "rural" in general (neighbouring the capital city, Lusaka), there are some areas with relatively easy access to the capital city. Men living in such areas may be involved in urbanized lifestyles, probably in relation to their jobs, in terms of eating habits and lifestyles, including high calorie diets and lack of exercise. Studies in Cameroon and Mali have shown a similar tendency with higher prevalence of hypertension among men in 'urban areas' than in rural areas.[21,22]

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The relationship between age and hypertension has been reported in SSA countries [23-25]. In our study, a significant association with age was observed only in women, reflecting the age-related distribution of hypertension between the genders, where the difference of the proportions of hypertension between younger (25–44 years) and older (45–64 years) age groups was large (23.6% vs. 51.0%, respectively) in women, but small in men (34.7% and 47.4%, respectively). Similar age disparities in the proportion of hypertension by gender have been reported in previous studies of Zambia and Senegal.[18,25] This may suggest that men are more likely to develop hypertension at a younger age than women. The reasons for this age disparity by gender should be one of the focus points in future research.

An association between hypertension and education level was observed only among women. Slightly high odds of hypertension in people with higher levels of education were also observed in the study in Malawi [21]. This may suggest that in SSA countries that experienced rapid economic growth in recent years, the risk of hypertension has increased among people with higher levels of education due to spread of urbanized eating habits and lifestyles (over-nutrition and physically inactive).[26] The reason why the association was detected only in women in our study is unclear but higher education may be related to urbanized eating habits and lifestyles more in women than in men.

The association between 'overweight and obesity" (BMI ≥ 25) and hypertension has been reported in SSA countries including Zambia, with its tendency being stronger in women than

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in men.[27] Similarly in our study, although the association was observed both in both genders, it was significant only in women. This may be related to biological factors such as an increase in obesity with age in women in African societies and their cultural preferences. In men, behavioural factors such as alcohol consumption and psychological stress may be more likely to be associated with developing hypertension than obesity.

Status of Hypertension Management

In this study, only 16.7% of the participants who presented with hypertension had previously been diagnosed with hypertension. Among the participants with documented hypertension but no previous diagnosis, 30% never had their BP measured. Our results concur with findings from a systematic review of hypertension in the SSA indicating that only 22.5% of people with hypertension had already been diagnosed with hypertension.[18] This indicates the need to strengthen screening and diagnosis of hypertension particularly at the primary healthcare level which is the entry level to health care systems in most SSA countries.

Moreover, only 8% of the participants in this study reported having been previously diagnosed with hypertension, which was much lower than the actual proportion presenting with hypertension in our study. In addition, only fewer than half of the participants diagnosed with hypertension were taking antihypertensive medications, and of them, many presented with hypertension at the time of the measurement, indicating challenges in accessing treatment and management of hypertension. A previous study in Zambia reported that 18% of people who presented with hypertension at the time of the study had been prescribed antihypertensive medication at a health centre.[18] In our study, only 7.9% of the participants with hypertension had been prescribed antihypertensive medication. Furthermore, about 83% of the participants who reported taking antihypertensive medication in our study presented hypertension at the time of measurement. This was consistent with the results of a previous study in Zambia where nearly 90% had poorly controlled hypertension,[18] and other reports from the entire SSA region.[2] These results indicate that there are various challenges in the management of hypertension in the rural areas of Zambia, as in other SSAs, in terms of 'difficulties in accessing appropriate treatment and health services including hypertension', 'lack of screening and diagnostic opportunities for hypertension', and 'lack of awareness of the importance of BP control'.

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Access to healthcare services related to hypertension

In this study, we also assessed the differences in access to healthcare services related to hypertension between the genders. Identifying the management status of hypertension (care cascade) is important evidence that can contribute to health policy and interventions.[28] We specifically focused on the 'history of BP measurement' as it relates to the awareness of having hypertension. In our study, more than 20% of the participants reported have never having had their BP measured previously, suggesting the difficulties in accessing screening and diagnostic services for hypertension care. In particular, despite the higher prevalence of hypertension among men than among women, the proportion of men who 'never had their BP measured' was 37.4%, which was 5.5 times higher than that of women. Men also tended to be less likely to have been diagnosed with and treated for hypertension.

There was a significant positive association between smoking and 'never had their BP measured' in men. While this finding requires further assessment in future research, it may suggest that people who engage in high-risk health behaviours such as smoking tend to be less concerned about their health and less likely to engage in health seeking behaviours than those who do not engage in such behaviour. In this study, we also included self-reported HIV status in the analysis as a factor affecting access to healthcare services. Men in older age groups and men with HIV-positive status were less likely to have 'never had their BP measured before', suggesting that they were likely to be aware of their BP. The association with 'older age group' may be due to the fact that they were likely to receive medical care during their lifetime. Regarding the association with 'HIV-positive', all HIV-positive individuals were receiving HIV treatment, so regular medical consultations at a healthcare facility may have been the important opportunity for BP measurement.

Men have fewer opportunities to access healthcare services other than for illness or injury, than women who visit healthcare facilities for maternal and child health services. Patients with asymptomatic conditions like hypertension may not receive the required healthcare services due to psychological and geographical barriers, e.g., low level of attention to health or distance to healthcare facilities. Therefore, along with strengthening the screening for hypertension, we suggest that the use of existing mobile health services, such as vaccination campaigns, mobile voluntary counselling and testing services (VCTs), and cooperation with community health workers may be advantageous in treating many people.[29] For women, although the number of people who never had their BP measured was too few, the odds of never having BP measured were significantly higher in the older age group. This gender difference will need to be examined in further research with a large sample size.

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Strengths and limitations

The strength of our study is that we used multi-stage cluster random sampling and obtained a relatively high response rate. Thus, our results are representative of patients at risk of CVD in the target population in the rural area. In terms of limitations, the recorded BP may have been higher than usual due to white coat hypertension. Socially desirable responses due to face-to-face interviews could also have affected the results, even though we trained interviewers before the study. Unmeasured factors may have affected some of the associations found in our study.

CONCLUSION

We found that more than one-third of the participants in a rural district in Zambia had hypertension. Among them, most were not diagnosed with hypertension yet and one-quarter of them never had their BP measured. These results indicate a serious lack of CVD prevention services, including access to and availability of healthcare services for hypertension, among rural residents in Zambia. Therefore, health promotion and screening strategies for hypertension are urgently required, especially in primary healthcare settings in rural areas. Particular attention should be paid to healthcare access, specifically among men.

Acknowledgments

We are thankful to all the participants, the staff at the Institute of Economic and Social Research, the University of Zambia, and the members of the Mumbwa District Medical Office for the local arrangement and support to this study. We gratefully acknowledge the local nurses and research assistants for their assistance with the data collection. Lastly, we extend our gratitude to the late Mubiana Macwan'gi for contributing to the supervision of the research in Zambia.

Contributors

YT, TT, MOK and MK contributed to study conception and design. YT, RZ and CD contributed to the data collection. YT, TT and MK contributed to data analysis and drafted the manuscript. YT, PPM, SPS, OA, RZ and CD revised the manuscript. MOK and MK supervised the study. All authors read and approved the final manuscript.

Funding

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This study was supported by the United Nations University, Institute for the Advanced Study of Sustainability (Global Leadership Training Program in Africa) and the Inter-Graduate School Program for Sustainable Development and Survivable Societies, Kyoto University. It was also supported by the 2016 Kyoto University School of Public Health Super Global Course's travel scholarship.

Competing interests

None declared.

Patient consent for publication

Not required.

Data sharing statement

Data are available upon reasonable request.

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Appendix

Table 1: Bivariate and multivariate correlates of 'never had blood pressure measured' (Women)

	Female (n=354)	Never had blood pressure measured (n=24)							
	Total	n of total (%)		Crude OR (95CI)		*p* value	Adjusted OR (95CI)		*p* value
Age									
25-44	226	6	(2.5)	1	(reference)		1	(reference)	
45-64	128	19	(14.5)	5.33	(2.18-13.06)	0.00	4.53	(1.81-11.35)	0.00
Residential area									
Urban	52	4	(6.9)	1	(reference)		–		
Rural	302	21	(6.8)	1.39	(0.40-4.81)	0.60	–		
Education									
<=primary	284	19	(6.7)	1	(reference)		–		
>=Secondary	70	5	(7.3)	0.997	(0.36-2.75)	0.995	–		
Work Status									
Employed	28	3	(9.3)	1	(reference)		–		
Unemployed/Retired	326	22	(6.6)	0.71	(0.20-2.50)	0.59	–		
HIV infection									
No	311	23	(7.3)	1	(reference)		–		
Yes	43	2	(3.6)	0.83	(0.24-2.89)	0.77	–		
Smoking									
Never, Ex-smoker	352	24	(6.7)	1	(reference)		–		
Current smoker	3	1	(20.0)	6.60	(0.58-75.32)	0.13	–		
Alcohol									
Never or a few times/m	335	20	(6.0)	1	(reference)		1	(reference)	
≥a few times/w or everyday	20	4	(21.1)	3.37	(1.04-10.88)	0.04	2.19	(0.65-7.43)	0.21
Body mass index (kg/m²)									
Normal (<25)	224	11	(4.8)	1	(reference)		1	(reference)	
Overweight/Obese (25 and over)	130	13	(10.3)	2.12	(0.95-4.72)	0.07	1.71	(0.74-3.92)	0.21

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

Table 2: Bivariate and multivariate correlates of 'never had blood pressure measured' (Overall)

