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GENDER DIFFERENCES IN THE ASSOCIATION BETWEEN MARITAL STATUS AND HYPERTENSION IN GHANA

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Summary. Hypertension is a significant contributor to the global burden of cardiovascular and related target organ diseases such as heart failure, coronary heart disease, stroke and kidney failure, and their associated premature morbidity, mortality and disability. Marital status is an important social characteristic known to predict a range of health outcomes including cardiovascular disease. However, little is known about its impact on hypertension in sub-Saharan Africa. This study explored the relationship between marital status and hypertension among women and men in Ghana. Drawing on data from the 2014 Ghana Demographic and Health Survey (GDHS), descriptive statistics and binary logistic regression models were used to analyse the link between marital status and hypertension. About 13% of women aged 15–49 and 15% of men aged 15–59 were found to be hypertensive. After controlling for lifestyle and socio-demographic covariates, the logistic regression models showed significantly higher odds of hypertension for married (OR = 2.14, 95% CI = 1.30–3.53), cohabiting (OR = 1.94, 95% CI = 1.16–3.23) and previously married (OR = 2.23, 95% CI = 1.29–3.84) women. In contrast, no significant association was found between any of the marital status cohorts and hypertension for men. Other significant predictors of hypertension were age, body mass index and wealth status. The results demonstrate that marital status is an independent risk factor for hypertension in Ghana for women, rather than men. This could have immediate and far-reaching consequences for cardiovascular health policy in Ghana. In particular, the findings could lead to better targeted public health interventions, including more effective risk factor assessment and patient education in clinical settings, which could lead to more effective patient management and improved cardiovascular outcomes.

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Introduction

Cardiovascular disease has been established as a leading cause of mortality globally, with 80% of cardiovascular disease-related deaths occurring in low- and middle-income countries (Murray *et al.*, 2012). Hypertension is an important cause of cardiovascular morbidity and mortality worldwide with responsibility for roughly 50% of deaths from stroke and heart disease (WHO, 2013; Go *et al.*, 2013). In 2008, over 40% of adults over 25 years old were affected worldwide, accounting for about 57 million Disability Adjusted Live Years (DALYS) and up to 7.5 million deaths (WHO, 2016).

Increasing age, gender, family history, genetics, race, cigarette smoking, high salt intake, consumption of saturated fats, high alcohol intake, physical inactivity, environmental stress and low socioeconomic status have been shown to be important determinants of hypertension in several studies (Addo *et al.*, 2012; van den Berg *et al.*, 2013; Laxmaiah *et al.*, 2015; Nyarko, 2016). The now routine use of automated ambulatory blood pressure monitors in clinical practice and research in the last two decades has revealed intra-day variability in blood pressure linked to the sleep–wake cycle (Fagard *et al.*, 2009; Cuspidi *et al.*, 2010; Hansen *et al.*, 2011) as well as routine daily activities and life circumstances (James, 1991; Ice & James, 2012). These activity-linked ‘physiological’ changes in blood pressure, termed ‘allostasis’, help individuals adapt to their activities and circumstances and shed some light on the link between social conditions, behaviour and cardiovascular health (Sterling, 2004; James, 2013).

Although hypertension is already a major health concern globally, its prevalence continues to rise disproportionally in low- and middle-income countries, particularly in urban communities (Danaei *et al.*, 2011; Murray *et al.*, 2012; WHO, 2013). In Africa, the prevalence of hypertension has been estimated to be about 46% for both sexes – the highest across all World Health Organization regions (WHO, 2016). This rise in the prevalence of hypertension in low- and middle-income countries has been linked to rapid (uncontrolled) urbanization and unhealthy lifestyle changes (consumption of Western-style diets, sedentary lifestyle, smoking and increased alcohol consumption) and a general increase in the prevalence of non-communicable diseases (WHO, 2010; Delisle *et al.*, 2012). In Ghana, the prevalence rate of hypertension is estimated to be between 25% and 48%, again with higher rates in urban than in rural populations (Amoah, 2003; Agyemang, 2006; Addo *et al.*, 2012). Importantly, almost half (47.5%) of those with hypertension in Ghana already have evidence of target organ damage, including complications to the eyes, heart, kidneys and brain (Addo *et al.*, 2009), which inevitably impacts morbidity and mortality. Unsurprisingly, hypertension has been reported to be the second leading cause of outpatient morbidity in Ghanaian adults over the age of 45 years and a major contributor to the rise in non-communicable diseases, which are responsible for about 42% of premature deaths in Ghana (Addo *et al.*, 2012; WHO, 2014). An in-depth understanding of the biology and epidemiology of hypertension globally and locally is therefore critical for the implementation of effective interventions.

Marital status is an important social characteristic that is known to predict a range of health outcomes, including cardiovascular health in particular (Brummett *et al.*, 2001; Lett *et al.*, 2005) and mortality in general (House, 2001; Kaplan & Kronick, 2006). Two main schools of thought have sought to explain the relationship between marital status and health outcomes – the social selection and social causation hypotheses (Joung *et al.*, 1998; Averett *et al.*, 2008). The social selection hypothesis purports that healthier individuals are selected into marriage and unhealthy persons into unmarried states. Proponents argue that the association between marital status and health may not be a function of marriage *per se* but a function of the selection of marriage partners, which favours healthy individuals (Averett *et al.*, 2008).

