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Impact of the 2017 American College of Cardiology/American Heart Association Guidelines on Prevalence of Hypertension in Ghana

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Abstract. We investigated the prevalence of hypertension in Ghana using the 2017 American College of Cardiology/American Heart Association (ACC/AHA) criteria and compared with prevalence estimates using the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) criteria. Among 13,220 Ghanaians aged 15–49 years, the prevalence of hypertension was 30.4% (95% CI: 29.3–31.6) based on the 2017 ACC/AHA guideline compared with 12.8% (95% CI: 12.0–13.6) when using the JNC7 guideline. The overall increase in prevalence was 17.6% (95% CI: 16.8–18.6). The increment in prevalence was 19.0% (95% CI: 17.5–20.7) among men and 17.7% (95% CI: 16.1–18.2) among women. People aged 40–49 years had the highest prevalence (51.1%; 95% CI: 49.0–53.3). We used multiple logistic regressions to obtain odds ratios. Urban dwelling, tertiary education, or being in higher wealth status was significantly associated with the odds of hypertension. The 2017 ACC/AHA guideline resulted in a significant increase in the prevalence of hypertension in Ghana. Scaling up of existing prevention and control strategies for hypertension such as health education through already established community health implementation and planning programs as well as improved screening and diagnostic protocols for hypertension should be prioritized.

INTRODUCTION

Hypertension accounts for about one-third of the global burden of disease according to 2015 estimates.[1] The prevalence of hypertension is estimated to be 30% in sub-Saharan Africa (SSA),[2] yet it is largely undiagnosed and untreated, increasing risk of complications such as kidney disease, stroke, and cardiovascular disease (CVD).[3] The current estimates of hypertension prevalence in SSA were based on using the cutoffs from the 1999 WHO–International Society of Hypertension (WHO-ISH) Guideline[4] or the Seventh Report of Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7),[5] where hypertension was defined as systolic/diastolic blood pressure (SBP/DBP) of ≥ 140/90 mmHg. The new 2017 American College of Cardiology/American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation, and Management of High BP in Adults[6] recently updated the criteria for defining hypertension. Evidence for the new classification was based on studies showing that the targeted SBP of < 130 mmHg reduces total mortality, and fatal and nonfatal cardiovascular events compared with an SBP of < 140 mmHg.[6] The new guideline defines hypertension as an SBP of ≥ 130 mmHg and/or a DBP of ≥ 80 mmHg, and recommends a treatment goal of SBP and DBP to < 130 mmHg and < 80 mmHg, respectively, for all adults taking antihypertensive medication.[6] Based on this new definition and recommendation, individuals previously classified as prehypertensive in the JNC7 guideline are now considered to have elevated BP (i.e., SBP 120–129 with the DBP < 80 mmHg) or stage 1 hypertension (i.e., SBP/DBP of 130–139/80–89 mmHg). For this group of people, lifestyle modification to control BP is recommended to slow down disease progression and complications if they have no history of CVD or low 10-year predicted risk for CVD.[7] The treatment goal for individuals with diabetes or chronic kidney disease has not changed.[6]

The new ACC/AHA guideline is likely to increase estimates of the prevalence of hypertension all over the world.[6–8] However, the prevalence estimates have not been obtained using this guideline in many countries, including Ghana. The objective of this study was to estimate the prevalence and determinants of hypertension in Ghana, a country in SSA, using the new ACC/AHA guideline and to calculate the change in the prevalence from the old guideline using data from the 2014 Ghana Demographics and Health Survey (GDHS).[7,9]

METHODS

Data source. The GDHS[9] is a nationally representative survey that was conducted between January and March 2014. It covered all rural, urban, and noninstitutionalized individuals residing within all 10 administrative regions of Ghana. The GDHS focused on child and maternal health as well as other health issues and provides relevant data for monitoring population health. The 2014 GDHS included measurements of BP and biomarkers for women aged 15–49 years and men aged 15–59 years. The Ghana Statistical Service, the Ghana Health Service (GHS), and the National Public Health Reference Laboratory of the GHS implemented the survey. The Inner City Fund (ICF) International provided technical assistance for the 2014 GDHS.[9]