	Overall (n=689)	Never had blood pressure measured (n=150)							
	Total	n of total (%)		Crude OR (95CI)		*p* value	Adjusted OR (95CI)		*p* value
Gender									
Male	335	125	(37.4)	7.71	(4.88-12.18)	0.00	6.27	(3.84-10.23)	0.00
Female	354	24	(6.8)	1	(reference)		1	(reference)	
Age									
25-44	429	89	(20.7)	1	(reference)		–		
45-64	260	61	(23.3)	0.90	(0.61-1.31)	0.57	–		
Residential area									
Urban	87	9	(10.7)	1	(reference)		1	(reference)	
Rural	602	140	(23.3)	3.02	(1.43-6.41)	0.00	2.70	(1.22-5.98)	0.01
Education									
<=primary	513	115	(22.5)	1	(reference)		–		
>=Secondary	177	34	(19.5)	0.96	(0.63-1.45)	0.84	–		
Work Status									
Employed	85	16	(18.7)	1	(reference)		–		
Unemployed/Retired	604	134	(22.1)	1.16	(0.67-2.01)	0.60	–		
HIV infection									
No	618	141	(22.9)	1	(reference)		1	(reference)	
Yes	71	8	(11.5)	0.44	(0.21-0.90)	0.03	0.46	(0.21-0.995)	0.049
Smoking									
Never, Ex-smoker	611	111	(18.2)	1	(reference)		1	(reference)	
Current smoker	79	39	(49.0)	4.46	(2.74-7.28)	0.00	2.11	(1.19-3.73)	0.01
Alcohol									
Never or a few times/m	560	105	(18.8)	1	(reference)		1	(reference)	
≥a few times/w or everyday	130	44	(34.1)	2.29	(1.50-3.50)	0.00	0.93	(0.55-1.55)	0.77
Body mass index (kg/m²)									
Normal (<25)	505	122	(24.1)	1	(reference)		1	(reference)	
Overweight/Obese (25 and over)	185	28	(15.0)	0.50	(0.31-0.79)	0.00	0.91	(0.55-1.53)	0.73

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

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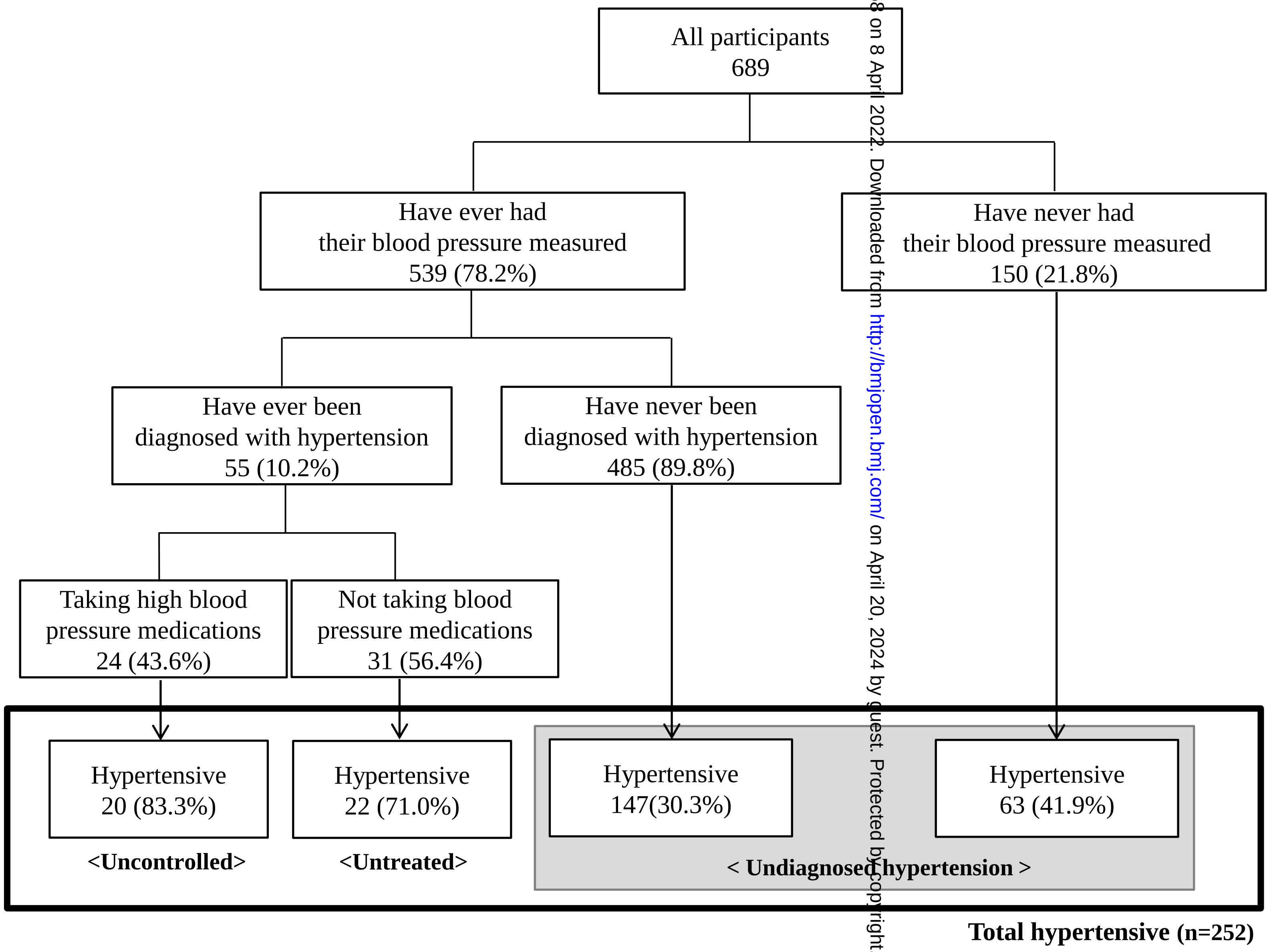

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5*
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	4
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7,8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9,10

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		(*b*) Report category boundaries when continuous variables were categorized	8,11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Hypertension, its correlates, and differences in access to healthcare services by gender among rural Zambian residents: a cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055668.R1
Article Type:	Original research
Date Submitted by the Author:	08-Dec-2021
Complete List of Authors:	Tateyama, Yukiko; Kyoto University, Health Service; Kyoto University, Global Health Interdisciplinary Unit, Center for the Promotion of Interdisciplinary Education and Research Techasrivichien, Teeranee ; Kyoto University, Global Health Interdisciplinary Unit, Center for the Promotion of Interdisciplinary Education and Research; International Institute of Socio-epidemiology Musumari, Patou Masika ; Kyoto University, Global Health Interdisciplinary Unit, Center for the Promotion of Interdisciplinary Education and Research; International Institute of Socio-epidemiology Suguimoto, S. Pilar; International Institute of Socio-epidemiology; National Institute of Health Ongosi, Anita; International Institute of Socio-epidemiology Zulu, Richard; Center for Primary Care Research, University of Zambia School of Medicine Dube, Christopher; Ndola District Health Office Ono-Kihara, Masako; Kyoto University, Global Health Interdisciplinary Unit, Center for the Promotion of Interdisciplinary Education and Research; International Institute of Socio-epidemiology Kihara, Masahiro; Kyoto University, Global Health Interdisciplinary Unit, Center for the Promotion of Interdisciplinary Education and Research; International Institute of Socio-epidemiology
Primary Subject Heading:	Global health
Secondary Subject Heading:	Public health
Keywords:	Hypertension < CARDIOLOGY, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PRIMARY CARE, PUBLIC HEALTH, EPIDEMIOLOGY

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Hypertension, its correlates, and differences in access to healthcare services by gender among rural Zambian residents: a cross-sectional study

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Word Count: 4088 words

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ABSTRACT

Objectives: To examine the prevalence of hypertension and access to related healthcare services among rural residents of Mumbwa district in Zambia.

Design: Cross-sectional study with probability cluster sampling.

Setting: Rural Zambia.

Participants: We recruited 690 residents from Mumbwa district aged 25–64 years who had been living in the study area for ≥6 months and had adopted the lifestyle of the study area. Pregnant women and women who had given birth in the past 6 months were excluded. The data collection—questionnaire survey and anthropometric and biological measurements—was conducted between May and July 2016.

Results: In the overall sample, 39.7% and 33.5% of the men and women had hypertension (SBP≥140 or DBP≥90 mmHg), respectively. Among the participants without a previous diagnosis of hypertension, 30.3% presented with hypertension at the time of measurement. In the multivariable analysis, alcohol intake and urban residence in men, and older age group, higher education, and body mass index ≥25 kg/m^2 in women were significantly associated with hypertension. Among the 21.8% who never had their blood pressure (BP) measured, 83.8% were men; among these men, older age (adjusted odds ratio [AOR], 0.43; 95% confidence interval [CI], 0.25–0.73) and HIV positive status (AOR, 0.37; 95%CI, 0.14–0.97) were negatively associated, while current smoker status (AOR, 2.09; 95%CI, 1.19–3.66) was positively associated with the lack of BP measurements.

Conclusion: We found that hypertension is prevalent in the target rural area. However, many were not aware of their hypertension status and many never had their BP measured, indicating a serious gap in cardiovascular disease prevention services in Zambia. There is an urgent need for health promotion and screening for hypertension, especially in the primary health services of rural Zambia. Issues related to healthcare accessibility in men require particular attention.

KEY WORDS

Hypertension, blood pressure, rural, cluster sampling, access, health promotion

Strengths and limitations of this study

- This study assessed the prevalence and factors associated with hypertension stratified by gender, to understand the current hypertension status among rural residents of Zambia.