The social causation hypothesis, on the other hand, argues that marital status determines an individual's exposure to the social or economic conditions that shape one's health outcomes. Thus, the married state could offer an economic and social environment that promotes healthier behaviours. However, physiological stress associated with taxing marital roles such as caring for children and spouses, increased pressures to earn a higher income and psychological stress from marital discord could negatively impact the health of married individuals (Law & Sbarra, 2009; Ferree, 2010). Further, the stresses associated with marital breakdown (spousal death, separation or divorce) could precipitate unhealthy lifestyles such as smoking, drinking and poor diet. On these hypotheses, the literature on allostasis and adaptation as a determinant of hypertension is particularly strong (Schnall *et al.*, 1990; Landsbergis *et al.*, 2003; James, 2013).

Most previous studies exploring the relationship between marital status and health were primarily conducted outside Africa (Brummett *et al.*, 2001; House, 2001; Lett *et al.*, 2005; Kaplan & Kronick, 2006; Averett *et al.*, 2008). Only a handful of these (Wang, 2005; Kaplan & Kronick, 2006; Molloy *et al.*, 2009; Schwandt *et al.*, 2010) focused on the relationship between marital status and hypertension. Evidence from these studies generally points towards an association between the unmarried state (including the never married, divorced, widowed or separated) and hypertension (Wang 2005; Schwandt *et al.*, 2010). One study (Schwandt *et al.*, 2010) looked specifically at gender differences and blood pressure in married versus unmarried African-Americans and found that single African-American women were more likely than single African-American men to have hypertension. Another study (Adeoye *et al.*, 2016), which specifically examined the relationship between gender and hypertension in Africans in Africa, found gender disparities in the prevalence of hypertension, with a higher prevalence in men than women. The authors, however, did not look at the effects of marital status in their study.

Given that: 1) evolutionary and ecological differences between populations may affect allostatic variation regulation of blood pressure (James, 2013 2017); 2) the evidence that familial responsibilities and domestic stress may affect blood pressure differently in men and women (James *et al.*, 1996; Brisson *et al.*, 1999; Gerin & James, 2010); 3) the possibility that marital status may affect blood pressure differently in men versus women (Wang 2005; Molloy *et al.*, 2009; Schwandt *et al.*, 2010); and 4) the dearth of studies examining these subjects in Africa, this study sought to examine the effect of marital status on hypertension in Ghana and whether this effect varies by gender. The findings of the present study fill a gap in the literature and should inform public health interventions aimed at reducing hypertension in Ghana and sub-Saharan Africa in general.

Methods

Data source

The study used data from the 2014 Ghana Demographic Health Survey (GDHS), which is the sixth in a series of nationally representative surveys of women, men and children for monitoring population dynamics and health situation in Ghana. For the collection of data, the GDHS employed a two-staged stratified sampling procedure in a cross-sectional design. The first stage involved the systematic random selection of clusters based on an updated master sampling frame constructed from the 2010 Ghana Population and Housing Census. The second stage involved the systematic sampling of the households listed in each cluster from which a nationally representative sample of 9396 women and 4388 men were interviewed, with a response rate of 98.5%.

The 2014 survey was the first in the series of GDHS since 1987/88 to measure the blood pressure of participants. More than 99% of the eligible women and men interviewed consented to having their blood pressure taken. The analysis in this study was therefore based on 9356 women and 4374 men with complete blood pressure data. All respondents provided written consent before each interview was conducted.

Dependent variable

The dependent variable was derived from the blood pressure measurements of respondents in the survey. Using standardized procedures, trained personnel measured blood pressure using the LIFE SOURCE® UA-767 Plus blood pressure monitor: a digital oscillometric blood pressure measuring device with automatic upper-arm inflation and automatic pressure. Three measurements of both systolic and diastolic blood pressure (measured in millimetres of mercury [mmHg]) were taken for each participant with an interval of at least 10 minutes between measurements during the interviews. The average of the second and third measurements was used to classify individuals with respect to hypertension (Ghana Statistical Service (GSS) *et al.*, 2015). No 24-hour ambulatory blood pressure measurements were obtained.

Participants who had a systolic blood pressure level of 140 mmHg or above, or a diastolic blood pressure level of 90 mmHg or above, or were taking antihypertensive medication to control their blood pressure at the time of the survey were classified as having hypertension and coded '1' (GSS *et al.*, 2015). Participants with a systolic blood pressure below 140 mmHg or a diastolic blood pressure below 90 mmHg or not taking antihypertensive medication to control their blood pressure at the time of the survey were classified as not having hypertension and coded '0' (GSS *et al.*, 2015). The term 'hypertension' as used in the current study is not meant to be a clinical diagnosis of the disease; rather, it is meant to provide an indication of the disease burden in the population at the time of the survey (GSS *et al.*, 2015).

Key explanatory variable and covariates

Participants answered questions about their marital status. Responses were grouped into five categories: never married, married, living together, divorced, separated and widowed. For the purpose of this study, four marital status categories were created, namely: never married, married, cohabiting (living together), and previously married (divorced, separated and widowed). In order to better assess the effect of marital status on hypertension, other covariates were controlled for.

Two groups of covariates were considered, namely: lifestyle-related factors and socio-demographic factors. The lifestyle-related factors considered were body mass index (BMI), days of fruit intake per week and days of vegetable intake per week. These are modifiable factors that may protect or predispose one to hypertension. Body mass index was expressed as the ratio of weight in kilograms to the square of height in metres (kg/m^2), and classified according to standard WHO (1995) cut-offs: underweight, BMI < 18.5 kg/m^2; normal weight, BMI of 18.5–24.9 kg/m^2; overweight, BMI of 25.0–29.9 kg/m^2; and obese, BMI ≥ 30.0 kg/m^2. Days of fruit intake per week and days of vegetable intake per week were each put into three categories: none, 1–3 and 4–7.

