Do determinants of hypertension status vary between Ghana and South Africa? Study on global AGEing and adult health

Benjamin D. Capistrant*, Karen Charlton#, Josh Snodgrass† and Paul Kowal◊,Δ

*School for Social Work, Smith College, Northampton, Massachusetts, United States of America
#School of Medicine, University of Wollongong, New South Wales, Australia
†University of Oregon, Eugene, Oregon, United States of America
◊WHO SAGE, Geneva, Switzerland
ΔResearch Centre for Gender, Health and Ageing, University of Newcastle, New South Wales, Australia

Address for correspondence:
Benjamin D. Capistrant
Assistant Professor
Smith College
School for Social Work
23 West Street
Northampton
Massachusetts 01063
United States of America

Email:
bcapistrant@smith.edu

ABSTRACT

Objectives: Determinants of hypertension prevalence, diagnosis and control are poorly understood in sub-Saharan Africa, including whether these determinants vary between and among countries.
Methods: A cross-sectional analysis of Study on global AGEing and adult health (SAGE) data, nationally representative samples of adults aged 50+ (n=3 458 South Africa; n=4 196 in Ghana). Hypertension prevalence and status (awareness, treatment and control) were determined from directly measured blood pressure and respondents' self-reported history of hypertension diagnosis and current treatment status. Sex-stratified, multivariable adjusted logistic regression models were used to test cross-country differences in demographic, socio-economic, environmental, and health-related determinants of hypertension prevalence and status.
Results: South Africans had higher age-standardised prevalence of hypertension (Men: 76%, Women: 82%) compared to Ghana (Men: 57%, Women: 61%). Odds of hypertension prevalence varied for rural residence and education varied between country. Consistent differences in awareness of hypertension between countries included education, income, and weight status by sex; sex-specific differences between countries were also apparent. Determinants of control and management of hypertension (education) differed between countries only for women.
Conclusions: Behavioural, environmental, and social determinants all influence hypertension prevalence and status for middle and older-age adults in sub-Saharan Africa, although differently between countries.
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INTRODUCTION

In sub-Saharan Africa, hypertension is common.[1-3] A recent meta-analysis found 30% of sub-Saharan Africans had prevalent hypertension,[4] which is close to the prevalence in the U.S.[5] Low- and middle-income countries have lower rates of hypertension control than high-income countries.[6] In Ghana and South Africa specifically, high blood pressure is the third leading risk factor contributing to disease burden.[7,8] Indeed, the population impact of hypertension in sub-Saharan Africa is considerable: hypertension treatment and control for the 10 - 20 million people in sub-Saharan African estimated to have hypertension could prevent 250 000 deaths and 500 000 long-term disabilities annually.[9]

Hypertension on the African continent is related to: demographic factors like urbanisation and population ageing; health behaviour factors like diet – namely, a shift in dietary patterns from reliance on traditional staples such as maize and sorghum to more processed foods that are high in salt;[10] decreased physical activity levels, as well as increasing obesity;[11,12] and, social factors like socio-economic gradients in non-communicable diseases (NCDs).[13] Despite calls to action for research into the prevalence, aetiology and prevention of hypertension in sub-Saharan Africa,[7] still little evidence exists on the most relevant, specific demographic, social and health-related determinants of hypertension status in and between sub-Saharan African countries.

We use novel data from the World Health Organisation (WHO) Study on global AGEing and adult health (SAGE) –

nationally representative samples of middle- and older-age adults from Ghana and South Africa using harmonised measures – to explore demographic, social, environmental and behavioural determinants of hypertension. Specifically, we tested whether there were significant differences in these determinants of hypertension prevalence, awareness, control and severity between Ghana and South African middle- and older-age adults.

METHODS

Study population

SAGE is a multi-country study of ageing and health with nationally representative samples of adults aged 50+ years from 6 countries: China, Ghana, India, Mexico, Russia and South Africa. This study uses cross-sectional data from SAGE sub-Saharan African countries Wave 1, collected using face-to-face interviews with household heads and adult household members aged 50+ in 2007/2008. The data are publicly available via the WHO Multi-Countries Study Data Archive.[14] The multistage, stratified, clustered sampling design is detailed elsewhere.[15] WHO coordinated the survey and calculated sampling weights with the data; when applied, these weights adjust for this complex design and allow generalisation to the comparable national population.

This study was restricted to SAGE respondents in Ghana and South Africa aged 50+ at the time of the interview who completed the questionnaire. Persons were excluded for missing either key outcome (for example, self-reported hypertension or measured blood pressure: South Africa: 0.6%, Ghana: 1.1%) or covariates of interest (South Africa: 5.4%, Ghana: 0.5%) for a final analytic sample in Ghana (n=4 196) and South Africa (n=3 458).