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- We employed a multi-stage cluster random sampling method and obtained a relatively high response rate, which helped ensure that the results are representative of the target population.
- Socially desirable responses due to face-to-face interviews might have affected the results.

INTRODUCTION

Hypertension is a major global health concern; currently, 17.9 million mortality cases are reported yearly due to coronary heart disease and stroke worldwide.[1] The burden of hypertension has increased globally during the past quarter century and accounts for 7% of disability-adjusted life years.[2] It has been reported that if no action is taken to control hypertension, economic losses will outstrip public healthcare spending.[3]

It is difficult to be aware of hypertension without assessment during the early stages because it is asymptomatic.[3] To address the increasing prevalence of hypertension, early detection and awareness are important, particularly at the primary healthcare level. However, many people with hypertension in sub-Saharan Africa (SSA) may remain undiagnosed, untreated, or uncontrolled because of an inadequate healthcare system.[4] In fact, a systematic review of SSA studies reported that only 22.5% of people with hypertension were aware of their status.[2] Additionally, a South African study found that among people with hypertension, 51% ever had their blood pressure (BP) measured, of which nearly half had not been informed of their high BP.[5] This indicates a lack of necessary health services for prevention and screening of hypertension, particularly in developing countries.

SSA has been reporting rising rates of hypertension, with the highest prevalence rate worldwide (46% of adults aged ≥25 years),[6] and the prevalence remains high in Zambia as well (19.0% in 2017).[7] A recent study in Zambia found that the prevalence of hypertension in people aged over 25 years in rural settings was 23.1%.[8] However, this information was obtained from the clinical visit records at primary healthcare facilities and did not include people without access to health facilities.

The aforementioned evidence underscores the importance of strengthening the assessment and treatment of hypertension. However, research on screening and diagnosis of hypertension has been limited in Zambia.[8-10] Therefore, we aimed to investigate the prevalence of hypertension including undiagnosed cases to understand the current status and access to

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healthcare service for hypertension among rural residents in Zambia. We also examined the correlation of demographic, behavioural, and biological factors with hypertension.

METHODS

Design and settings

This was a cross-sectional study conducted between May and July 2016 in Zambia. We selected Mumbwa district in Central Province as our study area because it is a typical rural area experiencing urbanization and economic growth while maintaining traditional culture. The district is located 150 km west of the capital Lusaka city and is home to approximately 210,847 inhabitants—15% in urban areas and 85% in rural areas.[11] The target population included residents aged 25–64 years. Since the objective of this study was to investigate lifestyle-related risk factors, we only included residents who had been living in the study area for ≥6 months and had adopted the prevalent lifestyle of the study area. Pregnant women and women who had given birth in the last 6 months were excluded because of potentially different dietary habits and lifestyles and the fact that prepartum and postpartum weight could affect their anthropometric and biological data.

Sampling

We employed a three-stage probability proportional to size (PPS) cluster sampling. The sample size calculation was based on the recommendations of the WHO STEPwise approach to surveillance (STEPS),[12] assuming a 95% confidence level, 5% margin of error (e2), and 30% prevalence of hypertension in rural areas.[12] The minimum sample size required was 167 subjects, which was increased to 800 to address design effects (loss of sampling efficiency due to cluster sampling), an assumed 20% non-response rate, and planned subgroup and multivariate analyses.

The Central Statistical Office (CSO) of Zambia provided the list of study sampling clusters and Standard Enumeration Areas (SEAs). In the first stage, we selected 32 SEAs through PPS sampling without replacement using the sampling frame of the Zambia Population and Housing Census 2010.[11] In the second stage, mappers from CSO and research assistants mapped each selected SEA and listed all households and their eligible members. Then, using the list of each SEA created, a total of 25 households in each SEA were selected through systematic sampling, which uses a random starting point and a sampling interval calculated by dividing the total number of households in each SEA. In the third stage, from each selected household, only one

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individual was selected using the Kish Household Coversheet based on the WHO STEPS.[12] We scheduled a date and place to administer the questionnaire survey and take anthropometric and biological measurements as per the participants' convenience. We met with all recruited individuals (if absent, their family members or closest neighbours) 1–2 days before testing to request them to start fasting at 8:00 pm on the day prior to the biological measurements and to visit the testing venue on the scheduled date.

Data collection

The questionnaire was developed in English and three local languages based on the review of Zambian and international literature[9,13] and the results of an earlier qualitative study. [14] A pilot study was conducted to resolve language discrepancies, to assess the face validity of the questionnaire and test-retest reliability, and confirm the feasibility of anthropometric and biological measurements. Face-to-face interviews were carried out by field staff at venues such as the participant's home, community meeting places, or schools. Additionally, licensed nurses were recruited and trained to collect anthropometric measurements and biological samples. A nurse explained the results of blood and urine tests to the participants following their cooperation with the study, then soap and washing paste were given as rewards for participation.

Measurements

BP was measured using electronic equipment (Omron HEM-7130-HP, Omron Corporation, Kyoto, Japan). Three measurements were taken from the participants at three-minute intervals while they were seated after 15 minutes of rest, and the average of the last two readings was recorded. Weight was measured while the participants were barefoot and wearing light clothing using an electronic scale (Omron HBF-223-G, Omron Corporation, Kyoto, Japan). Glycated haemoglobin (HbA1c) and blood lipids (total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides) were measured using point-of-care testing device (Cobas b 101, Roche Diagnostics K.K., Tokyo, Japan). Other variables used in the analysis included socio-demographic characteristics, food security using the Household Food Insecurity Access Scale,[15] medical history and current medications, psychological distress using the Kessler-6 scale,[16] and lifestyle-related variables (tobacco, alcohol, physical activity, and dietary habits). The results of the measurements were explained by local nurses and given to each participant. Those who had extremely abnormal results were encouraged to visit the nearest health facilities with the reports.

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Patient and public involvement

Participants were not involved in the design, conduct, reporting, and dissemination plans of our research.

Statistical analysis

We analysed the data using the Complex Sample module in IBM SPSS Statistics version 21 (IBM Corp., Armonk, NY, USA) to adjust for the effects of multistage sampling, clustering, and weighting. Sample weights accounted for different selection probabilities at each sampling stage, non-response rate in each SEA, and post-stratification adjustments to correct for differences between our sample and the district population estimates based on the 2010 census. Total weights were standardised as the final weight. Bivariate analyses were performed to determine statistically significant associations between independent variables and high BP (systolic BP (SBP) ≥140 or diastolic BP (DBP) ≥90 mmHg) using logistic regression. Variables that showed significant associations with high BP ($p < 0.10$) in the bivariate analysis were entered into the multiple logistic regression models stratified by gender.

Ethical considerations

This study was approved by the Ethics Committee of the Graduate School and Faculty of Medicine of Kyoto University, Japan (R0403) and ERES Converge, Zambia (No. 2016-Jan-003) for the pilot phase. The University of Zambia Biomedical Research Ethics Committee, Zambia (No. 011-02-16) and the National Health Research Authority, Zambia (MH/101/23/10-1) granted approval for the main survey. All participants provided written informed consent prior to their participation.

RESULTS

Of the 800 targeted subjects, 712 agreed to participate. We excluded 22 participants from the analyses due to missing interviews or anthropometric/biological data. The final valid response rate was 86.3%. Table 1 shows the weighted characteristics of the study population by gender. The proportion of men was 48.6%, and the mean age was 41.9 years (Standard error [SE] 0.6). Most of the participants were married (80.8%), had only primary education (74.3%), and were self-employed (69.7%). Nearly one-half had a monthly income of 50 USD or less (Zambia's minimum wage), and one-quarter were living with severe food insecurity. For the self-reported

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medical history, 10.4% had human immunodeficiency virus (HIV) and were receiving antiretroviral therapy. Only 8% and 0.7% of participants had been diagnosed with hypertension and diabetes, respectively. More than 50% of both men and women had family members or relatives who had hypertension, and about 20% reported having family members or relatives who had experienced a stroke.

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Table 1. Sociodemographic characteristics and related medical histories among overall participants in the Mumbwa district, Central Province of Zambia, 2016

	Overall n (%)		Male n (%)		Female n (%)	
Number						
Unweighted	690		332		358	
Weighted	689	(100)	335	(48.6)	354	(51.4)
Age, years [SE]						
	41.9	[0.6]	42.7	[0.8]	41.1	[0.7]
Residential area of the district						
Urban area	87	(10.4)	35	(14.7)	52	(12.6)
Rural area	602	(89.6)	300	(85.3)	302	(87.4)
Marital Status						
Not married	27	(3.9)	20	(5.8)	7	(2.0)
Married	557	(80.8)	300	(89.4)	257	(72.6)
Divorced/widow/widower	106	(15.4)	16	(4.8)	90	(25.4)
Education						
Primary	513	(74.3)	229	(68.3)	284	(80.1)
Secondary	127	(18.5)	77	(23.0)	50	(14.2)
Tertiary	49	(7.2)	29	(8.7)	20	(5.7)
Monthly income (USD)						
≤50	326	(47.4)	157	(46.9)	169	(47.8)
>50	362	(52.6)	178	(53.1)	185	(52.2)
Work Status						
Employed	85	(12.4)	58	(17.2)	28	(7.8)
Self-employed	481	(69.7)	255	(76.2)	225	(63.6)
Unemployed/Retired	123	(17.9)	22	(6.6)	101	(28.6)
Food security						
Secure	192	(27.9)	107	(32.1)	85	(23.9)
Mildly insecure	45	(6.6)	25	(7.4)	21	(5.8)
Moderately insecure	261	(37.9)	132	(39.4)	129	(36.4)
Severely insecure	191	(27.7)	71	(21.2)	120	(33.8)
Medical history (Self-reported)						
HIV positive*	71	(10.4)	28	(8.4)	43	(12.2)
Hypertension	55	(8.0)	18	(5.4)	37	(10.4)
Diabetes	5	(0.7)	3	(0.9)	2	(0.6)
Past history within family and relatives (Self-reported)						
Hypertension	381	(55.3)	174	(52.0)	207	(58.5)
Stroke	140	(20.3)	68	(20.4)	71	(20.2)
Heart disease	64	(9.3)	25	(7.5)	39	(11.0)
Diabetes	123	(17.9)	52	(15.5)	71	(20.2)

Data are umbers (%)

SE, standard error

Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.