The socio-demographic factors considered were age group (15–24, 25–34, 40–44, and 45 +), educational level (no education, primary, middle/junior secondary school (JSS)/ junior high school (JHS) and secondary/higher education), occupation (not working, professional/managerial, sales/trade, agricultural and manual labour), wealth status (poorest, poorer, middle, rich and richest), ethnicity (Akan, Ga/Adangme, Ewe, Mole-Dagbani, Gruma and 'Other') and type of locality (rural and urban)

Data analyses

All analyses were conducted using STATA version 11.0 software. Descriptive and inferential statistics were employed to explore the relationship between marital status and hypertension. All analyses were stratified by gender in accordance with the initial premise of potential gender differences in the effect of marital status on hypertension. Descriptive statistics were used to analyse and present the results for all variables considered in the study, and their relationship with hypertension. The chi-squared test was used to test for statistical significance ($p < 0.05$) in the descriptive analyses.

The next stage of the analyses involved the use of multivariate binary logistic regression analyses to estimate the effect of marital status on hypertension. Three models were estimated, with marital status in the first model (Model I). In Model II, lifestyle-related factors were included to assess their influence on the results between marital status and hypertension. Then in Model III, socio-demographic factors were fitted to assess their influence on the factors in the preceding models. Based on reviewed literature, an interaction term, comprising age and BMI, was introduced to ascertain possible moderation effects.

To explore possible cohort variations in the association between the covariates (lifestyle-related and socio-demographic factors) controlled for in Model III and hypertension, further regression analyses were conducted stratified by marital status and gender (see Table 5). The results from the final model (Model III) were used to assess the overall effect of marital status on hypertension. Results from binary logistic regression analyses were presented as odds ratios at 95% confidence intervals (CIs). In order to ensure representativeness and to correct for non-response, the GDHS weighting was applied in all analyses.

Results

Table 1 presents the distribution of marital status by the various characteristics of the study participants. All the characteristics considered in this study were found to be significantly ($p < 0.05$) associated with marital status. In general, about four in ten

Table 1. Marital status of men and women by background characteristics, 2014 GDHS

	Women					Men				
	Never married	Married	Cohabiting	Previously married		Never married	Married	Cohabiting	Previously married	
Characteristic	%	%	%	%	*n*	%	%	%	%	*n*
BMI										
Underweight	57.4	25.2	9.2	8.1	264	68.0	20.1	6.0	6.0	436
Normal	42.9	34.4	14.5	8.1	2289	44.3	40.1	10.2	5.4	3123
Overweight	22.1	48.5	15	14.5	1057	20.9	66.5	7.1	5.4	579
Obese	13.0	55.2	13.1	18.7	648	13.8	76.2	6.8	3.1	136
χ^2		324.71, $p < 0.001$					306.01, $p < 0.001$			
Fruit intake										
None	31.2	41.0	17.5	10.3	1619	44.5	41.4	7.7	6.4	731
1–3 days	34.9	39.0	14.9	11.1	3791	46.3	39.7	9.5	4.4	1920
4–7 days	31.7	45.8	12.6	9.9	3935	37.5	47.5	9.1	5.9	1723
χ^2		41.56, $p < 0.001$					34.35, $p < 0.001$			
Vegetable intake										
None	32.0	38.7	16.3	13.0	1,294	48.6	36.0	8.6	6.8	515
1–3 days	35.8	39.1	15.2	9.9	3743	46.3	40.1	8.3	5.2	1383
4–7 days	30.7	45.9	13.2	10.2	4303	39.2	46.2	9.6	5.0	2469
χ^2		65.99, $p < 0.001$					43.49, $p < 0.001$			
Age group (years)										
15–24	75.4	10.8	11.2	2.6	3223	94.9	1.9	2.6	0.6	1440
25–34	19.2	53.1	18.8	8.9	2968	36.3	40.7	18.0	5.0	1136
35–44	3.1	65.0	15.0	16.9	2313	5.9	75.6	10.8	7.7	927
45+	1.0	61.6	9.6	27.8	852	3.2	79.5	6.2	11.0	871
χ^2		4658.65, $p < 0.001$					2970.84, $p < 0.001$			
Educational level										
No education	7.5	69.5	13.0	10.0	1784	13.9	75.9	6.6	3.6	469
Primary	27.7	40.3	18.2	13.8	1669	45.7	38.3	9.2	6.8	587
Middle/JSS/JHS	34.6	35.7	17.6	12.0	3848	41.9	40.4	11.7	6.1	1865
Secondary/higher	56.1	32.2	6.5	5.1	2055	51.4	37.8	6.4	4.4	1453
χ^2		1591.32, $p < 0.001$					402.14, $p < 0.001$			

