Estimated Change in Prevalence of Hypertension in Bangladesh According to Following JNC 7 and ACC/AHA 2017: Secondary Analysis From Nationally Representative Data

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Abstract

Most studies followed either Joint National Committee 7 (JNC 7) or World Health Organization-International Society of Hypertension (WHO-ISH) guidelines to ascertain the prevalence of hypertension among Bangladeshi adults. The American College of Cardiology/American Heart Association (ACC/AHA) revised the definition of hypertension in 2017, which has significant public health importance. Identifying the change in the new guideline has resulted in the prevalence and associated factors of hypertension compared to that of the JNC7 guideline in Bangladesh. This study used data from the most recent round (2017-18) of the Bangladesh Demographic and Health Survey (BDHS). According to the 2017 ACC/AHA guideline, the participants were categorized as hypertensive if they had BP measurements greater than or equal to 130/80 mm Hg, which was greater than or equal to 140/90 mm Hg according to the JNC 7 guideline. A total of 11 959 weighted participants were included in the analysis. The median (IQR) age of the respondents was 34.0 (18.0-95.0) years. The prevalence of hypertension was 24.0% according to the JNC 7 guideline, which was 50.5% according to the 2017 ACC/AHA guideline. Participants who were overweight and obese, aged, member of affluent households, urban residents, and Rangpur division inhabitants had significantly higher odds of being hypertensive according to both guidelines. The new guideline suggests that half of the adult population in Bangladesh is hypertensive when measured according to the new guideline, urging the policymakers and public health practitioners to take immediate action to address the already established modifiable risk factors.

Background

Globally, cardiovascular diseases (CVDs) are considered the leading causes of deaths or disability-adjusted life years where hypertension plays a pivotal role in CVDs[1–3]. In 2016, around 17.9 million people died from CVDs, representing 31% of total global deaths, of which 9.4 million deaths were attributed to hypertension[4,5]. Worldwide, approximately 1.13 billion people have hypertension, and two-thirds of them live in low- and middle-income countries (LIMCs), including Bangladesh[4].

Due to the recent epidemiologic and demographic transitions, Bangladesh has documented a significant lifestyle and behavioural changes among their population with an increased prevalence of hypertension. According to Bangladesh Demographic and Health Survey (BDHS 2011) and the Non-Communicable Disease (NCD) Risk Factor Survey (2010), the prevalence of hypertension was 25.7% and 17.9%, respectively, among the adult population in Bangladesh[6,7]. Henceforth, hypertension remains the foremost disease burden among the major NCD-in Bangladesh like other South Asian countries such as India, Nepal, Bhutan, and SriLanka[8].

The blood pressure (BP) threshold to classify prehypertension and hypertension varies according to different guidelines. Previously, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) described hypertension as systolic blood pressure (SBP) of greater than or equal to 140 mmHg and/or diastolic blood pressure (DBP) of greater than or equal to 90 mmHg [9]. The 2017 American College of Cardiology/American Heart

Association (ACC/AHA) Guideline for Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults reduced BP threshold for hypertension. According to 2017 ACC/AHA guideline, hypertensive individuals have systolic blood pressure (SBP) greater than or equal to 130 mmHg and/or diastolic blood pressure (DBP) greater than or equal to 80 mmHg[10]. c.

Due to these changes in the 'cut-off' values, a significant number of people are reclassified as hypertensive, who were previously considered as pre-hypertensive[6,11–13]. For example, the prevalence of hypertension among adult Nepalese population was almost doubled using the ACC/AHA guidelines compared to the JNC 7 guidelines[11].

Muntner et al. reported a 14.7% increase in hypertension prevalence in the United States (USA) among the adult population aged more than 19 years[14]. Another study also found a 45.1% and 26.8% increase in the prevalence of hypertension among adults aged between 45 and 75 years in the USA and China, respectively, with new guideline[15]. Several studies recognized the importance of this revised classification for public health resource planning and prevention strategies[14–16]. Despite the increased burden of CVDs in developing countries, there remain inadequate available information on hypertension prevalence using ACC/AHA guidelines[17–19].

Previous studies in Bangladesh also reported a significant increase in hypertension prevalence in Bangladesh when new guideline (2017 ACC/AHA) is applied. Kibria et al. found that the prevalence of hypertension among Bangladeshi adults aged ≥35 years increased from 25.7% to 48.0% according to the new guideline[6]. Islam et al. reported the findings from 1843 Bangladeshi adults aged over 18 years and found similar increase (22.8%) in the prevalence of hypertension following application of 2017 ACC/AHA guidelines[20]. In another paper, Kibria et al. also reported that the association's factors and level changed when using the JNC 7 guidelines and ACC/AHA guidelines[12]. These changes in the prevalence and risk factors of hypertension have direct and indirect implications and hold significant merit in revising the public health policies and plans in addressing the issue[21]. However, all of these studies reported the findings from the 2011 BDHS survey data.