Hypertension measurement

Both self-reported hypertension and measured blood pressure information was captured during the interview process. Participants reported whether they had ever been diagnosed with hypertension ("Have you ever been diagnosed with high blood pressure [hypertension]?") and, if so, whether they had taken hypertension treatment in the last 2 weeks. Participants also had 3 seated blood pressure readings using an Omron automated, wrist-worn device, from which a mean systolic (SBP) and diastolic blood pressure (DBP) was calculated.

We define hypertension prevalence as having 1 or more of the following: SBP ≥140mmHg, DBP ≥90mmHg, or self-reported treatment for hypertension in the 2 weeks prior to interview irrespective of measured blood pressure levels. We also present prevalence of JNC-8 stage 2 hypertension (SBP ≥160mmHg, DBP ≥100mmHg).[16]

We also classified people by hypertension awareness and control. Those "aware" of their hypertension had self-reported a prior diagnosis of hypertension compared to a reference group who did not report a prior diagnosis but had high blood pressure on measurement. "Controlled" hypertensives were those who were aware of their condition and had measured blood pressure <140mmHg SBP and <90mmHg DBP compared to a reference of those who were aware and had measured blood pressure of SBP ≥140mmHg or DBP ≥90mmHg ("uncontrolled").

Determinants of hypertension (independent variables)

We considered demographic, socio-economic, and health factors that may be associated with hypertension prevalence, awareness, control, and severity. Demographic factors included age (continuous, centred at grand mean) and sex (reference: male). Socio-economic factors included: father's education (any/none; reference: none); own education (no formal education, <secondary (reference), >secondary); household income (reference: middle quintile); work history (ever/never, reference: never); current work status (yes/no, reference: no); and rural residence (reference: urban). Health behaviour factors included: self-reported smoking status (current, former, reference: never); self-rated overall general health (moderate/bad/very bad vs. reference: very good/good); current alcohol use (any/none, reference: none); body mass index (BMI <18.5, 18.5 - 24.9 (reference), 25 - 29.9, ≥30) calculated from measured height and weight: and any self-reported physical activity.[17]

Analysis strategy

Age-adjusted prevalence was estimated using direct standardisation and the WHO standard population.[18] Associations between individual covariates and hypertension prevalence, awareness, control, and stage were assessed using logistic regression. These 4 outcomes were considered separately. All analyses were stratified by country and sex since determinants of hypertension status, awareness and control likely vary by sex via social and economic pathways (such as education, access to resources, autonomy). Results from multivariable models were adjusted for all covariates. An interaction term between country and an individual covariate of interest was used (adjusted for all other covariates in the model) to test whether there were significant differences between country in the estimated association between each covariate and the outcome. Results are weighted and adjusted for the complex sample design, unless otherwise stated. All estimates were conducted using the svy procedures in Stata version 13.0.

RESULTS

Descriptive statistics are presented in Table I. The South African sample had higher education levels but more unemployment; more urban residents; more overweight/obesity; and more current smokers than the Ghanaian sample.

Age-standardised prevalence of the outcomes are presented in Figure 1. Hypertension prevalence was over 50% in both countries (Figure 1: South Africa, Total: 79.2%; Ghana, Total: 59.1%). One in 3 hypertensive South Africans was aware of their hypertension status (33.3%); this was half as high in Ghana (16.3%). Control of hypertension was about 20% and similar between countries (South Africa: 23.9%; Ghana: 19.9%). Of all those with measured hypertension, more than half (South Africa: 61.2%; Ghana: 54.9%) have Stage 2 or 3 hypertension. Unadjusted values are presented in Supplemental Table I.

Of the few factors significantly associated with having hypertension in Ghana and South Africa, 2 factors varied between countries for women and men (Table II). First, living in a rural environment was associated with a significantly lower odds of having hypertension in Ghana (Men, OR: 0.77, 95% CI: 0.58,1.01; Women, OR: 0.75, 95% CI: 0.58,0.98); whereas in South Africa, the odds were elevated, though not statistically significant (Men, OR: 1.18, 95% CI: 0.76, 1.82; Women, OR: 1.09, 95% CI: 0.74, 1.59). The role of education also varied: having no formal education in South Africa was associated with higher odds, but lower odds in Ghana. The between-country difference for no formal education was significant for men ($p<0.05$) and marginally significant for women ($p<0.1$). Overweight status was consistently and significantly associated with having hyper-

TABLE I: Sample characteristics – Weighted Means and Standard Errors.