Study population and survey design. The sampling frame used for the 2014 GDHS was derived from the 2010 Ghana Population and Housing Census.[10] The sampling frame followed a two-stage stratified sample design that involves clusters consisting of enumeration areas. In all, 427 clusters were selected: 216 and 211 in urban (localities with 5,000 or more people) and rural (localities with less than 5,000 people),[10] respectively. In the second stage, a systematic sampling of households listed in each cluster yielded a nationally representative sample of 9,396 women and 4,388 men between the ages 15–49 years and 15–59 years, respectively. The overall response rate for eligible women and men was 97% and 95%, respectively.[9]

Ethical approval. The Institutional Review Board of the University of Maryland, Baltimore, determined that this study met the criteria for nonhuman subject research because of the use of publicly available and de-identified data.

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Blood pressure measurement. Blood pressure was measured using a digital oscillometric BP measuring device. Measurements were taken three times at intervals of ≥ 10 minutes, and the average of the second and third measurements was used to report the final BP levels.[4,9]

Definition of hypertension. As per the JNC7 guideline, hypertension was defined as the SBP ≥ 140 mmHg or the DBP ≥ 90 mmHg or the use of antihypertensive medication. Based on the 2017 ACC/AHA guideline, hypertension was defined as the SBP ≥ 130 mmHg or the DBP ≥ 80 mmHg or current use of antihypertensive medication.[6] Both the JNC7[5] and the new 2017 ACC/AHA[6] guideline labeled individuals as having isolated systolic or diastolic hypertension if their SBP is greater than the threshold level with a normal DBP or a DBP greater than the threshold level with a normal SBP, respectively. Supplemental Table 1 shows the definition, categorization, and the method of measurement of all study variables used for estimating the prevalence of hypertension.

Statistical analyses. We limited our analysis to individuals aged 15–49 years to have a uniform age stratum for both men and women and used sampling weights to create nationally representative estimates. The study participants were described according to their background characteristics. We assessed the normality of continuous variables using standard methods and reported variables with skewed distribution as median and interquartile ranges (IQRs) as opposed to mean and SD. We categorized SBP and DBP according to both guidelines and estimated the proportion of the study population falling into each category overall and by gender. The proportion of participants taking BP-lowering drugs was also reported. We estimated the prevalence of isolated systolic, isolated diastolic, stage 1, and stage 2 hypertension along with the participants who were already taking prescribed antihypertensive drugs and had controlled BP according to the JNC7 and the 2017 ACC/AHA guidelines. The differences between the prevalence estimates of both guidelines were also obtained. The prevalence of hypertension and differences in estimates of prevalence of hypertension using JNC7 and 2017 ACC/AHA criteria[5,6] were calculated and presented according to demographic characteristics. Next, we evaluated characteristics independently associated with hypertension based on the 2017 ACC/AHA guideline using logistic regression analyses and reported odds ratios (ORs) and 95% CIs. All analyses were conducted in Stata statistical software version 14.0 (Stata Corp, College Station, TX).[11]

RESULTS

Table 1 describes study participants. Among 13,220 included respondents, the median age was 29 years (IQR: 21–38) and the majority of them were women (70.8%). The participants in the sample were predominantly Christian (78.1%), and 16.2% of respondents had no formal education, and only 1.8% used tobacco. The median age of the hypertensive participants was 38 years (IQR: 21–44) and 35 years (IQR: 27–52) based on JNC7 and 2017 ACC/AHA guidelines, respectively. Among hypertensive people, based on the JNC7 guideline, the median SBP and DBP were 137.0 mmHg (IQR: 125.0–148.5) and 92 mmHg (IQR: 86–98), respectively, whereas based on the 2017 ACC/AHA guideline, the median SBP and DBP were 125.0 mmHg (IQR: 116.5–135) and 85.0 mmHg (IQR: 81.5–90.5), respectively. More than half of the respondents were from urban regions (53.5%). Supplemental Table 2 shows the background characteristics of the respondents before application of weighting; these were similar to the characteristics of the weighted respondents.