Table 1. *Continued*

	Women					Men				
	Never married	Married	Cohabiting	Previously married		Never married	Married	Cohabiting	Previously married	
Characteristic	%	%	%	%	*n*	%	%	%	%	*n*
Wealth quintile										
Poorest	26.9	55.6	11.6	5.9	1507	41.6	50.7	4.7	3.0	750
Poorer	30.2	41.0	17.9	10.9	1635	38.8	44.1	9.8	7.2	778
Middle	33.0	32.8	18.7	15.5	1927	41.8	36.8	14.6	6.7	831
Richer	36.3	36.7	15.0	12.0	2103	46.3	37.0	11.3	5.4	956
Richest	35.8	47.6	9.3	7.3	2184	43.2	47.2	5.1	4.5	1059
χ^2	378.92, $p < 0.001$					101.77, $p < 0.001$				
Occupation										
Not working	65.4	19.4	11.1	4.1	2183	95.7	2.6	0.6	1.0	597
Prof./managerial	42.2	42.6	7.9	7.4	831	38.2	47.8	6.5	7.5	706
Sales/trade	22.4	46.7	16.1	14.8	3434	46.9	43.2	6.6	3.4	386
Agriculture	12.3	60.4	18.0	9.2	1746	30.1	55.0	9.1	5.9	1389
Manual labour	27.6	43.9	14.9	13.6	1147	32.5	46.3	15.0	6.2	1280
χ^2	1931.92, $p < 0.001$					907.07, $p < 0.001$				
Type of locality										
Urban	36.3	40.0	12.6	11	5031	45.9	40.5	8.4	5.2	2276
Rural	29.0	44.8	16.5	9.8	4325	39.0	45.8	9.7	5.5	2098
χ^2	90.86, $p < 0.001$					17.76, $p < 0.001$				
Ethnicity										
Akan	34.1	37.9	15.9	12.1	4676	44.9	38.9	11.1	5.1	2141
Ga/Adangbe	33.5	34.0	18.6	13.9	723	39.2	39.6	11.6	9.6	395
Ewe	34.0	35.5	19.4	11.1	1264	41.1	44.2	8.0	6.7	594
Mole-Dagbani	30.4	59.2	4.7	5.7	1384	39.5	52.5	4.8	3.3	630
Gurma	26.8	52.3	15.8	5.1	545	41.4	50.5	4.9	3.1	255
Other	32.6	49.8	9.3	8.3	762	40.9	47.9	6.2	5.0	359
χ^2	576.12, $p < 0.001$					121.03, $p < 0.001$				
Total	32.9	42.2	14.4	10.5	9356	42.6	43.1	9.1	5.2	4374

Total may vary across characteristics due to cases with missing information not shown separately.

participants were married (42.2% women and 43.1% men). Most obese participants were married (55.2% women and 76.2% men), whereas most of those categorized as underweight were in the never-married cohort (57.4% women and 68.0% men). The consumption of fruit and vegetables on most days of the week was higher among married participants, with over four in ten married men and women indicating they consumed fruit (45.8% women and 47.5% men) and vegetables (45.9% women and 46.2% men) 4–7 days per week.

With the exception of the 15–24 cohort, all age cohorts were dominated by married men and women (range of percantages). Participants with no education (69.5% women and 75.9% men), in the poorest wealth category (55.6% women and 50.7% men), engaged in agriculture (60.4% women and 55.0% men), residing in rural localities (44.8% women and 45.8% men) and belonging to the Mole-Dagbani ethnic group (59.2% women and 52.5% men) were most likely to be found in the married category.

As shown in Table 2, the overall prevalence of hypertension was only slightly higher in men (15.0%) than women (12.9%). With the exception of vegetable intake, the chi-squared test indicated a significant ($p < 0.05$) association between hypertension and all characteristics considered in the study. The prevalence of hypertension appeared to increase with BMI status, with about one-third of obese women being hypertensive compared with more than half of men in the same BMI category. The prevalence of hypertension was highest among women who consumed no fruit per week (14.1%), but highest for men who consumed fruit 4–7 days per week (17.5%). In terms of vegetable intake, hypertension was more common among those who consumed no vegetables at all per week (14.8% women and 16.5% men). Hypertension seemed to increase as age and wealth status increased, with variations between men and women. For instance, whereas more women (38.3%) than men (29.9%) aged 45 years or older had hypertension, more men (20.7%) than women (17.6%) in the richest wealth category had hypertension. With regards to level of education, the pattern of prevalence of hypertension for men increased in a manner similar to that observed for age and wealth status. All the other socio-demographic factors considered varied between women and men.

Tables 3 and 4 show the results of the binary logistic regression models fitted to explore the relationship between marital status and hypertension. In Model I (Tables 3 and 4), the odds of being hypertensive were significantly higher for all categories of marital status compared with the never-married category. Further, in all the marital status categories considered, the odds of being hypertensive were much higher for women (married, OR = 4.86, 95% CI = 3.80–6.22; cohabiting, OR = 2.86, 95% CI = 2.09–3.90; previously married, OR = 6.76, 95% CI = 5.07–9.02) compared with men (married, OR = 3.56, 95% CI = 2.73–4.63; cohabiting, OR = 2.08, 95% CI = 1.33–3.25; previously married, OR = 4.24, 95% CI = 2.62–6.88).

The inclusion of lifestyle-related factors in Model II neither changed the direction nor significance of the effect of marital status on hypertension as observed in Model I. For women, the magnitude of effect increased among those married and cohabiting, while the effect marginally reduced among those previously married. For men, however, the magnitude of effect was reduced for all categories of marital status. Among the lifestyle factors included in Model II, only BMI had significant effects on hypertension. The odds of being hypertensive were higher among those who were overweight and those who were obese, with the odds almost doubling for men (overweight, OR = 4.03,

Table 2. Prevalence of hypertension by background characteristics and gender, 2014 GDHS