	South Africa, Men (n=1 474)		South Africa, Women (n=1 983)		Ghana, Men (n=2 180)		Ghana, Women (n=2 016)	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Age	60.997	0.436	61.827	0.349	64.349	0.365	64.29	0.293
Father's Education, Any	0.294	0.022	0.329	0.022	0.147	0.011	0.158	0.012
Education, None	0.157	0.017	0.232	0.019	0.43	0.016	0.651	0.015
Education, High School+	0.236	0.021	0.234	0.017	0.338	0.016	0.143	0.011
Income, Bottom 2 Quintiles	0.394	0.029	0.401	0.026	0.336	0.015	0.412	0.016
Income, Top 2 Quintiles	0.465	0.030	0.373	0.024	0.464	0.017	0.370	0.016
Work, Ever Worked	0.906	0.012	0.821	0.018	0.983	0.004	0.979	0.006
Work, Currently Working	0.402	0.028	0.221	0.015	0.729	0.014	0.654	0.014
Rural	0.334	0.027	0.360	0.025	0.599	0.014	0.585	0.013
Poor Self-Rated Health	0.168	0.016	0.177	0.015	0.144	0.009	0.194	0.012
Smoking, Current	0.282	0.021	0.199	0.014	0.153	0.010	0.054	0.007
Smoking, Former	0.130	0.013	0.068	0.010	0.242	0.012	0.030	0.005
Drinking, Any	0.975	0.009	0.987	0.004	0.876	0.008	0.871	0.011
Any Physical Activity	0.652	0.026	0.569	0.023	0.875	0.011	0.826	0.014
Self-Reported Diabetes	0.070	0.010	0.112	0.012	0.033	0.005	0.045	0.005
BMI, <18.5	0.041	0.009	0.025	0.006	0.149	0.010	0.148	0.011
BMI, 18.5 - 24.9	0.270	0.021	0.189	0.014	0.588	0.014	0.482	0.015
BMI, 25 - 29.9	0.270	0.021	0.240	0.015	0.178	0.011	0.205	0.012
BMI, 30+	0.420	0.025	0.546	0.019	0.084	0.008	0.165	0.012

Note: Means and Standard Errors were estimated adjusting for the complex survey design and are weighted by the sampling weight.

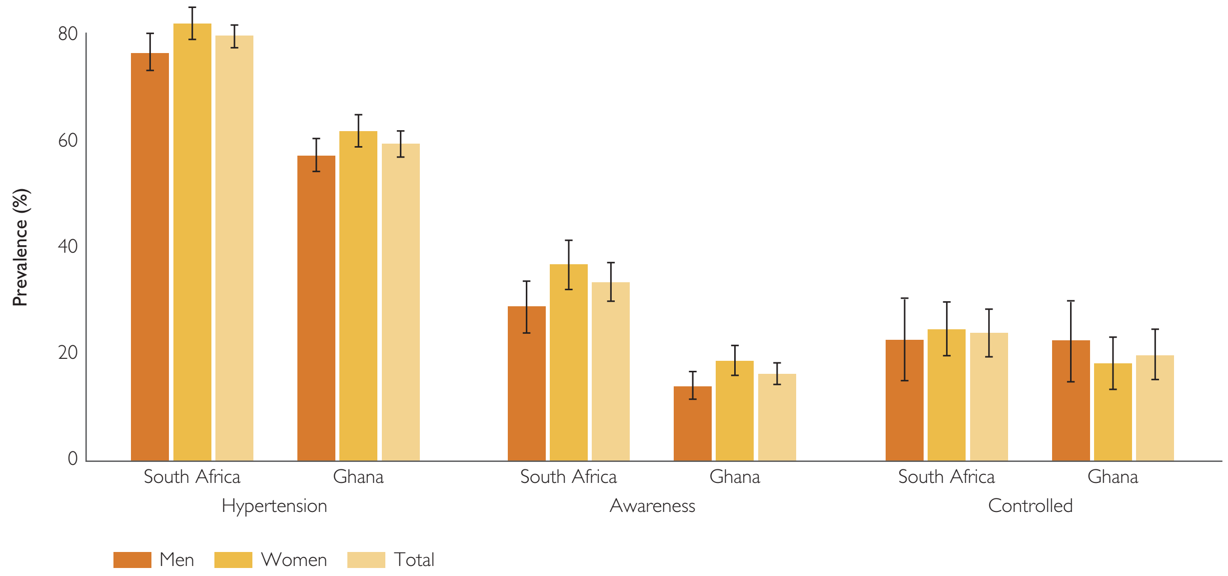

FIGURE 1: Prevalence of hypertension, awareness and control in adults aged 50+ years, by sex and country.

Prevalence of Awareness and Controlled are among those with hypertension.