According to the JNC7 guideline, 12.8% (95%CI: 12.0–13.6) of the people had hypertension, whereas the 2017 ACC/AHA guideline classified 30.4% (95% CI: 29.3–31.6) of the people as hypertensive (Table 2). The prevalence of hypertension according to the 2017 ACC/AHA guideline was 17.7% (95% CI: 16.8–18.6) higher than the prevalence of hypertension based on the JNC7 criteria. The estimated prevalence changed from 12.5% (95% CI: 11.1–14.1) to 31.5% (95% CI: 29.6, 33.6) among men and from 12.9% (95% CI: 11.9–13.9) to 30.0% (95% CI: 28.8–31.2) among women. Men and women had similar absolute changes in crude prevalence, 19.0% (95% CI: 17.5–20.7) and 17.1% (95% CI: 16.1–18.2), respectively.

Based on the 2017 ACC/AHA guideline, the prevalence of hypertension among men aged 40–49 years was 47.1% (95% CI: 43.1–51.2); the prevalence was 52.9% (95%CI: 50.3–55.5) among women in the same age category (Table 3). Regardless of the criteria, the prevalence of hypertension increased substantially.

Table 4 shows crude ORs and adjusted ORs (AORs) of factors associated with hypertension according to the 2017 ACC/AHA guideline. The fully adjusted model included age, gender, education, household wealth status, place of residence, and region. Participants aged 40–49 years (AOR: 5.0; 95% CI: 4.5–5.6) and 30–39 years (AOR: 2.6; 95% CI: 2.4–2.9) had higher odds of hypertension than those aged 15–29 years. Having a tertiary level of education compared with no formal education was associated with a 40% increase in the odds of hypertension (AOR: 1.4, 95% CI: 1.1–1.7). Compared with those in the poorest wealth quintile, being in the middle (AOR: 1.4, 95% CI: 1.1–1.6), richer (AOR: 1.5, 95% CI: 1.2–2.9), and the richest (AOR: 1.5, 95% CI: 1.2–1.9) wealth quintiles was associated with the increased odds of having hypertension. Compared with urban dwellers, participants living in rural areas were less likely to have hypertension (AOR: 0.8, 95% CI: 0.7–0.9). Participants living in the Northern (AOR: 0.7, 95% CI: 0.5–0.9) and Upper East (AOR: 0.7, 95% CI: 0.5–0.9) regions were less likely to have hypertension than those living in the Western region.

To determine whether the effect of wealth quintile and education level on the odds of having hypertension is modified by the place of residence, we evaluated the interaction between wealth quintiles and education level on the place of residence and found no evidence of interaction, suggesting that place of residence does not modify the effect of wealth or educational level on the odds of hyperattention (Supplemental Table 3).

DISCUSSION

This study highlights the impact of the revised definition of hypertension on the changes in the prevalence of hypertension in Ghana. The prevalence of hypertension among adults in Ghana between the ages of 15–49 years more than doubled comparedwith the previous estimate using the JNC7[5] or WHO-ISH[4] guidelines. The prevalence of hypertension is often higher among older adults (e.g., ≥ 50 years)[12,13]; hence, the observed increase in prevalence among a relatively younger age-group (i.e., 15–49 years) suggests that the prevalence may also be high among older adults in Ghana.