Therefore, the present research was carried out to identify the change the new guideline has resulted in the prevalence and associated factors of hypertension in comparison to that of the JNC 7 guideline using the most recent Bangladesh Demographic and Health Survey (BDHS) 2017-18 data. This new dataset encompasses comparatively larger measurement of BP with greater participants than the previous round. Therefore, the findings using this latest dataset can have broad policy implications regarding hypertension management in Bangladesh.

Key Points: **Question.** What is the change the new guideline has resulted in the prevalence and associated factors of hypertension in comparison to that of the JNC 7 guideline among the adult population in Bangladesh?

Methods

Data sources. The current study analyzed the most recent (2017-18 (BDHS) data. The survey was carried out from October 2017 to March 2018 under the authority of the National Institute of Population Research and Training (NIPORT), Medical Education and Family Welfare Division, Ministry of Health and Family Welfare. The survey's principal objective was to assess the health indicators and provide a detailed overview of population, maternal, and child health issues along with the status of several non-communicable diseases such as hypertension and diabetes among adults.

Study population and survey design. The sampling frame used for the 2017-18 BDHS is the complete list of enumeration areas (EAs) covering the entire population residing in Bangladesh. The survey used a list of enumeration areas (EAs) provided by the Bangladesh Bureau of Statistics (BBS) of the 2011 Population and Housing Census of the People's Republic of Bangladesh. The survey's primary sampling unit (PSU) is an EA covering on average 120 households, in 2017-18. The BDHS 2017-18 was a multistage stratified cluster sample of households' survey, carried out in two and three stages in rural and urban settings. In the first stage of sampling, in rural areas, wards were selected, followed by Primary Sampling Units (PSUs), then households were selected from the PSUs. In urban areas, wards were selected through the PSUs technique, and one enumeration area (EA) was taken from each PSUs, then the households were taken from the selected EAs sample. A detailed description of the survey design, methodologies, sample size, questionnaires, and findings can be found in the final report summary of BDHS 2017-18[22]. Anthropometric measurements and blood pressure (BP) were measured only from the study participants' systematically selected subsample.

Measurements. The participants' Bodu Mass Index (BMI), height, and weight were measured using the World Health Organization (WHO) standard procedures and classified accordingly[23]. The BMI was calculated by dividing body weight in kilograms by the square of height (m^2) in meters. As underweight (<18.5 kg/m^2), normal weight (18.5–25.5 kg/m^2), overweight (25.5–29.9 kg/m^2), and obese (≥30.0 kg/m^2)[23]. In the time of the individual interview, three times the BP was measured using UA-767F/FAC (A&D Medical) blood pressure monitors at about 5 minutes interval[24]. The average of the second and third measurement was used to categorize the respondents with respect to hypertension as recommended by (WHO 1999; NIH 1997)[24]. The LIFE SOURCE® UA-767 Plus BP monitor was used to measure blood pressure. This automatic device includes separate cuffs (small, medium, and large). Three blood pressure measurements were taken at intervals of approximately 10 minutes. The average of the second and third measurements was used to report respondents' blood pressure values[22].

Definition of hypertension. The dependent variable for this study was hypertension. A person with systolic blood pressure (SBP) greater than or equal to (≥140 mmHg) or a diastolic blood pressure (DBP) greater than or equal to (≥90 mmHg) was considered hypertensive as suggested by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7)[25]. While according to the American College of Cardiology/American Heart Association 2017 (ACC/AHA 2017) guideline, individuals who have an SBP greater than or equal to (≥130 mm Hg) or a DBP greater than or equal to (≥80 mm Hg) or take any prescribed anti-hypertensive drugs to control

blood pressure were categorized as hypertensive[26]. The category of pre-hypertension was transformed into elevated blood pressure in the 2017 ACC/AHA guideline[26].

Independent variables . The independent variables included in the study were selected based on previous literature reporting the risk of developing hypertension in population in low- and middle-income countries[6,11,12,27–30]. The household factors included administrative division, place of residence and wealth quintile whereas the socioeconomic and individual factors included: participants' current age; education level; and occupation; behavioural characteristics included cigarette smoking; and the BMI was categorized as underweight (BMI<18.5 kg/m^2), normal (BMI: 18.5–24.5 kg/m^2), overweight (BMI: 25.5–29.9 kg/m^2) and obese (BMI ≥30.0 kg/m^2).