SUPPLEMENTAL TABLE I: Frequencies of Outcome Variables.

	South Africa			Ghana		
	%	n	Weighted n	%	n	Weighted n
Hypertension Status						
Men						
Non-Hypertensive	25%	368	733 497	43%	991	629 606
Hypertensive	76%	1 106	2 258 727	57%	1 189	837 047
Women						
Non-Hypertensive	19%	387	704 208	39%	768	515 836
Hypertensive	81%	1 596	3 084 553	62%	1 248	824 873
Hypertension Awareness						
Men						
Unaware	72%	788	1 614 246	85%	1 037	713 714
Aware	29%	318	644 482	15%	152	123 333
Women						
Unaware	64%	966	1 969 460	81%	1 008	668 607
Aware	36%	630	1 115 094	19%	240	156 266
Hypertension Control						
Men						
Uncontrolled	78%	241	504 699	76%	117	93 204
Controlled	22%	77	139 782	24%	35	30 129
Women						
Uncontrolled	75%	487	839 667	80%	183	124 588
Controlled	25%	143	275 427	20%	57	31 678

Note: Hypertension is defined as either a self-reported diagnosis or measured high blood pressure at the time of the interview. % Aware is calculated as the number who self-reported a diagnosis divided by all those who had hypertension. % Controlled is the number of people who were aware of their hypertension who had measured high blood pressure under JNC-7 guidelines for definitions of hypertension. % Stage 2 is the number of people who had measured Stage 2 or 3 blood pressure of all those uncontrolled hypertensives.

TABLE II: Odds Ratios (OR) and 95% Confidence Intervals (CI) of sex- and country-stratified determinants of hypertension prevalence.

	Men			Women		
	South Africa (n= 474) OR [95%CI]	Ghana (n=2 180) OR [95%CI]	Country Int. p-value	South Africa (n=1 983) OR [95%CI]	Ghana (n=2 016) OR [95%CI]	Country Int. p-value
Age	1.03	1.00	*	1.01	1.00	
	[1.00,1.05]	[0.99,1.01]		[0.99,1.03]	[0.99,1.02]	
Father's Education, Any	1.02	0.91		1.27	1.46	+
	[0.63,1.67]	[0.65,1.26]		[0.79,2.05]	[1.00,2.12]	
Education, None	1.29	0.80	*	1.01	0.90	+
	[0.79,2.11]	[0.60,1.08]		[0.68,1.51]	[0.68,1.20]	
Education, Secondary+	0.96	0.92		0.67	0.83	+
	[0.56,1.64]	[0.69,1.22]		[0.41,1.11]	[0.55,1.23]	
Income, Bottom 2 Quintiles	0.76	0.83		0.94	1.07	
	[0.44,1.32]	[0.62,1.11]		[0.59,1.51]	[0.80,1.44]	
Income, Top 2 Quintiles	1.03	0.98		0.89	1.01	
	[0.62,1.72]	[0.72,1.34]		[0.52,1.53]	[0.75,1.37]	
Work, Ever	0.64	2.01	+	0.91	1.01	
	[0.32,1.29]	[0.85,4.76]		[0.52,1.61]	[0.31,3.30]	
Work, Current	1.01	0.83		0.84	0.71	
	[0.68,1.50]	[0.62,1.10]		[0.55,1.27]	[0.55,0.93]	
Rural	1.18	0.77	*	1.09	0.75	*
	[0.76,1.82]	[0.58,1.01]		[0.74,1.59]	[0.58,0.98]	
Self-rated Health, Bad	0.96	1.15		1.25	1.21	
	[0.52,1.78]	[0.82,1.61]		[0.78,2.02]	[0.91,1.61]	
Smoker, Current	1.19	0.76	+	0.87	0.98	
	[0.76,1.86]	[0.56,1.03]		[0.57,1.34]	[0.58,1.66]	
Smoker, Former	1.39	1.23		1.02	0.72	
	[0.79,2.44]	[0.94,1.61]		[0.47,2.24]	[0.38,1.39]	
Drink, Any	2.8	1.05		0.85	1.14	
	[0.70,11.19]	[0.78,1.42]		[0.28,2.53]	[0.84,1.55]	
Physical Activity	0.99	0.84		1.01	0.99	
	[0.66,1.49]	[0.59,1.20]		[0.66,1.55]	[0.71,1.39]	
Self-reported Diabetes	2.03	1.4		2.27	1.6	
	[0.99,4.17]	[0.71,2.78]		[1.20,4.32]	[0.90,2.85]	
BMI<18.5	0.67	0.64		1.05	0.68	
	[0.28,1.59]	[0.46,0.88]		[0.41,2.67]	[0.47,0.97]	
BMI 25 - 29.9	1.33	1.67		1.82	1.81	
	[0.81,2.17]	[1.23,2.28]		[1.14,2.88]	[1.34,2.45]	
BMI 30+	1.09	1.69		1.47	2.04	*
	[0.68,1.76]	[0.96,2.97]		[0.94,2.31]	[1.43,2.91]	