TABLE 1
Characteristics of weighted survey participants, n = 13,220

Characteristic	Overall (N = 13,220)	Hypertensive patients	
		Joint National Committee 7 (n = 1,690)	2017 American College of Cardiology/ American Heart Association (n = 4,025)
Systolic blood pressure (mmHg), median (IQR)	110.0 (102.5–119.5)	137.0 (125.0–148.5)	125.0 (116.5–135.0)
Diastolic blood pressure (mmHg), median (IQR)	72.5 (66.0–80.0)	92 (86–98)	85.0 (81.5–90.5)
Take drugs to lower blood pressure			
No	12,609 (95.4)	1,079 (63.9)	3,414 (84.8)
Yes	611 (4.6)	611 (36.1)	611 (15.2)
Age (years)			
Median (IQR)	29 (21–38)	38 (21–44)	35 (27–52)
15–29	6,859 (51.9)	345 (20.4)	1,272 (31.6)
30–39	3,679 (27.8)	583 (34.5)	1,381 (34.3)
40–49	2,682 (20.3)	762 (45.1)	1,372 (34.1)
Gender			
Male	3,856 (29.2)	483 (28.6)	1,216 (30.2)
Female	9,364 (70.8)	1,207 (71.4)	2,809 (69.8)
Uses tobacco			
No	12,983 (98.2)	1,657 (98.0)	3,946 (98.0)
Yes	237 (1.8)	33 (2.0)	79 (2.0)
Religion			
Christianity	10,328 (78.1)	1,369 (81.0)	3,198 (79.4)
Islam	2,099 (15.9)	232 (13.7)	586 (14.6)
Other	792 (6.0)	89 (5.3)	241 (6.0)
Education			
No formal education	2,146 (16.2)	259 (15.3)	611 (15.2)
Primary	2,209 (16.7)	261 (15.5)	636 (15.8)
Secondary	7,827 (59.2)	995 (58.9)	2,384 (59.2)
Tertiary	1,038 (7.9)	175 (10.3)	394 (9.8)
Household wealth status			
Poorest	2,145 (16.2)	148 (8.7)	424 (10.5)
Poorer	2,282 (17.3)	210 (12.4)	593 (14.7)
Middle	2,696 (20.4)	328 (19.4)	809 (20.1)
Richer	2,953 (22.3)	442 (26.2)	1,004 (24.9)
Richest	3,144 (23.8)	562 (33.3)	1,195 (29.7)
Place of residence			
Urban	7,072 (53.5)	1,119 (66.2)	2,485 (61.8)
Rural	6,148 (46.5)	571 (33.8)	1,540 (38.2)
Region			
Western	1,482 (11.2)	163 (9.7)	455 (11.3)
Central	1,313 (9.9)	156 (9.2)	375 (9.3)
Greater Accra	2,722 (20.6)	426 (25.2)	1,042 (25.9)
Volta	1,013 (7.7)	154 (9.1)	302 (7.5)
Eastern	1,233 (9.3)	140 (8.3)	347 (8.6)
Ashanti	2,463 (18.6)	395 (23.4)	817 (20.3)
Brong Ahafo	1,085 (8.2)	120 (7.1)	318 (7.9)
Northern	1,101 (8.3)	81 (4.8)	210 (5.2)
Upper East	503 (3.8)	37 (2.2)	95 (2.4)
Upper West	305 (2.3)	18 (1.1)	64 (1.6)

IQR = interquartile range. Numbers are presented with n (%) unless otherwise specified.

Our results are similar to those reported by Muntner and others who analyzed data from the National Health and Nutrition Examination Survey 2011–2014, and found the crude prevalence of hypertension among adults aged ≥ 20 years as 31.9% and 45.6%, based on the JNC7 and the 2017 ACC/AHA criteria, respectively.[7] Following application of the new guideline, similar changes in prevalence were observed in Sweden, China, and other coutries.[14–19]

Accumulating evidence suggests that lifestyle modification[20,21] and pharmacologic treatment[22] of prehypertension[5] demonstrate positive benefit in lowering BP and reduction in the risk for CVD, CVD complications, and mortality.[23,24] However, despite the significant increase in the prevalence of hypertension based on the new guideline, the 2017 ACC/AHA only recommends initiating pharmacotherapy in those with stage 1 hypertension (≥ 130/80) who have a history of clinical CVD or ≥ 10% 10-year atherosclerotic CVD (ASCVD) risk and those with stage 2 hypertension (≥ 140/90).[6] Estimation of participants who will require pharmacotherapy was outside the purview of this study, as our data had no relevant information by which to compute ASCVD risk.[24] Nonetheless, we expect that the proportion of those requiring antihypertensive therapy will increase.