*All have been receiving antiretroviral treatment.

Table 2 shows the prevalence of hypertension in each stage and the current status of access to health services for hypertension stratified by gender. The prevalence of hypertension (Stage 2 and hypertensive crisis) was 36.6% in the overall sample and was greater in men than in women but without statistical significance (39.7% vs. 33.5%, p=0.10). In contrast, the prevalence of hypertensive crisis, which refers to severe BP elevation, was slightly higher in women than in men (5.1% vs. 3.2%) (p=0.32). Prehypertension (SBP, 120–139 or DBP, 80–89 mmHg [Elevated and Stage 1]), which is the risk of developing future hypertension and cardiovascular disease, was found in 39.9% of the men and 30.6% of the women, and the difference was statistically significant (p=0.02). There was a significant association between the stage of hypertension and age in both men and women (men, p=0.02; women, p<0.01). Area of residence in the district had a significant association with hypertension in men (p=0.02) but not in women (p=0.82). Regarding access to healthcare services for hypertension, the prevalence

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of hypertension was higher among men than among women, and the proportion of men who had "never had their BP measured" was significantly higher than that of women (37.3% [125/335] vs. 6.8% [24/354]; p<0.01). The proportion of participants who were previously diagnosed with hypertension was 5.4% [18/335] for men and 10.5% [37/354] for women, and 2.4% [8/335] and 4.5% [16/354] received antihypertensive treatment, respectively (p=0.09, p=0.25).

Table 2. Stage of hypertension relative to demographics and access to care and services among all participants in the Mumbwa district, Central Province of Zambia, 2016

Male

	Overall	Normal	Prehypertension		Hypertension		*p* value
			Elevated	Stage 1	Stage 2	Hypertensive crisis	
Total n(%)	335	68 (20.4)	33 (9.8)	101 (30.1)	122 (36.5)	11 (3.2)	
Age							
25-44	203	45 (22.0)	26 (12.7)	62 (30.6)	68 (33.4)	3 (1.3)	0.02
45-64	132	24 (17.9)	7 (5.4)	39 (29.2)	54 (41.2)	8 (6.2)	
Residential area of the district							
Urban area	35	5 (13.2)	1 (2.9)	8 (22.1)	17 (48.5)	5 (13.2)	0.02
Rural area	300	64 (21.2)	32 (10.6)	93 (31.0)	105 (35.1)	6 (2.1)	
Access to hypertension care and services							
Have never blood pressure measured	125	27 (21.3)	8 (6.1)	35 (27.9)	55 (43.9)	1 (0.8)	0.11
Diagnosed as hypertensive	18	2 (11.4)	0 (0.0)	2 (11.4)	8 (45.7)	6 (31.4)	<0.01
On treatment	8	0 (0.0)	0 (0.0)	1 (13.3)	2 (26.7)	5 (60.0)	<0.01
Medical history (Self-reported)							
HIV positive	28	8 (29.1)	2 (7.3)	9 (30.9)	9 (32.7)	0 (0.0)	0.69
Diabetic	3	0 (0.0)	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	0.80

Female

	Overall	Normal	Prehypertension		Hypertension		*p* value
			Elevated	Stage 1	Stage 2	Hypertensive crisis	
Total n(%)	354	127 (35.8)	12 (3.3)	97 (27.3)	101 (28.4)	18 (5.1)	
Age							
25-44	226	105 (46.4)	5 (2.3)	63 (27.7)	50 (22.0)	4 (1.6)	<0.01
45-64	128	22 (17.3)	7 (5.2)	34 (26.5)	51 (39.8)	14 (11.2)	
Residential area of the district							
Urban area	52	16 (31.7)	2 (3.0)	17 (32.7)	15 (28.7)	2 (4.0)	0.82
Rural area	302	111 (36.6)	10 (3.4)	80 (26.4)	86 (28.4)	16 (5.3)	
Access to hypertension care and services							
Have never blood pressure measured	24	8 (31.9)	1 (2.1)	9 (38.3)	7 (27.7)	0 (0.0)	0.53
Diagnosed as hypertensive	37	2 (4.2)	0 (0.0)	7 (19.4)	15 (40.3)	13 (36.1)	0.00
On treatment	16	0 (0.0)	0 (0.0)	3 (18.8)	6 (34.4)	8 (46.9)	0.00
Medical history (Self-reported)							
HIV positive	43	19 (44.0)	3 (6.0)	11 (26.2)	10 (23.8)	0 (0.0)	0.36
Diabetic	2	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)	0.90

Data are number (%)
HIV, human immunodeficiency virus
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
Blood pressure category: Normal (SBP<120 and DBP<80), Elevated (SBP 120-129 and DBP < 80), Stage 1 (SBP 130-139 or DBP 80-89), Stage 2 (SBP≥140 or DBP≥90), Hypertensive crisis (SBP>180 and/or DBP>120)

The present status of hypertension screening and diagnosis is shown in Figure 1. Among the residents, 21.8% (150/689) never had their BP measured, and the main reasons given were 'do not know where to obtain the service' (41.6%), 'do not have the time or opportunity to check' (24.8%), and 'I think it is not important or I am healthy' (18.8%). Among the participants who never had their BP measured, 41.9% (63/150) presented with hypertension at the time of measurement in this study. Among participants who had their BP measured previously, 89.8% (485/539) had not been diagnosed with hypertension but 30.3% (147/485) presented with

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hypertension. Among the participants already diagnosed with hypertension, 56.4% (31/55) were not using antihypertensive medication, of which 71.0% (22/31) presented with hypertension. Furthermore, most participants using antihypertensive medication (20/24) presented with hypertension, indicating poor BP control. Among individuals with HIV-positive status (N=71), the distribution of hypertension and its stages showed no difference from the overall distribution, but subgroup analysis showed that the proportion of individuals who had never had their BP measured was lower than the overall proportion for both men and women (Supplementary Table 1).

Table 3 shows the prevalence of hypertension in relation to each covariate and the association of each covariate with hypertension by multivariable analysis (adjusted for the variables with $p<0.10$ in the bivariate analysis) in the overall sample analysis and the analysis stratified by gender (Supplementary Table 2). In the overall sample, older age group (45–64 years) (adjusted odds ratio [AOR] = 1.95, 95% confidence interval [CI], 1.35–2.80), higher education (≥college) (2.00, 95%CI, 1.04–3.82), alcohol intake (a few times/week or everyday) (2.14, 95%CI, 1.28–3.58), and body mass index (BMI) ≥25 kg/m^2 (1.83, 95%CI, 1.24–2.71) were positively associated, while HIV-positive status was negatively associated with hypertension (0.53, 95%CI, 0.29–0.96). Gender, marital status, food insecurity, smoking, physical activity, cooking oil intake, sugar intake, and HbA1c were not associated with hypertension. There was a significant association between hypertension and alcohol intake in both genders (men ≥a few times/week or everyday: 2.28, 95%CI, 1.24–4.17; women ≤a few times/month: 1.79, 95%CI, 1.01–3.19), but the association with urban residence was significant only in men (2.46, 95%CI, 1.09–5.56). Older age (45–64 years) (2.68, 95%CI, 1.56–4.63), higher education (≥college) (3.39, 95%CI, 1.19–9.64), low-level alcohol intake (≤a few times/month) (1.79, 95%CI, 1.01–3.19), and BMI ≥25 kg/m^2 (1.98, 95%CI, 1.18–3.29) showed significant association with hypertension only in women.