	Women		Men	
Characteristic	%	*n*	%	*n*
Marital status				
Never married	4.2	3081	7.2	1861
Married	17.7	3950	21.7	1884
Cohabiting	11.2	1347	14.0	396
Previously married	23.0	978	24.8	233
χ^2	361.18, $p < 0.001$		161.91, $p < 0.001$	
BMI				
Underweight	4.9	264	6.9	436
Normal	8.9	2289	11.4	3123
Overweight	15.6	1057	31.2	579
Obese	31.0	648	54.3	136
χ^2	241.58, $p < 0.001$		309.99, $p < 0.001$	
Fruit intake				
None	14.1	1619	12.9	731
1–3 days	12.4	3791	13.5	1920
4–7 days	12.7	3935	17.5	1723
χ^2	6.62, $p = 0.036$		7.41, $p = 0.025$	
Vegetable intake				
None	14.8	1294	16.5	515
1–3 days	11.5	3743	15.4	1383
4–7 days	13.4	4303	14.4	2469
χ^2	10.08, $p = 0.006$		0.73, $p = 0.691$	
Age group (years)				
15–24	3.2	3223	4.1	1440
25–34	10.1	2968	12.2	1136
35–44	20.5	2313	21.4	927
45+	38.3	852	29.9	871
χ^2	852.32, $p < 0.001$		300.76, $p < 0.001$	
Educational level				
No education	12.4	1784	11.9	469
Primary	12.9	1669	9.3	587
Middle/JSS/JHS	14.5	3848	15.1	1865
Secondary/higher	10.1	2055	18.2	1453
χ^2	12.01, $p = 0.007$		19.63, $p < 0.001$	
Wealth quintile				
Poorest	6.6	1507	9.1	750
Poorer	9.9	1635	10.4	778
Middle	13.1	1927	11.6	831
Richer	14.3	2103	19.9	956
Richest	17.6	2184	20.7	1059
χ^2	128.40, $p < 0.001$		86.49, $p < 0.001$	

Table 2. *Continued*

	Women		Men	
Characteristic	%	*n*	%	*n*
Occupation				
Not working	6.1	2183	5.1	597
Prof./managerial	15.0	831	24.1	706
Sales/trade	18.1	3434	16.8	386
Agriculture	10.2	1746	11.3	1389
Manual labour	13.0	1147	18.1	1280
χ^2	192.42, $p < 0.001$		111.55, $p < 0.001$	
Type of locality				
Urban	15.8	5031	18.4	2276
Rural	9.4	4325	11.3	2098
χ^2	80.72, $p < 0.001$		45.48, $p < 0.001$	
Ethnicity				
Akan	14.0	4676	17.0	2141
Ga/Adangbe	13.8	723	13.7	395
Ewe	16.3	1264	17.3	594
Mole-Dagbani	9.5	1384	9.3	630
Gurma	5.3	545	10.1	255
Other	10.6	762	14.1	359
χ^2	77.78, $p < 0.001$		30.24, $p < 0.001$	
Total	12.9	9356	15.03	4374

Total may vary across characteristics due to casing with missing information not shown separately.

95% CI = 2.47–6.59; obese, OR = 10.24, 95% CI = 5.38–19.50) compared with women (overweight, OR = 2.39, 95% CI = 1.15–4.96; obese, OR = 5.33, 95% CI = 2.55–11.12).

With socio-demographic factors included in Model III, the effect was still positive and statistically significant for women, although the magnitude reduced for all the marital status categories. Thus, compared with never-married women, the odds of developing hypertension were about twice as high for married (OR = 1.82, 95% CI = 1.10–3.02), cohabiting (OR = 1.68, 95% CI = 1.00–2.81) and previously married (OR = 1.89, 95% CI = 1.09–3.27) women. In sharp contrast, the association between marital status and hypertension was no longer statistically significant for men, while the direction of effect changed from positive to negative for those in marital unions (married and cohabiting). In the final model (Model III), the effect of BMI on hypertension slightly reduced for men, while for women, the effect found between being overweight and hypertension was no longer significant. Turning to socio-demographic covariates, increasing age had the greatest positive effect on hypertension for both women and men. Women in the richest wealth quintile had higher odds of developing hypertension.

The interacting term (Age_BMI) introduced in the final model was significantly associated with hypertension for both women and men. The results of covariates stratified by marriage cohorts and gender revealed considerable variations in the factors associated with hypertension across gender and marital status (see Table 5). For instance, BMI was

Table 3. Logistic regression results for marital status and hypertension among women in Ghana, 2014 GDHS

	Model I		Model II		Model II	
Characteristic	OR	95% CI	OR	95% CI	OR	95% CI
Marital status						
Never married	1.0		1.0		1.0	
Married	4.86**	[3.80, 6.22]	4.91**	[3.37, 7.15]	1.82*	[1.10, 3.02]
Cohabiting	2.86**	[2.09, 3.90]	3.31**	[2.10, 5.23]	1.68*	[1.00, 2.81]
Previously married	6.76**	[5.07, 9.02]	6.24**	[4.01, 9.68]	1.89*	[1.09, 3.27]
BMI						
Underweight			1.0		1.0	
Normal			1.62	[0.79, 3.32]	1.42	[0.72, 3.02]
Overweight			2.39*	[1.15, 4.96]	1.63	[0.81, 3.60]
Obese			5.33**	[2.55, 11.12]	1.59**	[1.13, 2.26]
Fruit intake						
None			1.0		1.0	
1–3 days			1.03	[0.74, 1.42]	1.07	[0.77, 1.50]
4–7 days			0.85	[0.61, 1.18]	0.85	[0.60, 1.20]
Vegetable intake						
None			1.0		1.0	
1–3 days			0.76	[0.54, 1.08]	0.84	[0.58, 1.20]
4–7 days			0.97	[0.69, 1.35]	1.08	[0.75, 1.53]
Age group (years)						
15–24					1.0	
25–34					1.51*	[1.06, 3.05]
35–44					2.18*	[0.94, 5.02]
45+					3.41**	[2.14, 6.44]
Educational level						
No education					1.0	
Primary					1.24	[0.86, 1.80]
Middle/JSS/JHS					1.14	[0.80, 1.62]
Secondary/higher					0.93	[0.57, 1.50]
Wealth quintile						
Poorest					1.0	
Poorer					1.25	[0.79, 1.96]
Middle					1.60	[0.98, 2.60]
Richer					1.56	[0.90, 2.73]
Richest					2.10*	[1.17, 3.79]
Occupation						
Not working					1.0	
Prof./managerial					1.07	[0.61, 1.90]
Sales/trade					1.18	[0.78, 1.79]
Agriculture					0.94	[0.58, 1.52]
Manual labour					1.00	[0.62, 1.61]
Type of locality						
Urban					1.0	
Rural					0.97	[0.71, 1.34]