The high prevalence of hypertension observed among people living in urban areas, among those with tertiary-level educations, and among wealthy households is corroborated by studies conducted in Bangladesh.[25,26] This is because recent and unprecedented rapid urbanization in Ghana and the attainment of middle-income status, with its attendant adoption of sedentary lifestyle, are risk factors for hypertension.[27] The association between higher wealth status and hypertension may be partly explained by the fact that people in higher wealth status are more likely to patronize

TABLE 2
Comparison of hypertension prevalence among males and females by stages, categories, and guidelines (95% CI)

	Categories	JNC7	2017 ACC/AHA	Difference
Male	Normal blood pressure	55.5 (53.5, 57.5)	55.5 (53.5, 57.5)	–
	Isolated systolic hypertension	2.5 (1.9, 3.2)	3.4 (2.7, 4.2)	0.9 (–3.5, 5.3)
	Isolated diastolic hypertension	3.6 (2.8, 4.5)	14.7 (13.4, 16.1)	11.1 (6.7, 15.4)
	Both systolic and diastolic hypertension	4.7 (3.9, 5.6)	12.4 (11.1, 14.0)	7.8 (3.5, 12.0)
	Controlled patients on medication	1.8 (1.2, 2.6)	1.0 (0.6, 1.7)	–0.8 (–5.2, 3.6)
	Prehypertension*/elevated blood pressure*	32.0 (30.1, 33.9)	13.0 (11.6, 14.5)	19.0 (17.5, 20.7)
	Stage 1 hypertension	9.4 (8.2, 10.8)	20.8 (19.3, 22.5)	19.0 (17.5, 20.7)
	Stage 2 hypertension	3.1 (2.4, 3.9)	10.7 (9.5, 12.0)	7.6 (6.7, 8.7)
	Crude (stage 1 plus stage 2) hypertension	12.5 (11.1, 14.1)	31.5 (29.6, 33.6)	19.0 (17.5, 20.7)
Female	Normal blood pressure	66.9 (65.5, 68.2)	66.9 (65.5, 68.2)	–
	Isolated systolic hypertension	1.1 (0.8, 1.4)	0.7 (0.5, 0.9)	–0.4 (–3.2, 2.5)
	Isolated diastolic hypertension	4.4 (4.0, 5.0)	18.8 (17.8, 20.0)	14.4 (11.7, 17.1)
	Both systolic and diastolic hypertension	4.4 (3.8, 5.0)	8.8 (8.0, 9.7)	4.4 (1.7, 7.2)
	Controlled patients on medication	3.0 (2.6, 3.4)	1.6 (1.3, 2.0)	–1.4 (–4.2, 1.5)
	Prehypertension*/elevated blood pressure*	20.2 (19.1, 21.4)	3.1 (2.7, 3.6)	17.1 (16.1, 18.2)
	Stage 1 hypertension	9.5 (8.7, 10.3)	20.1 (19.1, 21.2)	17.1 (16.1, 18.2)
	Stage 2 hypertension	3.4 (2.9, 3.9)	9.9 (9.1, 10.8)	6.5 (5.9, 7.1)
	Crude (stage 1 plus stage 2) hypertension	12.9 (11.9, 13.9)	30.0 (28.8, 31.2)	17.1 (16.1, 18.2)
Overall	Normal blood pressure	63.6 (62.3, 64.7)	63.6 (62.3, 64.7)	–
	Isolated systolic hypertension	1.5 (1.2, 1.8)	1.5 (1.2, 1.7)	0.0 (–2.4, 2.4)
	Isolated diastolic hypertension	4.2 (3.8, 4.6)	17.6 (16.8, 18.5)	13.4 (11.2, 15.7)
	Both systolic and diastolic hypertension	4.5 (4.0, 5.0)	9.9 (9.1, 10.7)	5.4 (3.1, 7.7)
	Controlled patients on medication	2.6 (2.3, 3.0)	1.5 (1.2, 1.8)	–1.1 (–3.5, 1.2)
	Prehypertension*/elevated blood pressure*	23.7 (22.7, 24.7)	6.0 (5.5, 6.6)	17.7 (16.8, 18.6)
	Stage 1 hypertension	9.5 (8.9, 10.1)	20.3 (19.4, 21.3)	17.7 (16.8, 18.6)
	Stage 2 hypertension	3.3 (2.9, 3.8)	10.1 (9.4, 10.9)	6.8 (6.3, 7.4)
	Crude (stage 1 plus stage 2) hypertension	12.8 (12.0, 13.6)	30.4 (29.3, 31.6)	17.7 (16.8, 18.6)