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Table 3. Multivariate correlates of hypertension among all participants in the Mumbwa district, Central Province of Zambia, 2016

	Overall						Male						Female					
	Total	Hypertension n (%)		Adjusted OR (95%CI)		*p* value	Total	Hypertension n (%)		Adjusted OR (95%CI)		*p* value	Total	Hypertension n(%)		Adjusted OR (95%CI)		*p* value
Socio-demographic characteristics																		
Gender																		
Male	335	133	(39.7)	–			–	–		N/A			–	–		N/A		
Female	354	119	(33.5)	–			–	–					–	–				
Age																		
25-44	429	124	(28.9)	1	(Reference)		203	70	(34.7)	1	(Reference)		226	53	(23.6)	1	(Reference)	
45-64	260	128	(49.2)	1.95	(1.35-2.80)	0.00	132	63	(47.5)	1.57	(0.95-2.58)	0.07	128	65	(51.0)	2.68	(1.56-4.63)	0.00
Marital Status																		
Not married	27	8	(30.8)	1	(Reference)		20	7	(34.2)	–			7	2	(21.4)	–		
Married	557	200	(36.0)	1.57	(0.63-3.90)	0.33	300	120	(40.0)	–			257	81	(31.4)	–		
Divorced/Widow/Widowed	106	43	(40.8)	1.83	(0.68-4.97)	0.23	16	7	(41.9)	–			90	36	(40.6)	–		
Education																		
≤primary	513	185	(36.1)	1	(Reference)		229	90	(39.6)	–			284	95	(33.3)	1	(Reference)	
Secondary	127	44	(34.7)	1.03	(0.66-1.61)	0.89	77	32	(41.3)	–			50	12	(24.5)	0.68	(0.32-1.45)	0.32
≥college	49	23	(45.8)	2.00	(1.04-3.82)	0.04	29	11	(36.8)	–			20	12	(59.0)	3.39	(1.19-9.64)	0.02
Work Status																		
Employed	85	29	(33.7)	–			58	19	(33.0)	1	(Reference)		28	10	(35.2)	–		
Self-employed	481	178	(37.1)	–			255	102	(39.8)	1.43	(0.74-2.78)	0.29	225	77	(34.0)	–		
Unemployed/Retired	123	45	(36.3)	–			22	12	(55.8)	1.95	(0.66-5.75)	0.22	101	32	(32.0)	–		
Residential area of the district																		
Urban area	87	39	(44.4)	–			35	22	(61.8)	2.46	(1.09-5.56)	0.03	52	17	(32.7)	–		
Rural area	602	213	(35.4)	–			300	112	(37.2)	1	(Reference)		302	102	(33.7)	–		
Food security																		
Secure	192	58	(30.2)	1	(Reference)		107	33	(31.1)	–			85	25	(29.1)	–		
Insecure	497	194	(39.0)	1.46	(0.99-2.16)	0.06	228	100	(43.8)	–			269	94	(34.9)	–		
Family planning																		
Not used	–	–		–			–	–		–			249	96	(38.6)	1	(Reference)	
Used	–	–		–			–	–		–			101	96	(21.8)	0.61	(0.32-1.153)	0.13
No data	–	–		–			–	–		–			4	1	(14.3)	–		
Behavioral and psychological characteristics																		
Smoking																		
Never	525	179	(34.1)	1	(Reference)		185	66	(35.8)	–			340	113	(33.1)	–		
Ex-smoker	86	37	(43.1)	1.26	(0.73-2.18)	0.41	74	33	(44.4)	–			12	4	(34.8)	–		
Current smoker	79	36	(45.8)	1.27	(0.71-2.29)	0.42	76	34	(44.6)	–			3	2	(80.0)	–		
Alcohol																		
Never	354	106	(30.0)	1	(Reference)		102	30	(29.3)	1	(Reference)		252	77	(30.3)	1	(Reference)	
≤a few times/month	206	80	(39.0)	1.49	(0.98-2.27)	0.06	123	49	(39.6)	1.43	(0.78-2.59)	0.24	82	31	(38.1)	1.79	(1.01-3.19)	0.046
≥a few times/week or everyday	130	65	(50.4)	2.14	(1.28-3.58)	0.00	110	54	(49.5)	2.28	(1.24-4.17)	0.01	20	11	(55.3)	1.61	(0.58-4.49)	0.37
Physical activity (activities of daily life and sports ≥once a week)																		
Neither	54	25	(46.2)	1	(Reference)		16	8	(46.9)	–			38	17	(45.9)	1	(Reference)	
Either	497	182	(36.6)	0.62	(0.34-1.15)	0.13	215	96	(44.7)	–			282	86	(30.4)	0.51	(0.24-1.08)	0.08
Both	138	45	(32.5)	0.66	(0.32-1.35)	0.25	104	29	(28.2)	–			34	15	(45.5)	1.60	(0.54-4.71)	0.40
Cooking oil intake																		
Low <20.83ml	510	198	(38.8)	1	(Reference)		244	103	(42.2)	–			266	95	(35.7)	–		
High ≥20.83ml	177	54	(30.5)	0.71	(0.48-1.07)	0.10	92	30	(33.1)	–			85	24	(27.7)	–		
Don't know	1	0	(0.0)	–			–	–		–			1	0	(0.0)	–		
No data	2	0	(0.0)	–			–	–		–			2	0	(0.0)	–		
Sugar intake																		

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Low <28.0g	353	136	(38.6)	1	(Reference)		168	70	(42.0)	–			185	66	(35.6)	–		
High ≥28.0g	335	114	(33.9)	0.79	(0.56-1.12)	0.18	167	62	(37.0)	–			168	52	(30.9)	–		
No data	2	2	(100.0)	–			1	1	(100.0)	–			1	1	(100.0)	–		
Clinical characteristics																		
Body mass index (kg/m^2)																		
Normal (<25)	505	167	(33.1)	1	(Reference)		281	106	(37.9)	1	(Reference)		224	61	(27.1)	1	(Reference)	
Overweight/Obese (≥25)	185	85	(46.0)	1.83	(1.24-2.71)	0.00	54	27	(49.1)	1.73	(0.91-3.29)	0.09	130	58	(44.7)	1.98	(1.18-3.29)	0.01
HbA1c																		
Normal (<5.7)	404	144	(35.6)	1	(Reference)		222	89	(40.1)	–			182	55	(30.1)	1	(Reference)	
High risk (5.7-6.4)	266	96	(36.1)	1.05	(0.73-1.50)	0.80	111	42	(38.1)	–			156	54	(34.7)	1.02	(0.61-1.71)	0.93
Diabetes (≥6.5)	18	12	(65.7)	2.69	(0.91-7.96)	0.07	3	2	(66.7)	–			15	10	(65.5)	2.33	(0.68-7.96)	0.18
No data	1	0	(0.00)	–			0	0	(0.0)				1	0	(0.0)	–		
Medical history (self-reported)																		
HIV status (Self-reported)																		
Negative	618	232	(37.6)	1	(Reference)		307	124	(40.4)	–			311	108	(34.9)	1	(Reference)	
Positive	71	20	(27.3)	0.53	(0.29-0.96)	0.04	28	9.25	(32.7)	–			43	10	(23.8)	0.54	(0.24-1.24)	0.15

Data are number (%)

Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.

"No data" and "Don't know" were excluded from statistical test.

Hypertension is defined as SBP 140 ≥ mmHg or DBP ≥90 mmHg.

OR: Odds ratio

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Table 4 shows factors associated with ‘never had BP measured’ among men, as 83.8% (125/150) of participants who never had their BP measured were men. In the multivariable analysis, older age (0.43, 95%CI, 0.25–0.73) and HIV positive status (0.37, 95%CI, 0.14–0.97) were negatively associated, while being a current smoker was positively associated with ‘never had BP measured’ (2.09, 95%CI, 1.19–3.66). In contrast, in women, though not shown in the table, older age was positively associated with ‘never had BP measured’ (4.53, 95%CI, 1.81–11.4) (Supplementary Table 3,4).

Table 4. Bivariate and multivariate correlates of "never had blood pressure measured"（Men only）

	Male (n=335)	Never had blood pressure measured (n=125)							
	Total	n of total (%)		Crude OR (95%CI)		*p* value	Adjusted OR (95%CI)		*p* value
Age									
25-44	203	83	(41.0)	1	(reference)		1	(reference)	
45-64	132	42	(31.9)	0.48	(0.30-0.77)	0.00	0.43	(0.25-0.73)	0.00
Residential area of the district									
Urban area	35	6	(16.2)	1	(reference)		1	(reference)	
Rural area	300	120	(39.9)	3.60	(1.35-9.61)	0.01	2.79	(0.98-7.93)	0.06
Education									
Primary	229	96	(42.0)	1	(reference)		1	(reference)	
≥Secondary	106	29	(27.5)	0.62	(0.38-1.01)	0.05	0.84	(0.48-1.45)	0.53
Work Status									
Employed	58	13	(23.2)	1	(reference)		1	(reference)	
Unemployed/Retired	278	112	(40.4)	2.04	(1.08-3.83)	0.03	1.86	(0.92-3.76)	0.09
HIV infection									
No	307	119	(38.7)	1	(reference)		1	(reference)	
Yes	28	7	(23.6)	0.40	(0.16-1.02)	0.06	0.37	(0.14-0.97)	0.04
Smoking									
Never, Ex-smoker	259	87	(33.7)	1	(reference)		1	(reference)	
Current smoker	76	38	(50.0)	2.01	(1.19-3.38)	0.01	2.09	(1.19-3.66)	0.01
Alcohol									
Never or a few times/month	225	85	(37.9)	1	(reference)		–		
≥a few times/week or everyday	110	40	(36.4)	1.03	(0.64-1.66)	0.91	–		
Body mass index (kg/m²) [c]									
Normal (<25)	281	111	(39.6)	1	(reference)		1	(reference)	
Overweight/Obese (≥25)	54	14	(26.4)	0.43	(0.22-0.85)	0.02	0.66	(0.32-1.40)	0.28

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

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DISCUSSION

In this study, we assessed the prevalence and the risk factors for hypertension by gender to understand the current situation of hypertension among rural residents in Zambia. We also explored the status of screening and diagnosis of hypertension and its correlates to evaluate the situation of access to healthcare services for hypertension.

We found that more than 35% of the participants had hypertension, and the profile of hypertension correlates was different between men and women. More than 80% of the people with high BP measurements had never been previously diagnosed with hypertension, and 30% of them had never had their BP measured, suggesting the lack of access to or availability of healthcare services for BP control.