*Note: Hypertension prevalence is defined as either measured high blood pressure at study interview or self-reported diagnosis of hypertension. Interactions are of each independent variable and the country indicator in a pooled model (i.e., Age*Ghana). + p<0.01, * p<0.05, ** p<0.01, *** p<0.001*

tension: compared to normal weight, overweight and obese individuals had higher odds of having hypertension. The magnitude of this association differed for women between the countries ($p<0.05$).

Awareness of having hypertension differed significantly between countries for both men and women by income, BMI and education (Table III). The differences between countries were in either the magnitude or direction of the association; more-

TABLE III: Odds Ratios (OR) and 95% Confidence Intervals (CI) of sex- and country-stratified determinants of hypertension awareness.

	Men			Women		
	South Africa (n=1 106) OR [95%CI]	Ghana (n=1 189) OR [95%CI]	Country Int. p-value	South Africa (n=1 596) OR [95%CI]	Ghana (n=1 248) OR [95%CI]	Country Int. p-value
Age	1.01	1.02		1.04	1.02	***
	[0.99,1.04]	[1.00,1.04]		[1.03,1.06]	[1.00,1.04]	
Father's Education, Any	1.11	1.19		1.12	1.13	**
	[0.65,1.88]	[0.68,2.08]		[0.76,1.66]	[0.70,1.81]	
Education, None	1.17	0.61	*	0.89	1.14	***
	[0.68,2.03]	[0.30,1.26]		[0.60,1.32]	[0.64,2.04]	
Education, Secondary$^+$	0.77	1.15	*	0.98	4.16	***
	[0.42,1.41]	[0.67,1.98]		[0.63,1.53]	[2.24,7.71]	
Income, Bottom 2 Quintiles	0.49	0.44	*	0.8	0.76	**
	[0.26,0.92]	[0.18,1.07]		[0.51,1.27]	[0.42,1.39]	
Income, Top 2 Quintiles	0.77	1.27	**	1.23	2.1	***
	[0.40,1.48]	[0.62,2.59]		[0.82,1.84]	[1.22,3.63]	
Work, Ever	0.46	0.93		0.86	8.04	**
	[0.22,0.96]	[0.12,6.86]		[0.55,1.35]	[1.00,64.96]	
Work, Current	0.89	0.6		0.72	0.51	
	[0.52,1.51]	[0.36,1.00]		[0.45,1.14]	[0.32,0.81]	
Rural	0.57	0.45		0.98	0.71	**
	[0.33,0.98]	[0.26,0.79]		[0.65,1.46]	[0.47,1.08]	
Self-rated Health, Bad	1.03	2.58		1.36	1.03	*
	[0.56,1.88]	[1.43,4.63]		[0.86,2.13]	[0.64,1.65]	
Smoker, Current	1.25	0.99		0.94	1.03	
	[0.67,2.31]	[0.48,2.07]		[0.60,1.46]	[0.35,3.02]	
Smoker, Former	1.41	0.73		0.98	0.35	
	[0.79,2.55]	[0.43,1.24]		[0.55,1.75]	[0.07,1.73]	
Drink, Any	2.03	0.50		4.91	1.41	*
	[0.16,26.67]	[0.27,0.95]		[1.45,16.57]	[0.84,2.38]	
Physical Activity	0.79	0.85		1.10	1.04	
	[0.47,1.35]	[0.52,1.41]		[0.78,1.55]	[0.70,1.56]	
Self-reported Diabetes	7.63	2.93		3.77	2.81	
	[3.89,14.96]	[1.51,5.69]		[2.19,6.49]	[1.54,5.13]	
BMI<18.5	7.10	0.95	**	0.65	0.74	
	[2.41,20.94]	[0.34,2.71]		[0.20,2.08]	[0.37,1.48]	
BMI 25 - 29.9	1.10	1.97	**	0.87	1.57	*
	[0.61,2.00]	[1.29,3.02]		[0.53,1.44]	[0.99,2.49]	
BMI 30$^+$	1.64	1.40		1.48	1.78	
	[0.92,2.93]	[0.72,2.74]		[0.88,2.48]	[1.06,2.98]	