ACC/AHA = American College of Cardiology/American Heart Association; JNC = Joint National Committee.
* Prehypertension and elevated blood pressure according to the JNC7 and 2017 ACC/AHA guidelines, respectively.

restaurants, and most restaurants often serve food high in calories and salt.[28] High salt consumption is also linked to hypertension,[29] and high-caloric foods are associated with overweight/obesity, which is an independent risk factor for hypertension.[30]

Tertiary-level education was associated with higher prevalence and the odds of hypertension. Individuals with tertiary education are more likely to be in the richest wealth quintile and may adopt unhealthy eating habits associated with their affluent status. Conversely, there was protective effect of rural habitation, living in the Northern, Upper East, or Upper West regions, on the odds of hypertension.[9] The main occupation of rural dwellers in Ghana and people from Northern, Upper East, and Upper West regions is mostly non-mechanized agriculture.[9] This type of farming activity involves manual and intense physical activity that is likely to lead to physical fitness and lower body mass index, thus decreasing the risk for hypertension.

Our findings have significant policy, public health and clinical practice implications. Although implementation of the new guideline will pose a burden on the already deteriorated and under-resourced health systems of many emerging economies including Ghana,[31] its adoption will help prevent and reduce complication of hypertension because the SBP target of < 130 mmHg reduces total mortality and composite cardiovascular events compared with the SBP of < 140 mmHg.[6,23] There is already a low level of awareness of hypertension in Ghana even under the current threshold for the definition of hypertension (BP > 140/90 mmHg).[32] Moreover, those aware of their hypertensive status may be unaware of the importance of managing their hypertension to prevent complications. In this study, only 37% of individuals (i.e., aged 15–49 years) based on the JNC7 definition[5] of hypertension were taking antihypertensives. Lack of access to antihypertensive medications, medication noncompliance, and lack of access to health care may also explain the low rate of therapy among hypertensive individuals observed in our study. The key to success may lie in expanding existing prevention and control strategies; educating healthcare practitioners, policy-makers, and other stake holders about the new guideline and the paradigm shift in the classification of hypertension; and its impact on diagnosis of hypertension in particular, and healthcare resource needs in general.

Other measures such as updating current national treatment guidelines to reflect the 2017 ACC/AHA recommendations are also suggested. Furthermore, healthcare provider education on current treatment protocols and best practices is recommended. Further research is needed to compute clinical CVD or ASCVD risk scores unique to the Ghanaian population. This could help identify which group of people with stage 1 hypertension based on the 2017 ACC/AHA guideline may benefit from early initiation of intensive pharmacotherapy when appropriate, to mitigate the complications of untreated or undertreated hypertension. Additional research to determine the prevalence of hypertension among older individuals is warranted.

Strengths and limitations. To our knowledge, this study is the first to apply the new 2017 ACC/AHA guideline to estimate the prevalence of hypertension in Ghana. The DHS is an internationally recognized program that uses validated methods

TABLE 3
Prevalence (95% CI) of hypertension according to JNC7 and 2017 ACC/AHA guidelines and difference between the two by demographic characteristics