The prevalence of hypertension in rural areas

The prevalence of hypertension among the targeted rural residents of this study in 2016 was 39.7% in men and 33.5% in women, both being much higher than the national averages found in the Zambia STEPS Survey of 2017 (20.5% and 17.6%, respectively).[7] Previous research has reported mixed findings regarding the prevalence of hypertension in rural areas of Zambia. While a similar rate (46.9%) was reported among people attending health check-ups in other rural areas of Zambia,[17] 23.1% was reported in a primary healthcare-based study conducted in several rural districts between 2011–2014.[18] However, comparing our results with those of previous studies is difficult due to methodological differences. For example, previous studies used convenient sampling with potential selection bias, while we conducted probability sampling of the whole area. Studies using probability sampling are required for documenting the accurate BP status among Zambian rural populations. The prevalence rates of prehypertension and hypertension were slightly higher in men than in women in our study, a tendency that has been observed throughout the African region.[6]

Gender differences in factors associated with hypertension

In this study, a gender difference was found not only in the prevalence of hypertension, but also in the profile of the correlates of hypertension. In men, residence in the urban area of the district and high frequency of alcohol intake were significantly associated with hypertension. While in women, older age, higher education level, low frequency of alcohol intake, and BMI ≥25 kg/m^2 were associated with hypertension, suggesting the different mechanism(s) involved in the development of high BP between the genders. This implies that different pathways for

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hypertension including behavioural and socio-cultural factors exist between men and women, which could affect prevention strategies [19]

Alcohol consumption was the only factor moderately associated with hypertension in both genders, which is in line with well-established findings worldwide.[20] Although the exact mechanism is unclear, it can be caused directly through the chronic effect of alcohol and/or indirectly through related socioeconomic status and lifestyles among the study population.[20] Regardless of the mechanism, it is important to follow the trend of alcohol intake over time with special attention to the type, amount, and pattern since it may rapidly change in both quantity and quality with future economic growth.

Living in the urban area of the district was significantly associated with hypertension only in men. Although the study region was "rural" in general (neighbouring the capital city, Lusaka), there are some areas with relatively easy access to the capital city. Men living in such areas may be involved in urbanized lifestyles, probably in relation to their jobs, in terms of eating habits and lifestyles, including high calorie diets and lack of exercise. Studies in Cameroon and Mali have shown a similar tendency with higher prevalence of hypertension among men in "urban areas" than in rural areas.[21,22]

The relationship between age and hypertension has been reported in SSA countries.[23-25] In our study, a significant association with age was observed only in women, reflecting the age-related distribution of hypertension between the genders, where the difference in prevalence between younger (25–44 years) and older (45–64 years) age groups was large (23.6% vs. 51.0%, respectively) in women, but small in men (34.7% and 47.4%, respectively). Similar age disparities in the prevalence of hypertension by gender have been reported in previous studies of Zambia and Senegal.[18,25] This may suggest that men are more likely to develop hypertension at a younger age than women. The reasons for this age disparity by gender should be one of the focus points in future research.

An association between hypertension and education level was observed only among women. Slightly high odds of hypertension in people with higher levels of education were also observed in a study in Malawi [21]. This may suggest that in SSA countries that experienced rapid economic growth in recent years, the risk of hypertension has increased among people with higher levels of education due to spread of urbanized eating habits and lifestyles (over-nutrition and physical inactivity).[26] The reason why the association was detected only in women in our study is unclear; however, higher education may be related to urbanized eating habits and lifestyles more in women than in men.

The association of overweight and obesity (BMI $\geq$ 25 kg/m^2) with hypertension has been reported in SSA countries including Zambia, with its tendency being stronger in women than

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in men.[27] Similarly in our study, although the association was observed in both genders, it was significant only in women. This may be related to biological factors such as an increase in obesity with age in women in African societies and their cultural preferences. In men, behavioural factors such as alcohol consumption and psychological stress are more likely to be associated with developing hypertension than obesity.

Status of Hypertension Management

In this study, only 16.7% of the participants who presented with hypertension had previously been diagnosed. Among the participants with documented hypertension but no previous diagnosis, 30% never had their BP measured. Our results concur with findings from a systematic review of hypertension in SSA indicating that only 22.5% of people with hypertension had already been diagnosed.[18] This indicates the need to strengthen hypertension screening and diagnosis, particularly at the primary healthcare level which is the entry level to health care systems in most SSA countries.

Moreover, only 8% of the participants in this study reported having been previously diagnosed with hypertension, which was much lower than the actual proportion presenting with hypertension. In addition, only fewer than half of the participants diagnosed with hypertension were using antihypertensive medications, and many of them presented with hypertension at the time of the measurement, indicating challenges in accessing treatment for hypertension. A previous study in Zambia reported that 18% of people who presented with hypertension at the time of the study had been prescribed antihypertensive medication at a health centre.[18] In our study, only 7.9% of the participants with hypertension had been prescribed antihypertensive medication. Furthermore, about 83% of the participants who reported using antihypertensive medication in our study presented with hypertension at the time of measurement. This was consistent with the results of a previous study in Zambia where nearly 90% had poorly controlled hypertension,[18] and other reports from the entire SSA region.[2] These results indicate that there are various challenges in the management of hypertension in the rural areas of Zambia, as in other SSAs, in terms of ‘difficulties in accessing appropriate treatment and health services including hypertension’, ‘lack of screening and diagnostic opportunities for hypertension’, and ‘lack of awareness of the importance of BP control’.

Access to healthcare services related to hypertension

We also assessed the differences in access to healthcare services related to hypertension between the genders. Identifying the management status of hypertension (care cascade) can

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contribute to health policy and interventions.[28] We focused on the history of BP measurement as it relates to the awareness of hypertension status. In our study, more than 20% of the participants had never had their BP measured previously, suggesting the difficulties in accessing screening and diagnostic services for hypertension care. Despite the higher prevalence of hypertension among men than among women, the proportion of men who 'never had their BP measured' was 37.4%, which was 5.5 times higher than that of women. Men also tended to be less likely to have been diagnosed with and treated for hypertension.

There was a significant positive association between smoking and 'never had their BP measured' in men. While this finding requires further assessment in future, it may suggest that people who engage in high-risk health behaviours such as smoking tend to be less concerned about their health and less likely to engage in health seeking behaviours than those who do not engage in such behaviour. In this study, we also included self-reported HIV status in the analysis as a factor affecting access to healthcare services. Men in older age groups and men with HIV-positive status were less likely to have 'never had their BP measured', suggesting that they were likely to be aware of their BP. The association with 'older age group' may be because they were likely to receive medical care during their lifetime. Regarding the association with HIV-positive status, all HIV-positive individuals were receiving HIV treatment, so regular medical consultations at a healthcare facility may have provided the opportunity for BP measurement.

Men have fewer opportunities to access healthcare services besides illness or injury, compared to women who visit for maternal and child health services. Patients with asymptomatic conditions like hypertension may not receive the required healthcare services due to psychological and geographical barriers, e.g., low level of attention to health or distance to healthcare facilities. In Zambia, access to quality essential healthcare services remains limited due to weak health systems including workforce shortage. For instance, the proportion of medical doctors per 10,000 population was 0.93 in 2016 and the universal health coverage service coverage index in 2017 was lower than the global average.[29] Therefore, along with strengthening hypertension screening, we suggest that the use of existing mobile health services, such as vaccination campaigns, mobile voluntary counselling and testing services, and cooperation with community health workers may be advantageous in treating many people.[30] For women, although only a few never had their BP measured, the odds of never having BP measured were significantly higher in the older age group. This gender difference should be examined in further research with a large sample size.

Strengths and limitations

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The strength of our study is that we used multi-stage cluster random sampling and obtained a relatively high response rate. Thus, our results are representative of patients at risk of CVD in the target population in the rural area. Regarding limitations, the recorded BP may have been higher than usual due to white coat hypertension. A previous study that used the same hypertension criteria as our study reported that the prevalence of white coat hypertension (false-positive) was 13%, masked hypertension (false-negative) 14%, and correctly classified hypertension 73%.[31] Therefore, data on the prevalence of hypertension in this study should be interpreted cautiously. Socially desirable responses due to face-to-face interviews could also have affected the results, even though we trained the interviewers before the study. Unmeasured factors may have affected some of the associations found in our study.

CONCLUSION

More than one-third of the participants in a rural district in Zambia had hypertension; most were not diagnosed yet and one-quarter of them never had their BP measured. These results indicate a lack of CVD prevention services, including access to and availability of healthcare services for hypertension, among rural residents in Zambia. Therefore, health promotion and screening strategies for hypertension are urgently required, especially in primary healthcare settings in rural areas. Particular attention should be paid to healthcare access, specifically among men.

Acknowledgments

We are thankful to all the participants, the staff at the Institute of Economic and Social Research, the University of Zambia, and the members of the Mumbwa District Medical Office for the local arrangement and support to this study. We gratefully acknowledge the local nurses and research assistants for their assistance with the data collection. Lastly, we extend our gratitude to the late Mubiana Macwan'gi for contributing to the supervision of the research in Zambia.

Contributors

YT, TT, MOK and MK contributed to study conception and design. YT, RZ and CD contributed to the data collection. YT, TT and MK contributed to data analysis and drafted the manuscript. YT, PMM, SPS, AO, RZ and CD revised the manuscript. MOK and MK supervised the study. All authors read and approved the final manuscript.

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Funding

This study was supported by the United Nations University, Institute for the Advanced Study of Sustainability (Global Leadership Training Program in Africa) and the Inter-Graduate School Program for Sustainable Development and Survivable Societies, Kyoto University. It was also supported by the 2016 Kyoto University School of Public Health Super Global Course's travel scholarship.