Note: The dependent variable is constructed among those who self-report having had a hypertension diagnosis. Specifically, the dichotomous outcome variable reflects whether someone who had measured hypertension at the interview reported having ever been diagnosed with hypertension during the study interview.
*+ p<0.01, * p<0.05, ** p<0.01, *** p<0.001*

over, these differences were sometimes consistent between men and women, and other times differed by sex. For lower income, the statistically significant difference between countries was in the magnitudes of the associations and was consistent by sex. Men and women in the poorer 2 income quintiles had a lower odds of hypertension awareness in both countries compared to those in the middle-income quintile. The size of the association was significantly stronger (that is, further from the null) in Ghana (Men, OR: 0.44, 95% CI: 0.18,1.07; Women, OR: 0.76, 95% CI: 0.42,1.39) than in South Africa (Men, OR: 0.49, 95% CI: 0.26,0.92; Women, OR: 0.80, 95% CI: 0.51,1.27). However, for higher income, education and overweight, the between country variation was in either the direction of association, differentially by sex, or both. For higher education, the associations were different in direction between countries, but consistent by sex. South Africans with higher education had lower odds of awareness (Men, OR: 0.77, 95% CI: 0.42,1.41; Women, OR: 0.98, 95% CI: 0.63,1.53), whereas Ghanaians had higher odds of being aware of having hypertension (Men, OR: 1.15, 95% CI: 0.67,1.98; Women, OR: 4.16, 95% CI: 2.24,7.71). For no formal education and overweight, the associations were different in direction between countries and by sex. Overweight was consistently associated with higher odds of awareness for men across countries; for women the odds were low for South African women and high for Ghanaian women. Other salient factors for sex-specific cross-national differences included: for men, low BMI and social cohesion; for women, the factors were age, father's education, work history, rural location of dwelling, poor self-rated health, and alcohol use.

Control of hypertension differed between countries in men and women by current working status. Hypertension control for men also differed by country for those with higher income, smoking status and drinking status; for women, patterns differed between countries by father's education and any education and self-reported diabetes (Table IV).

DISCUSSION

In this cross-sectional study of hypertension in 2 nationally representative samples of middle- and older-age sub-Saharan African adults, we found notable variation between South Africans and Ghanaians on hypertension prevalence and distribution of hypertension stages. For instance, 4 out of 5 South Africans have hypertension, and only one-third of them are aware of their hypertension status. Determinants of hypertension status, awareness of hypertension, and control of hypertension varied between countries and by sex. Notably, rural location, income, education and BMI were common determinants of hypertension status and often varied between countries and by sex in terms of either the direction or magnitudes of the associations.

The age-standardised prevalence of hypertension identified in our study (South Africa was roughly 79% (Men: 76%, Women: 81%); Ghana roughly 59% (Men: 57%, Women: 62%) was higher than other global[19] meta-analyses of hypertension. However, these results are within the wide range of prevalence found by another recent meta-analysis (15% - 74%) of hypertension in sub-Saharan Africa.[4,20-22] Other studies of older adults in sub-Saharan Africa have also found similarly high prevalence of hypertension: in one study, 70% of an urban Tanzanian population aged 70+ years were hypertensive.[23]

Our results of age-adjusted hypertension awareness (16.3% in Ghana and 33.3% in South Africa, Figure 1) are consistent with the aforementioned recent meta-analysis across sub-Saharan Africa that estimated 27% of those with hypertension are aware of their hypertension status.[4] Other studies from South Africa found higher awareness of hypertension than we found (56%[24] vs. 33%). Compared to a study of black South Africans in Cape Town, we found similar awareness among South African men (29% vs. 28%) but lower for South African women (39% vs. 68%).[25] The differences in results could be attributed to sample differences or temporal trends.[26] Our results showed rural residence was an important determinant of hypertension awareness, which is consistent with other evidence that awareness is lower in rural areas than urban areas in sub-Saharan Africa.[27,28]

In lower- and middle-income countries, the social gradients of NCDs, including hypertension, are generally reversed from what they are in the U.S. and high income countries,[29] whereby those among higher socio-economic positions having the highest burden of NCDs prevalence.[30] The patterns of the reverse social gradient were more consistent in Ghana.[31] Women with more education and income were more likely to be aware of their hypertension, which is consistent with having greater awareness of NCDs and healthcare access. In general, however, the patterns of social determinants of hypertension status, awareness, control and severity in this study's findings varied by outcome and were less consistent overall with a reverse social gradient.

In terms of health factors determining hypertension prevalence and status, BMI was the most common significant factor. Consistent with previous literature on the association between BMI and hypertension prevalence in sub-Saharan Africa,[32] we report here that being obese carries a higher risk of hypertension only in Ghana, despite a higher prevalence of both conditions in South Africa. There were increased odds of awareness in overweight/obese Ghanaians compared to those of desirable weight but this association was not evident in South Africans (Figure 2). Men and women in Ghana were considerably leaner than their counterparts in South Africa, which may explain, in part, the difference in awareness of hypertension. Given that weight status is a common risk factor for cardiovascular and other non-communicable diseases, further attention should be paid to its relevance to reducing population burden of NCD risk.