Table 3. *Continued*

	Model I		Model II		Model II	
Characteristic	OR	95% CI	OR	95% CI	OR	95% CI
Ethnicity						
Akan					1.0	
Ga/Adangbe					0.91	[0.57, 1.43]
Ewe					1.59	[1.13, 2.26]
Mole-Dagbani					1.27	[0.86, 1.87]
Gurma					0.67	[0.34, 1.35]
Other					0.92	[0.61, 1.39]
Age_BMI					1.00**	[1.0, 1.00]

OR, Odds Ratios; 95% confidence intervals in parentheses; $*p<0.05$, $**p<0.01$.
Model I, marital status; Model II, marital status, BMI, fruit intake and vegetable intake; Model III, marital status, BMI, fruit intake, vegetable intake, age, educational level, wealth quintile, occupation, type of locality and ethnicity.

only significantly associated with hypertension for cohabiting women, while this was the case for fruit intake among never-married men. Similarly, age was significantly associated with hypertension for both never-married women and men, as well as previously married women, whereas educational level was associated with hypertension among married women and cohabiting men.

Discussion

To the best of the authors' knowledge, this is the first study of Africans residing in Africa to have explored the effects of marital status on hypertension, with a focus on gender. The results indicate the presence of an independent material effect of marital status on hypertension for women, and an absence of any such effect for men. Specifically, married and co-habiting women, as well as previously married women, were found to be more at risk of developing hypertension compared with their male counterparts.

Hitherto, a variety of studies, conducted largely outside Africa, have shown that supportive social networks promote longer life expectancy and health (Schoenbach *et al.*, 1986; Welin *et al.*, 1992). Others have revealed a specific protective effect for marriage on health (Brummett *et al.*, 2001; Lett *et al.*, 2005; Kaplan & Kronick, 2006; Manzoli *et al.*, 2007). On gender, the protective effect of marriage with respect to mortality has been found to be more significant in men compared with women (Kaplan & Kronick, 2006; Scafato *et al.*, 2008). In general therefore, evidence has suggested an association between the unmarried states (never married, divorced, widowed or separated women) and hypertension, which might reflect a lack of social support (Wang 2005; Schwandt *et al.*, 2010).

Other investigators (Adeoye *et al.*, 2016) examining the relationship between gender and hypertension in Africa, found gender disparities in the prevalence of hypertension, with more men than women reported to be hypertensive. These authors, however, did not look at the effects of marital status on their findings. The present study is therefore a significant

Table 4. Logistic regression results for marital status and hypertension among men in Ghana, 2014 GDHS

	Model I		Model II		Model III	
Characteristic	OR	95% CI	OR	95% CI	OR	95% CI
Marital status						
Never married	1.0		1.0		1.0	
Married	3.56**	[2.73, 4.63]	2.72**	[2.05, 3.61]	0.862	[0.55, 1.33]
Cohabiting	2.08**	[1.33, 3.25]	1.95**	[1.22, 3.11]	0.855	[0.50, 1.46]
Previously married	4.24**	[2.62, 6.88]	4.15**	[2.47, 6.96]	1.276	[0.68, 2.37]
BMI						
Underweight			1.0		1.0	
Normal			1.38	[0.89, 2.14]	0.98	[0.59, 1.62]
Overweight			4.03**	[2.47, 6.59]	1.42*	[0.71, 2.82]
Obese			10.24**	[5.38, 19.5]	2.87*	[1.04, 7.90]
Fruit intake						
None			1.0		1.0	
1–3 days			1.04	[0.75, 1.45]	0.94	[0.65, 1.34]
4–7 days			1.29	[0.92, 1.80]	1.12	[0.77, 1.61]
Vegetable intake						
None			1.0		1.0	
1–3 days			0.88	[0.59, 1.31]	0.93	[0.61, 1.44]
4–7 days			0.78	[0.53, 1.14]	0.89	[0.58, 1.36]
Age group (years)						
15–24					1.0	
25–34					2.153*	[1.04, 4.41]
35–44					2.22*	[1.29, 3.81]
45+					6.23*	[4.36, 15.0]
Educational level						
No education					1.0	
Primary					1.20	[0.72, 2.00]
Middle/JSS/JHS					1.36	[0.86, 2.16]
Secondary/higher					1.43	[0.85, 2.40]
Wealth quintile						
Poorest					1.0	
Poorer					0.82	[0.53, 1.28]
Middle					0.84	[0.51, 1.37]
Richer					1.26	[0.74, 2.13]
Richest					0.80	[0.45, 1.44]
Occupation						
Not working					1.0	
Prof./managerial					1.28	[0.71, 2.31]
Sales/trade					0.98	[0.52, 1.85]
Agriculture					0.97	[0.52, 1.81]
Manual labour					1.10	[0.62, 1.96]
Type of locality						
Urban					1.0	
Rural					0.75	[0.54, 1.05]