Competing interests

None declared.

Patient consent for publication

Not required.

Data sharing statement

Data are available upon reasonable request.

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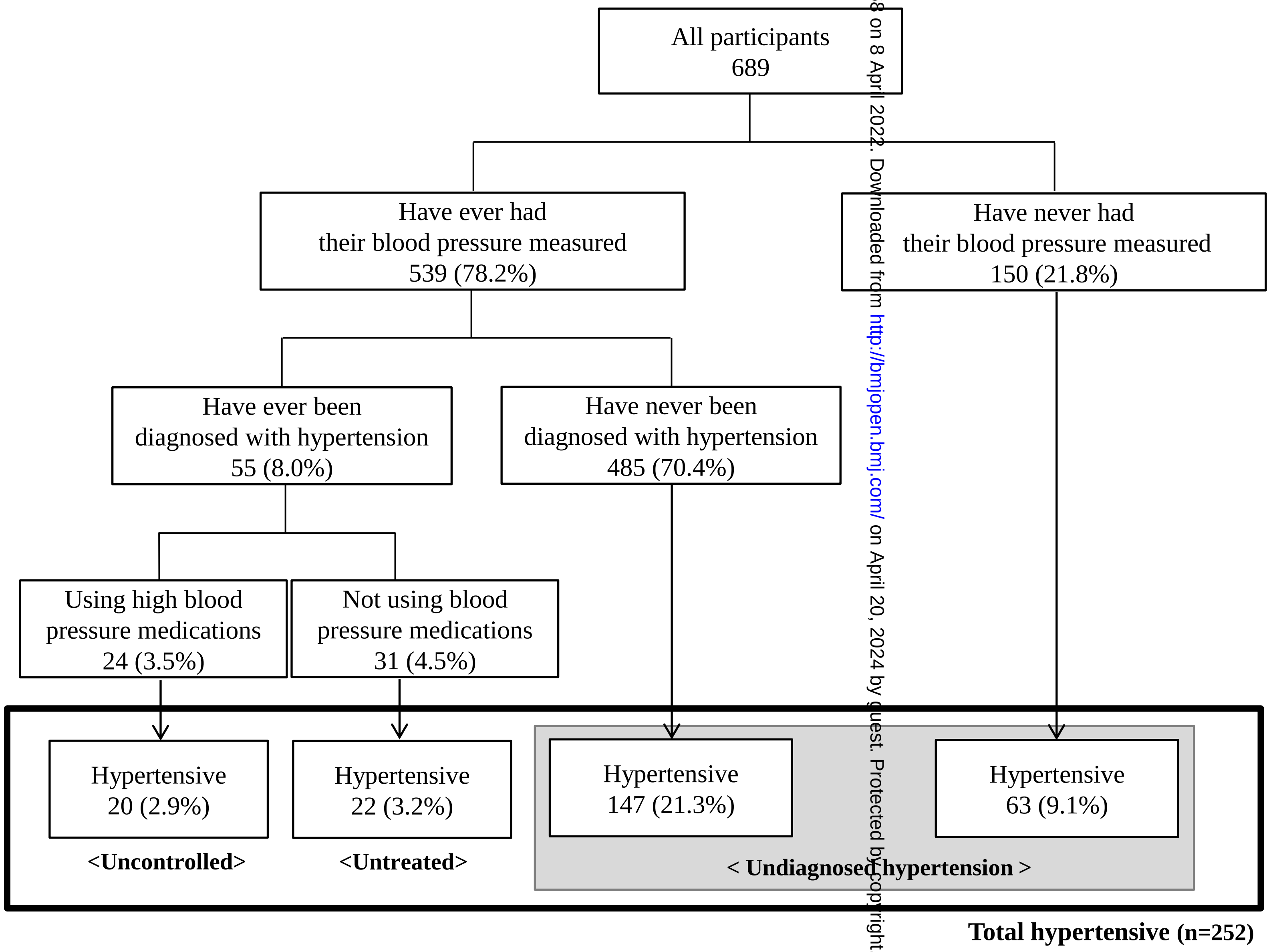

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Supplementary Tables

Table 1. Access to hypertension care and services among People Living with HIV (N=71)

	Overall n	(%)	Male n	(%)	Female n	(%)
Age						
25-44	49	(68.3)	15	(52.7)	34	(78.6)
45-64	23	(31.7)	13	(47.3)	9	(21.4)
Residential area of the district						
Urban area	3	(4.3)	0	(0.0)	3	(7.1)
Rural area	68	(95.7)	28	(100.0)	40	(92.9)
Blood pressure						
High (hypertension)	20	(27.3)	9	(32.7)	10	(23.8)
Access to hypertension care and services						
Have never blood pressure measured	8	(11.5)	7	(23.6)	2	(3.6)
Diagnosed as hypertensive	5	(7.2)	4	(12.7)	2	(3.6)
On treatment	0	(0.0)	0	(0.0)	0	(0.0)

Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
Hypertension is defined as SBP 140 ≥ mmHg or DBP ≥90 mmHg.

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Table 2. Bivariate and Multivariate correlates of hypertension among all participants in the Mumbwa district, Central Province of Zambia, 2016 (by gender)

	Male						**Female**					
		Hypertension						**Hypertension**				
	n	n(%)	Crude OR (95%CI)	*p* value	Adjusted OR (95%CI)	*p* value	n	n(%)	Crude OR (95%CI)	*p* value	Adjusted OR (95%CI)	*p* value
Socio-demographic characteristics												
Age												
25-44	203	70 (34.7)	1 (Reference)		1 (Reference)		226	53 (23.6)	1 (Reference)		1 (Reference)	
45-64	132	63 (47.5)	1.05 (1.250-3.133)	0.004	1.57 (0.95-2.58)	0.07	128	65 (51.0)	3.54 (2.236-5.616)	0.000	2.68 (1.56-4.63)	0.00
Marital Status												
Not married	20	7 (34.2)	1 (Reference)		–		7	2 (21.4)	1 (Reference)		–	
Married	300	120 (40.0)	1.78 (0.628-5.025)	0.278	–		257	81 (31.4)	2.01 (0.424-9.534)	0.379	–	
Divorced/Widow/Widowed	16	7 (41.9)	1.75 (0.442-6.928)	0.425	–		90	36 (40.6)	3.34 (0.686-16.232)	0.136	–	
Education												
≤primary	229	90 (39.6)	1 (Reference)		–		284	95 (33.3)	1 (Reference)		1 (Reference)	
Secondary	77	32 (41.3)	1.09 (0.644-1.860)	0.739	–		50	12 (24.5)	0.83 (0.426-1.617)	0.583	0.68 (0.32-1.45)	0.32
≥college	29	11 (36.8)	1.03 (0.469-2.283)	0.932	–		20	12 (59.0)	3.85 (1.488-9.974)	0.005	3.39 (1.19-9.64)	0.02
Work Status												
Employed	58	19 (33.0)	1 (Reference)		1 (Reference)		28	10 (35.2)	1 (Reference)		–	
Self-employed	255	102 (39.8)	1.34 (0.726-2.456)	0.352	1.43 (0.74-2.78)	0.29	225	77 (34.0)	0.84 (0.388-1.820)	0.659	–	
Unemployed/Retired	22	12 (55.8)	2.80 (1.025-7.646)	0.045	1.95 (0.66-5.75)	0.22	101	32 (32.0)	0.69 (0.299-1.596)	0.387	–	
Monthly income (USD)												
≤50	157	61 (38.9)	1 (Reference)		–		169	51 (30.1)	1 (Reference)		–	
>50	178	72 (40.5)	1.02 (0.652-1.599)	0.927	–		185	68 (36.7)	1.29 (0.832-2.011)	0.252	–	
Residential area												
Rural	300	112 (37.2)	1 (Reference)		1 (Reference)		302	102 (33.7)	1 (Reference)		–	
Urban	35	22 (61.8)	2.46 (1.176-5.144)	0.017	2.46 (1.09-5.56)	0.03	52	17 (32.7)	0.98 (0.528-1.802)	0.937	–	
Food security												
Secure	107	33 (31.1)	1 (Reference)		–		85	25 (29.1)	1 (Reference)		–	
Insecure	228	100 (43.8)	1.47 (0.901-2.399)	0.122	–		269	94 (34.9)	1.39 (0.822-2.353)	0.220	–	
Family planning												
Not used	–	–	–		–		249	96 (38.6)	1 (Reference)		1 (Reference)	
Used	–	–	–		–		101	96 (21.8)	0.42 (0.248-0.724)	0.002	0.61 (0.32-1.153)	0.13
No data	–	–	–		–		4	1 (14.3)	–		–	
Behavioral and psychological characteristic												
Smoking												
Never	185	66 (35.8)	1 (Reference)		–		340	113 (33.1)	1 (Reference)		–	
Ex-smoker	74	33 (44.4)	1.42 (0.816-2.463)	0.216	–		12	4 (34.8)	0.74 (0.192-2.831)	0.657	–	
Current smoker	76	34 (44.6)	1.42 (0.889-2.724)	0.113	–		3	2 (80.0)	3.93 (0.353-43.805)	0.266	–	
Alcohol												
Never	102	30 (29.3)	1 (Reference)		1 (Reference)		252	77 (30.3)	1 (Reference)		1 (Reference)	
≤a few times/m	123	49 (39.6)	1.66 (0.938-2.937)	0.082	1.43 (0.78-2.59)	0.24	82	31 (38.1)	1.40 (0.844-2.320)	0.193	1.79 (1.01-3.19)	0.046
≥a few times/w or everyday	110	54 (49.5)	2.37 (1.323-4.248)	0.004	2.28 (1.24-4.17)	0.01	20	11 (55.3)	2.49 (1.014-6.110)	0.046	1.61 (0.58-4.49)	0.37
Fruit and vegetable intake (fruits ≥once a week, vegetables daily)												
Neither	50	20 (40.2)	1 (Reference)		–		51	14 (27.0)	1 (Reference)		–	
Either	159	66 (41.3)	1.06 (0.548-2.015)	0.862	–		160	53 (33.3)	1.18 (0.570-2.422)	0.661	–	
Both	126	47 (37.6)	1.15 (0.585-2.253)	0.689	–		142	51 (36.1)	1.44 (0.697-2.975)	0.324	–	
Physical activity (activities of daily life and sports ≥once a week)												
Neither	16	8 (46.9)	1 (Reference)		–		38	17 (45.9)	1 (Reference)		1 (Reference)	
Either	215	96 (44.7)	0.99 (0.361-2.696)	0.980	–		282	86 (30.4)	0.52 (0.266-1.032)	0.062	0.51 (0.24-1.08)	0.08
Both	104	29 (28.2)	0.53 (0.185-1.527)	0.240	–		34	15 (45.5)	0.91 (0.354-2.324)	0.840	1.60 (0.54-4.71)	0.40
Salt intake (per day)												
<5g	228	89 (39.2)	1 (Reference)		–		295	102 (34.5)	1 (Reference)		–	
≥5g	90	33 (36.4)	0.82 (0.495-1.365)	0.449	–		58	16 (27.4)	0.63 (0.347-1.156)	0.137	–	