TABLE IV: Odds Ratios (OR) and 95% Confidence Intervals (CI) of sex- and country-stratified determinants of hypertension control.

	Men			Women		
	South Africa (n=318) OR [95%CI]	Ghana (n=152) OR [95%CI]	Country Int. p-value	South Africa (n=630) OR [95%CI]	Ghana (n=250) OR [95%CI]	Country Int. p-value
Age	0.97	1		1.01	1.05	
	[0.92,1.03]	[0.95,1.06]		[0.98,1.03]	[1.00,1.10]	
Father's Education, Any	1.29	3.11		0.55	1.14	*
	[0.49,3.36]	[0.92,10.58]		[0.31,0.98]	[0.52,2.54]	
Education, None	0.58	0.65		3.39	0.33	*
	[0.13,2.57]	[0.15,2.71]		[1.64,7.00]	[0.11,0.97]	
Education, Secondary+	0.55	0.55		1.49	0.50	
	[0.18,1.66]	[0.15,1.99]		[0.71,3.11]	[0.18,1.41]	
Income, Bottom 2 Quintiles	0.99	0.77		0.82	3.74	
	[0.29,3.37]	[0.12,4.87]		[0.39,1.74]	[0.81,17.27]	
Income, Top 2 Quintiles	4.55	0.53	+	1.76	5.8	
	[1.62,12.78]	[0.11,2.57]		[0.88,3.50]	[1.24,27.02]	
Work, Ever	1.8	1.00		1.92	1.00	
	[0.47,6.97]	[1.00,1.00]		[0.68,5.44]	[1.00,1.00]	
Work, Current	0.48	1.72	+	1.44	0.71	*
	[0.17,1.39]	[0.60,4.94]		[0.74,2.82]	[0.31,1.60]	
Rural	0.46	0.4		0.75	0.59	
	[0.16,1.33]	[0.12,1.38]		[0.40,1.40]	[0.25,1.37]	
Self-rated Health, Bad	2.42	0.68		0.39	0.5	
	[0.83,7.02]	[0.14,3.41]		[0.13,1.17]	[0.20,1.24]	
Smoker, Current	2.55	0.29	+	0.82	1.38	
	[1.18,5.47]	[0.03,3.28]		[0.37,1.81]	[0.23,8.20]	
Smoker, Former	5.27	0.55	*	0.65	1	
	[1.87,14.87]	[0.19,1.54]		[0.19,2.20]	[1.00,1.00]	
Drink, Any	1.00	0.39	***	1.00	3.23	
	[1.00,1.00]	[0.15,1.02]		[1.00,1.00]	[0.95,10.99]	
Physical Activity	0.56	0.33		0.74	0.82	
	[0.24,1.27]	[0.11,0.94]		[0.40,1.38]	[0.35,1.92]	
Self-reported Diabetes	0.44	1.46		0.46	1.51	*
	[0.14,1.40]	[0.38,5.62]		[0.24,0.88]	[0.60,3.80]	
BMI<18.5	0.69	0.53		4.33	0.83	
	[0.10,5.00]	[0.09,3.04]		[0.64,29.42]	[0.18,3.73]	
BMI 25 - 29.9	0.84	1.01		1.31	0.34	
	[0.25,2.81]	[0.37,2.71]		[0.56,3.08]	[0.14,0.88]	
BMI 30+	0.68	0.32		1.58	0.31	
	[0.25,1.87]	[0.10,1.06]		[0.67,3.70]	[0.14,0.70]	

Note: The dependent variable is constructed among those who self-report having had a hypertension diagnosis. Specifically, the dichotomous outcome variable reflects whether someone who reported having ever been diagnosed with hypertension had controlled hypertension when measured during the study interview.
*+ p<0.01, * p<0.05, ** p<0.01, *** p<0.001*

Implications for policy and practice

There are direct implications of the findings that more than half of older adults in both Ghana and South Africa have hypertension. Clinical guidelines and practice in sub-Saharan Africa should be especially cognisant of managing such high blood pressure given elevated risk of stroke and other cardiovascular events.