Table 4. *Continued*

	Model I		Model II		Model III	
Characteristic	OR	95% CI	OR	95% CI	OR	95% CI
Ethnicity						
Akan					1.0	
Ga/Adangbe					0.50	[0.31, 0.80]
Ewe					0.91	[0.63, 1.29]
Mole-Dagbani					0.64*	[0.44, 0.95]
Gurma					1.02	[0.57, 1.82]
Other					0.98	[0.63, 1.51]
Age_BMI					1.00**	[1.00, 1.00]

OR, Odds Ratio; 95% confidence intervals in parentheses; $*p < 0.05$, $**p < 0.01$.
Model I, marital status; Model II, marital status, BMI, fruit intake and vegetable intake; Model III, marital status, BMI, fruit intake, vegetable intake, age, educational level, wealth quintile, occupation, type of locality and ethnicity.

departure from the existing literature, helping to fill a gap in the current understanding of gender differences in the relationship between marriage and hypertension in Africa.

While further exploration of the mechanisms by which marital unions shape the risk of hypertension among women is merited, a number of plausible explanations consistent with the social causation hypothesis are surmised, as follows. First, being in a marital union in sub-Saharan Africa confers significant socioeconomic advantages for women, particularly through spousal income support. Such ‘improvements’ in the socioeconomic circumstance of women could increase their affordability and consumption of foods associated with a high Dietary Guidelines Index (Livingston & McNaughton, 2016), thereby increasing their risk of developing hypertension. In Ghana, this could be exacerbated by common cultural and traditional food practices such as the heavy use of salt – an increased intake of which is now clearly associated with hypertension (Graudal *et al.*, 2017) – in cooking and at the table, as well as the consumption of salted fish and meat (Agyemang *et al.*, 2005).

Another plausible explanation in line with the social causation hypothesis relates to stress associated with changes in the roles of women as they enter into marital unions. Ghanaian women are often expected to combine work with the traditional responsibilities of caring for their spouse, children and, in some instances, kin members – a phenomenon described as the ‘double burden’ (Ferree, 2010). This may generate significant physiological stresses for married and cohabiting women exposing them to the risk of hypertension. This is consistent with a number of studies suggesting that familial responsibilities at home and other domestic stresses, rather than job strain at work as is the case for men (Steptoe *et al.*, 1999; Landsbergis *et al.*, 2003; Brown *et al.*, 2003; Riese *et al.*, 2004), contribute to the induction and maintenance of hypertensive states in women (Brisson *et al.*, 1999; Gerin & James, 2010; Ice & James, 2012). The effects of this in Ghana (and possibly the rest of Sub-Saharan Africa), where most wives and co-habiting women carry heavy culturally dictated domestic stress burdens, cannot be overstated.

In line with this, it is interesting that domestic stresses have been shown to have a greater effect on blood pressure in women than in men in ambulatory blood pressure

Table 5. Logistic regression results on factors associated with hypertension by gender and marital status, 2014 GDHS

	Women				Men			
Characteristic	Never married OR	Married OR	Cohabiting OR	Previously married OR	Never married OR	Married OR	Cohabiting OR	Previously married OR
BMI								
Underweight								
Normal	1.80	0.85	1.01	1.06	0.85	0.67	0.81	1.47
Overweight	1.61	0.66	2.13**	0.37	1.09	0.98	1.30	1.14
Obese	4.95	0.63	1.86	0.32	2.31	2.86	—	0.33
Fruit intake								
None								
1–3 days	2.71	0.98	0.64	1.15	0.41*	1.19	1.87	2.63
4–7 days	1.86	0.78	0.56	1.02	0.77	1.36	1.07	2.05
Vegetable intake								
None								
1–3 days	0.90	0.94	0.41	1.26	1.12	0.87	0.95	1.39
4–7 days	1.48	1.36	0.41	1.19	1.05	0.98	1.26	0.31
Age group (years)								
15–24								
25–34	3.82**	0.52	0.75	11.09**	1.13	0.44	0.86	0.30
35–44	0.62	0.73	0.44	23.85**	0.67	0.61	1.74	1.00
45+	9.42	1.20	1.35	43.44**	0.067*	0.64	1.69	2.15
Educational level								
No education								
Primary	1.17	1.58*	1.20	0.59	0.75	1.15	5.64	3.36
Middle/JSS/JHS	1.99	1.44	1.14	0.48	1.19	1.11	6.62	7.25
Secondary/higher	2.34	0.89	0.53	0.56	1.08	0.97	22.9*	7.47

Table 5. *Continued*

Characteristic	Women				Men			
	Never married OR	Married OR	Cohabiting OR	Previously married OR	Never married OR	Married OR	Cohabiting OR	Previously married OR
Wealth quintile								
Poorest								
Poorer	0.85	1.79*	0.37	0.68	0.59	0.93	0.45	0.50
Middle	1.94	1.60	0.36	1.89	0.47	1.07	0.98	0.53
Richer	1.63	2.04*	0.42	1.08	0.67	1.41	1.72	0.94
Richest	2.76	2.03	0.70	2.91	0.25*	1.14	1.28	0.76
Occupation								
Not working								
Prof./managerial	0.60	1.36	0.56	1.01	0.63	0.56	2.23	0.25
Sales/trade	1.21	1.11	1.29	2.04	0.79	0.38	1.62	0.26
Agriculture	0.72	0.70	1.94	2.30	0.96	0.29	0.43	0.17
Manual labour	0.13*	0.66	3.33	4.51*	1.39	0.32	3.04	0.15
Type of locality								
Urban								
Rural	2.29	0.85	0.53	1.06	0.39**	0.88	0.43	2.28
Ethnicity								
Akan								
Ga/Adangbe	1.99	0.94	0.12*	0.95	0.21	0.58	0.60	0.96
Ewe	2.50	1.56	1.33	1.55	1.13	0.95	0.17*	1.50
Mole-Dagbani	1.92	1.42	0.65	0.55	0.32	0.77	0.50	0.52
Gurma	2.24	1.02		0.18	0.88	1.04	2.65	0.19
Other	1.53	0.98	1.81	0.46	0.42	1.16	2.64	1.28
Age_BMI	1.00	1.00**	1.01**	1.00**	1.01**	1.00*	1.00	1.00