	JNC 7	2017 ACC/AHA	Difference
Age (years)			
15–29	5.0 (4.4, 5.7)	18.5 (17.3, 19.9)	13.5 (12.4, 14.8)
30–39	15.9 (14.4, 17.4)	37.5 (35.5, 39.6)	21.6 (20.3, 23.2)
40–49	28.4 (26.3, 30.6)	51.1 (49.0, 53.3)	22.7 (20.9, 24.7)
Overall	12.8% (12.0,13.6)	30.4% (29.3, 31.6)	17.7% (16.8,18.6)
Male (years)			
15–29	6.2% (5.0, 7.8)	20.8% (18.5, 23.2)	14.5% (12.7, 16.6)
30–39	17.1% (14.1, 20.4)	40.6% (36.8, 44.6)	23.6% (20.5, 26.9)
40–49	22.6% (19.3, 26.2)	47.1% (43.1, 51.2)	24.6% (21.4, 28.0)
Overall	12.5% (11.1, 14.1)	31.5% (29.6, 33.6)	19.0% (17.5, 20.7)
Female (years)			
15–29	4.5% (3.8, 5.4)	17.6% (16.2, 19.1)	13.1% (11.8, 14.6)
30–39	15.4% (13.7, 17.3)	36.4% (34.1,38.6)	21.0% (19.2, 22.8)
40–49	30.9% (28.4, 33.6)	52.9% (50.3, 55.5)	21.9% (19.7, 24.3)
Overall	12.9% (11.9, 13.9)	30.0% (28.8, 31.2)	17.1% (16.1, 18.2)
Uses tobacco			
No	12.8 (12.0, 13.6)	30.4 (29.2, 31.6)	17.6 (16.7, 18.6)
Yes	14.0 (9.0, 21.1)	33.5 (26.4, 41.5)	19.5 (14.1, 26.3)
Religion			
Christianity	13.3 (12.4, 14.2)	31.0 (29.7, 32.3)	17.7 (16.7, 18.7)
Islam	11.0 (9.3, 13.0)	27.9 (24.5, 31.7)	16.9 (14.2, 20.0)
Other	11.3 (8.6, 14.7)	30.4 (26.2, 35.1)	19.1 (15.9, 22.8)
Education			
No formal education	12.1 (10.6, 13.8)	28.5 (26.1, 30.9)	16.4 (14.3, 18.7)
Primary	11.8 (10.2, 13.6)	28.8 (26.5, 31.2)	17.0 (15.1, 19.0)
Secondary	12.7 (11.7, 13.8)	30.5 (28.9, 32.0)	17.8 (16.6, 19.0)
Tertiary	16.8 (13.8, 20.3)	37.9 (34.1, 41.8)	21.1 (18.1, 24.4)
Household wealth status			
Poorest	6.9 (5.7, 8.2)	19.8 (17.7, 22.0)	12.9 (11.2, 14.8)
Poorer	9.2 (8.1, 10.4)	26.0 (23.6, 28.6)	16.8 (14.7, 19.1)
Middle	12.2 (10.5, 14.0)	30.0 (27.8, 32.3)	17.8 (16.2, 19.6)
Richer	15.0 (13.3, 16.8)	34.0 (31.7, 36.3)	19.0 (17.2, 21.0)
Richest	17.9 (16.0, 19.9)	38.0 (35.3, 40.9)	20.1 (18.2, 22.3)
Place of residence			
Urban	15.8 (14.7, 17.1)	35.1 (33.5, 36.8)	19.3 (18.1, 20.6)
Rural	9.3 (8.5, 10.2)	25.0 (23.6, 26.6)	15.7 (14.4, 17.2)
Region			
Western	11.0 (9.5, 12.8)	30.7 (27.8, 33.7)	19.7 (17.1, 22.5)
Central	11.9 (9.5, 14.7)	28.5 (25.7, 31.5)	16.6 (14.6, 18.9)
Greater Accra	15.7 (13.8, 17.7)	38.3 (35.1, 41.6)	22.6 (20.4, 25.1)
Volta	15.2 (12.9, 17.8)	29.8 (26.5, 33.4)	14.6 (12.4, 17.1)
Eastern	11.3 (9.4, 13.6)	28.2 (25.5, 31.1)	16.9 (15.0, 18.9)
Ashanti	16.0 (13.8, 18.5)	33.2 (30.7, 35.8)	17.2 (14.9, 19.6)
Brong Ahafo	11.1 (9.4, 12.9)	29.3 (26.5, 32.3)	18.2 (16.3, 20.4)
Northern	7.4 (5.5, 9.8)	19.1 (15.9, 22.8)	11.7 (8.8, 15.5)
Upper East	7.4 (5.5, 10.0)	18.8 (15.7, 22.4)	11.4 (9.4, 13.7)
Upper West	6.0 (4.4, 8.2)	21.1 (18.3, 24.3)	15.1 (12.5, 18.0)