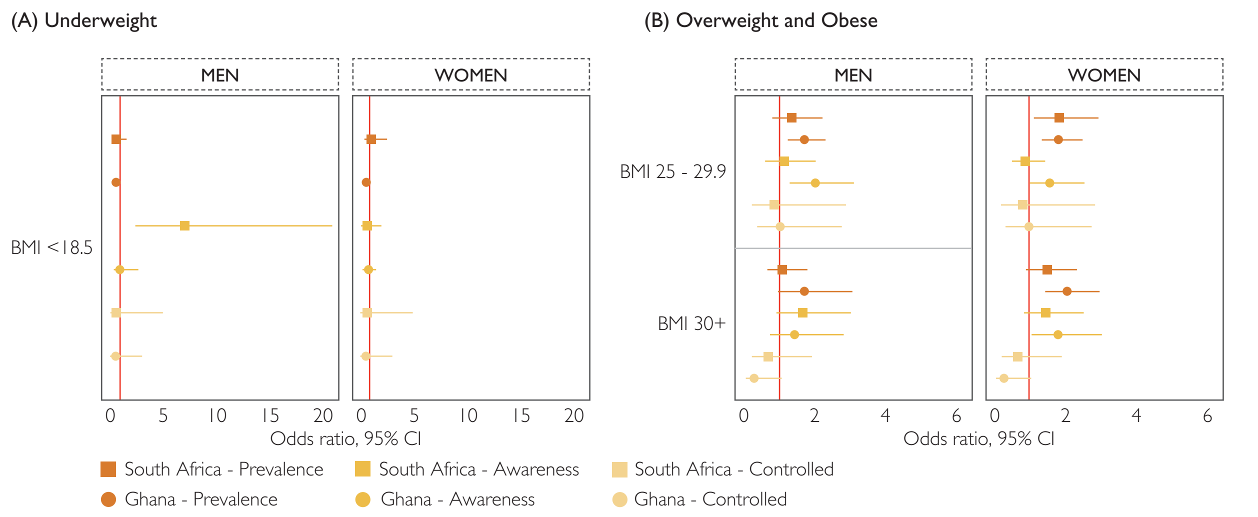

FIGURE 2: Association between BMI (reference: BMI 18.5 - 24.9) for (A) underweight and (B) overweight/obese and hypertension, awareness and control in adults aged 50+ years, by sex and country.

Our data suggests that culturally-specific health messages for hypertension prevalence, diagnosis and treatment may be beneficial. For example, in Ghana it may be effective to focus on strategies to prevent excessive weight gain with age, whereas low uptake of weight loss and maintenance programmes because of prevailing social perceptions may stymie hypertension prevention efforts in South Africa.[33,34] Previous reports have identified that barriers to blood pressure control in South Africans include limited hypertension-related knowledge, poor quality of life and stressors such as family death.[35]

The WHO's cardiovascular disease prevention approach includes population-based strategies, including dietary modification.[36,37] The WHO Global Action Plan for the Prevention of NCDs (2013 - 2020) included a 30% reduction of population-level salt intake as one of 9 priority actions needed globally and was considered a "best-buy" strategy.[36] Proposed population health approaches to reduce hypertension burden, especially those operating through the formal health sector,[38] should be cognisant of the potential disparities of access along these social lines. Our results suggest that the country patterns with respect to awareness of hypertension – a proxy indicator of interactions with the health care system – varied by socio-economic factors and differentially by sex.

Strengths and limitations

These findings should be considered in the context of key limitations. Despite the standardised training on positioning, variability in blood pressure measurement results may be introduced by interviewers and respondents at the point of data collection. The wrist-worn devices may also overestimate hypertension; however, the results are reasonably accurate averaged over the population.[39] Although the analyses included many other hypertension risk factors, there was no detailed assessment of dietary intake, particularly sodium intake and levels in this wave of interviews.

These limitations notwithstanding, this study has numerous strengths. This study used cross-sectional data from nationally representative samples of community-dwelling older adults from Ghana and South Africa with response rates of 81% and 75%, respectively.[15] This sample is also one of the few in sub-Saharan Africa that includes a substantial portion of older adults. In addition to directly measured blood pressure, the harmonised survey measures of biological, clinical and social factors offer a unique ability to conduct cross-national comparisons.

CONCLUSION

In conclusion, this cross-sectional study of social, behavioural and environmental determinants of hypertension status (prevalence, awareness, control) among 7 513 middle- and older-age adults in Ghana and South Africa, found rural residence, education and weight status consistently differed between countries, particularly for hypertension awareness. Specifically, higher education and income were associated with higher odds of hypertension awareness in Ghana than South Africa. There was less significant between-country variation in the determinants of hypertension prevalence and control. National and local clinical and prevention efforts across sub-Saharan Africa to lower burden of hypertension, particularly raising awareness of hypertension status, can use these results to tailor messages to the different factors that are shown here to impact men and women.

DECLARATIONS

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Conflict of interest: none declared.

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