OR = Odds Ratios; *$p < 0.05$, **$p < 0.01$.

studies (James *et al.*, 1988), while catecholamine levels (best described as stress hormones) which correlate positively with blood pressure and pulse rate remain high in working married women even after leaving work – suggesting that home stress may continue to affect sympathetic activation at home and taking us closer to a pathophysiological mechanism (James *et al.*, 1988; Frankenhaueser *et al.*, 1989; Luecken *et al.*, 1997).

It has been suggested that although a happy marriage has been said to provide emotional benefits, including the reduction of stress (Law & Sbarra, 2009), many women in unions seldom reap these benefits, especially during periods of marital strain (Umberson *et al.*, 1996; Wickrama *et al.*, 2001). If correct, this could be another explanation for why married and cohabiting women in the current study had a higher probability of being hypertensive. While marriage and its demands can also result in stress in men, the traditionally patriarchal nature of Ghanaian society limits opportunities for stress-relieving leisure activities for women in Ghana and similar sub-Saharan African regions (Henderson, 1996; Adam, 2014). It is still uncommon for women to go out and socialize without their husbands or children in many parts of Ghana. For cohabiting women, who were also more likely to be hypertensive in this study, living with a man without completing traditionally required legal or customary rites could expose them to scorn and stigma within their communities (Okyere-Manu, 2015). This, and the perceived uncertainty surrounding the future of such a relationship, could compound stress levels, which have been linked to hypertension (Sparrenberger *et al.*, 2009; Gasperin *et al.*, 2009). This is indeed a common scenario in Ghana.

The finding that women in disrupted unions (previously married) also had a higher probability of developing hypertension is congruent with previous studies on the negative effects of disrupted marriages on health (Lee *et al.*, 2005; Ikeda *et al.*, 2007), and in particular hypertension (Wang, 2005; Schwandt *et al.*, 2010). With the dissolution of marriage, many women in Ghana lose considerable economic resources as well as social support systems previously enjoyed in marriage. This could lead to health-compromising behaviours such as poorer diet and depression, which have both been linked to hypertension (Lee *et al.*, 2005; Ndanuko *et al.*, 2016). Also, previously married women may have developed hypertension as a result of the stresses associated with a difficult marriage or spousal death, and would have to endure the additional stresses of marital dissolution or the grieving process.

It was also observed in this study that increasing BMI and age, as well as their interactive effect, were significantly associated with hypertension for both men and women. This is consistent with several studies, including work done in Ghana (Landsberg *et al.*, 2013; van den Berg *et al.*, 2013; Williams *et al.*, 2013; Laxmaiah *et al.*, 2015; Jiang *et al.*, 2016). Wealth status was the only socio-demographic factor that uniquely predicted hypertension in women, and more specifically married women. This finding concurs with previous research on the relationship between socioeconomic status and hypertension in low- and middle-income countries (Alam *et al.*, 2015; Laxmaiah *et al.*, 2015). Women with a higher wealth index may have reduced physical activity and increased consumption of High Dietary Guidelines Index foods, which could expose them to the risk of hypertension. The use of energy saving devices (e.g. motorized vehicles, refrigerators, washing machine etc.) and increased inactive leisure time (e.g. watching television, movies, computing etc.) in richer households might also help explain this finding (Lear *et al.*, 2014).

The study has a number of limitations. First, the cross-sectional nature of the study design limits the ability to derive temporal and causal links between hypertension and marital status, as well as the other factors explored in the study. Thus, the study was limited to the identification of associations. Second, the study could not directly test the effects of other potentially influencing factors of hypertension such as stress levels, smoking, alcohol consumption and physical activity due to lack of data. Finally, the blood pressure measurements in the GDHS survey used in the study were obtained by the traditional non-ambulatory blood pressure measurement method. It is now well established that blood pressure varies diurnally and with activities of daily living and social and environmental stressors. Ambulatory blood pressure measurement is the gold standard in clinical practice and preferred to non-ambulatory blood pressure measurements, even if repeated and averaged (as was done in the GDHS survey). The blood pressure values analysed therefore need to be interpreted with some degree of caution. Nonetheless, the findings of the present study are largely generalizable given that the study used a nationally representative dataset from an internationally recognized survey (GDHS).

In conclusion, the present study has demonstrated that marital status is an important independent predictor of hypertension in Ghana for women, rather than men. This observation persisted for married, cohabiting and previously married women, after controlling for lifestyle and socio-demographic factors. Importantly, other correlates of hypertension depended on one's marital status or gender. This finding, a first in Ghana, could have immediate and far reaching consequences for the management of cardiovascular health in Ghana. In particular, it could lead to more informed and better targeted public health interventions as well as improved risk factor assessment and education in clinical settings for more effective patient management and better clinical outcomes.

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Ethical Approval. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Ethical clearance for the survey was obtained from the Ghana Health Service Ethical Review Committee in Accra, Ghana.

Conflicts of Interest. The authors have no conflicts of interest to declare.

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