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Don't know	16	11	(65.6)	–			–			1	1	(100.0)	–			–		
Cooking oil intake																		
Low <20.83ml	244	103	(42.2)	1	(Reference)		–			266	95	(35.7)	1	(Reference)		–		
High ≥20.83ml	92	30	(33.1)	0.72	(0.429-1.218)	0.223	–			85	24	(27.7)	0.71	(0.420-1.203)	0.204	–		
Don't know	—	—		–			–			1	0	(0.0)	–			–		
No data	—	—		–			–			2	0	(0.0)	–			–		
Sugar intake																		
Low <28.0g	168	70	(42.0)	1	(Reference)		–			185	66	(35.6)	1	(Reference)		–		
High ≥28.0g	167	62	(37.0)	0.73	(0.464-1.139)	0.164	–			168	52	(30.9)	0.73	(0.471-1.140)	0.168	–		
No data	1	1	(100.0)	–			–			1	1	(100.0)	–			–		
Psychological distress (K6)																		
Low	166	58	(35.0)	1	(Reference)		–			169	77	(45.3)	1	(Reference)		–		
High (10 and over)	169	56	(32.8)	0.73	(0.463-1.137)	0.162	–			184	94	(51.1)	0.97	(0.627-1.508)	0.901	–		
Clinical characteristics																		
Body mass index (kg/m^2) [c]																		
Normal (<25)	281	106	(37.9)	1	(Reference)		1	(Reference)		224	61	(27.1)	1	(Reference)		1	(Reference)	
Overweight/Obese (>=25)	54	27	(49.1)	2.04	(1.13-3.70)	0.02	1.73	(0.91-3.29)	0.09	130	58	(44.7)	2.51	(1.59-3.94)	0.00	1.98	(1.18-3.29)	0.01
Blood lipids																		
Normal	70	27	(39.0)	1	(Reference)		–			42	9	(22.2)	1	(Reference)		–		
Abnormal	263	106	(40.3)	1.09	(0.630-1.887)	0.757	–			310	109	(35.2)	1.56	(0.758-3.220)	0.227	–		
No data	3	0	(0.0)	–			–			3	1	(20.0)	–			–		
HbA1c																		
Normal (<5.7)	222	89	(40.1)	1	(Reference)		–			182	55	(30.1)	1	(Reference)		1	(Reference)	
High risk (5.7-6.4)	111	42	(38.1)	0.81	(0.502-1.320)	0.404	–			156	54	(34.7)	1.38	(0.879-2.179)	0.161	1.02	(0.61-1.71)	0.93
Diabetes (>=6.5)	3	2	(66.7)	3.30	(0.295-36.973)	0.333	–			15	10	(65.5)	4.87	(1.588-14.921)	0.006	2.33	(0.68-7.96)	0.18
No data	0	0	(0.0)	–						1	0	(0.0)	–			–		
Medical history (self-reported)																		
HIV infection (Self-reported)																		
No	307	124	(40.4)	1	(Reference)		–			311	108	(34.9)	1	(Reference)		1	(Reference)	
Yes	28	9	(32.7)	0.77	(0.338-1.743)	0.527	–			43	10	(23.8)	0.47	(0.226-0.983)	0.045	0.54	(0.24-1.24)	0.15

Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
"No data" and "Don't know" excludes from statistical test
Hypertension is defined as SBP 140 ≥ mmHg or DBP ≥90 mmHg.
Abnormal blood lipid includes any abnormal measurements in total cholesterol, triglyceride, LDL-cholesterol, or HDL-cholesterol
Cooking oil intake is defined as low and high by median (20.83ml).
Sugar intake is defined as low and high by median (28.0g).

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Table 3: Bivariate and multivariate correlates of 'never had blood pressure measured' (Women)

	Female (n=354)	Never had blood pressure measured (n=24)							
	Total	n of total (%)		Crude OR (95CI)		*p* value	Adjusted OR (95CI)		*p* value
Age									
25-44	226	6	(2.5)	1	(reference)		1	(reference)	
45-64	128	19	(14.5)	5.33	(2.18-13.06)	0.00	4.53	(1.81-11.35)	0.00
Residential area									
Urban	52	4	(6.9)	1	(reference)		–		
Rural	302	21	(6.8)	1.39	(0.40-4.81)	0.60	–		
Education									
<=primary	284	19	(6.7)	1	(reference)		–		
>=Secondary	70	5	(7.3)	0.997	(0.36-2.75)	0.995	–		
Work Status									
Employed	28	3	(9.3)	1	(reference)		–		
Unemployed/Retired	326	22	(6.6)	0.71	(0.20-2.50)	0.59	–		
HIV infection									
No	311	23	(7.3)	1	(reference)		–		
Yes	43	2	(3.6)	0.83	(0.24-2.89)	0.77	–		
Smoking									
Never, Ex-smoker	352	24	(6.7)	1	(reference)		–		
Current smoker	3	1	(20.0)	6.60	(0.58-75.32)	0.13	–		
Alcohol									
Never or a few times/m	335	20	(6.0)	1	(reference)		1	(reference)	
≥a few times/w or everyday	20	4	(21.1)	3.37	(1.04-10.88)	0.04	2.19	(0.65-7.43)	0.21
Body mass index (kg/m^2)									
Normal (<25)	224	11	(4.8)	1	(reference)		1	(reference)	
Overweight/Obese (25 and over)	130	13	(10.3)	2.12	(0.95-4.72)	0.07	1.71	(0.74-3.92)	0.21

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

Table 4: Bivariate and multivariate correlates of 'never had blood pressure measured' (Overall)

	Overall (n=689)	Never had blood pressure measured (n=150)							
	Total	n of total (%)		Crude OR (95CI)		*p* value	Adjusted OR (95CI)		*p* value
Gender									
Male	335	125	(37.4)	7.71	(4.88-12.18)	0.00	6.27	(3.84-10.23)	0.00
Female	354	24	(6.8)	1	(reference)		1	(reference)	
Age									
25-44	429	89	(20.7)	1	(reference)		–		
45-64	260	61	(23.3)	0.90	(0.61-1.31)	0.57	–		
Residential area									
Urban	87	9	(10.7)	1	(reference)		1	(reference)	
Rural	602	140	(23.3)	3.02	(1.43-6.41)	0.00	2.70	(1.22-5.98)	0.01
Education									
<=primary	513	115	(22.5)	1	(reference)		–		
>=Secondary	177	34	(19.5)	0.96	(0.63-1.45)	0.84	–		
Work Status									
Employed	85	16	(18.7)	1	(reference)		–		
Unemployed/Retired	604	134	(22.1)	1.16	(0.67-2.01)	0.60	–		
HIV infection									
No	618	141	(22.9)	1	(reference)		1	(reference)	
Yes	71	8	(11.5)	0.44	(0.21-0.90)	0.03	0.46	(0.21-0.995)	0.049
Smoking									
Never, Ex-smoker	611	111	(18.2)	1	(reference)		1	(reference)	
Current smoker	79	39	(49.0)	4.46	(2.74-7.28)	0.00	2.11	(1.19-3.73)	0.01
Alcohol									
Never or a few times/m	560	105	(18.8)	1	(reference)		1	(reference)	
≥a few times/w or everyday	130	44	(34.1)	2.29	(1.50-3.50)	0.00	0.93	(0.55-1.55)	0.77
Body mass index (kg/m^2)									
Normal (<25)	505	122	(24.1)	1	(reference)		1	(reference)	
Overweight/Obese (25 and over)	185	28	(15.0)	0.50	(0.31-0.79)	0.00	0.91	(0.55-1.53)	0.73

Data are number (%).
Totals of percentages may differ from 100 due to rounding. Weighted values are rounded to the nearest integer.
OR: Odds ratio

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5*
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	4
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7,8

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11,12,13
		(*b*) Report category boundaries when continuous variables were categorized	9,12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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