ACC/AHA = American College of Cardiology/American Heart Association; JNC = Joint National Committee.

to collect survey data across many countries globally. Furthermore, the GDHS 2014[9] is the first since its inception, to incorporate BP measurements among the noninstitutionalized population in Ghana, thereby permitting reliable estimation of hypertension in Ghana as per the new guideline. The very high response rate (99%) of the GDHS 2014 and the nationally representative nature of the sample, from which estimates of hypertension were made, ensured that our results are generalizable to the Ghanaian population. Survey participants in this study were relatively young; hence, estimates of prevalence of hypertension in people aged ≥ 50 years were not possible. However, given that this older group (i.e., ≥ 50 years) is known to have a higher prevalence of hypertension based on the JNC7 and WHO-ISH criteria,[12,13,33] we anticipate that prevalence in this cohort will even be higher. Because of the cross-sectional nature of the data, the observed association may not be causal. We were not able to estimate the prevalence and association as per many factors, including overweight/obesity, dietary habits, and other factors. Blood pressure of participants was also measured on a single day instead of multiple measurements over a period.

CONCLUSION

Our study found a substantial increase in the prevalence of hypertension among Ghanaians aged 15–49 years using the new 2017 ACC/AHA definition of hypertension. The increased prevalence of hypertension highlights the need for the initiation and expansion of public health intervention strategies to increase awareness, diagnosis, and treatment to prevent complications of hypertension.

TABLE 4

Results of simple and multiple logistic regression analyses investigating association of hypertension with selected background characteristics based on the 2017 ACC/AHA guideline

Trait	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Age (years)		
15–29	Ref.	Ref.
30–39	2.6*** (2.4, 2.9)	2.6*** (2.4, 2.9)
40–49	4.6*** (4.1, 5.2)	5.0*** (4.5, 5.6)
Gender		
Male	Ref.	Ref.
Female	0.9 (0.8, 1.0)	0.9 (0.9, 1.1)
Uses tobacco		
No	Ref.	
Yes	1.2 (0.8, 1.6)	
Religion		
Christianity	Ref.	
Islam	0.9 (0.7, 1.0)	
Other	1.0 (0.8, 1.2)	
Education		
No formal education	Ref.	Ref.
Primary	1.0 (0.9, 1.2)	1.1 (0.9, 1.3)
Secondary	1.1 (1.0, 1.3)	1.1 (1.0, 1.3)
Tertiary	1.5*** (1.3, 1.9)	1.4** (1.1, 1.7)
Household wealth status		
Poorest	Ref.	Ref.
Poorer	1.4*** (1.2, 1.7)	1.1 (0.9, 1.4)
Middle	1.7*** (1.5, 2.0)	1.4*** (1.1, 1.6)
Richer	2.1*** (1.8, 2.5)	1.5*** (1.2, 1.9)
Richest	2.5*** (2.1, 3.0)	1.5*** (1.2, 1.9)
Place of residence		
Urban	Ref.	Ref.
Rural	0.6*** (0.6, 0.7)	0.8** (0.7, 0.9)
Region		
Western	Ref.	Ref.
Central	0.9 (0.7, 1.1)	0.8 (0.7, 1.0)
Greater Accra	1.4*** (1.2, 1.7)	1.1 (0.9, 1.4)
Volta	1 (0.8, 1.2)	1 (0.8, 1.2)
Eastern	0.9 (0.7, 1.1)	0.8 (0.7, 1.0)
Ashanti	1.1 (0.9, 1.3)	1.0 (0.8, 1.2)
Brong Ahafo	0.9 (0.8, 1.1)	1.0 (0.8, 1.2)
Northern	0.5*** (0.4, 0.7)	0.7** (0.5, 0.9)
Upper East	0.5*** (0.4, 0.7)	0.7* (0.5, 0.9)
Upper West	0.6*** (0.5, 0.8)	0.8 (0.6, 1.0)

ACC/AHA = American College of Cardiology/American Heart Association.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

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