Statistical analysis. Before estimating the prevalence of hypertension in both settings, the normality of the continuous variables was investigated through skewed distribution and reported with medians and interquartile ranges (IQRs). We estimated the prevalence of hypertension and reported the differences between the two guidelines. Besides, we reported the prevalence by background characteristics of the study participants through complex sample design. Along with this, the study utilized a logistic regression model to identify the most potential confounders associated with developing hypertension and described those factors found statistically significant at p-value less than (<0.005). Before doing the analysis, the datasets were weighted to adjust due to the clustered sampling design followed by appropriate techniques of Demographic Health Survey (DHS). The Statistical Package for Social Science (SPSS.26) version was used to analyze this study's data.

Ethical consideration. The study used secondary data from the Demographic and Health Surveys Program publicly available; therefore, we did not require any further ethical approval. The details of ethical procedures followed by the Demographic and Health Surveys Program can be found in the BDHS report[22].

Results

A total of 11 959 weighted participants were included in this analysis. The median (IQR) age of the respondents was 34.0 years (18.0–95.0). Of the total survey participants, 6835 (57.2%) were female (Table 1). The median (IQR) SBP and DBP were 118 (109–131) and 80 (73–87), respectively. The majority of the participants (75.8%) reported having their blood pressure measured at least once previously. The median BMI was 21.91 (19.4–24.9). In addition, 25.4% had no education, and 73.4% were residing in rural areas.

Table 1
Distribution of Respondents by Background Characteristics

	BDHS 2017-18		
	All Participants (N = 11 959), No. (%)	**Participants With Hypertension per JNC 7 (n = 2866), No. (%)**	**Participants With Hypertension per 2017 ACC/AHA (n = 6044), No. (%)**
SBP, Median (IQR), mm Hg	118 (109–131)		
DBP, Median (IQR), mm Hg	80 (73–87)		
Ever Measured Blood Pressure	9063 (75.8)	2379 (26.2)	4795 (52.9)
Know About Hypertension Status	1534 (12.8)	988 (64.4)	1286 (83.8)
Taking Antihypertensive Medication for BP	1216 (10.2)	812 (66.8)	1049 (86.3)
Administrative Divisions			
Barisal	659 (5.5)	184 (27.9)	349 (53.0)
Chittagong	2057 (17.2)	507 (24.6)	1065 (51.8)
Dhaka	2770 (23.2)	564 (20.4)	1256 (45.4)
Khulna	1488 (12.4)	399 (26.8)	833 (56.0)
Rajshahi	1729 (14.5)	440 (25.4)	908 (52.5)
Rangpur	1503 (12.6)	424 (28.2)	829 (55.2)
Sylhet	780 (6.5)	165 (21.2)	366 (46.9)
Mymensingh	973 (8.1)	183 (18.8)	438 (45.0)
Place of Residence			
Urban	3180 (26.6)	767 (24.1)	1674 (52.6)
Rural	8779 (73.4)	2099 (23.9)	4370 (49.8)
Sex of the Participants			
Male	5124 (42.8)	1221 (23.8)	2667 (52.0)
Female	6835 (57.2)	1646 (24.1)	3376 (49.4)
Age of the Participants, y			

	BDHS 2017-18		
Age Median (IQR)	34.0 (18.0–95.0)		
18–24	2422 (20.3)	184 (7.6)	744 (30.7)
25–34	2972 (24.9)	412 (13.9)	1284 (43.2)
35–44	2417 (20.2)	612 (25.3)	1326 (54.8)
45–54	1672 (14.0)	564 (33.8)	1047 (62.6)
55–64	1350 (11.3)	533 (38.5)	860 (63.7)
≥ 65	1126 (9.4)	562 (48.9)	782 (69.4)
BMI Level			
Median (IQR)	21.91 (19.4–24.9)		
Underweight (< 18.5 kg/m^2)	2071 (17.3)	338 (16.3)	723 (34.9)
Normal (18.5–24.9 kg/m^2)	7010 (58.6)	1482 (21.1)	3342 (47.7)
Overweight (25.0-29.9 kg/m^2)	2389 (20.0)	868 (36.3)	1620 (67.8)
Obesity (≥ 30.0 kg/m^2)	489 (4.1)	178 (36.3)	359 (73.4)
Education Level			
No Education	3032 (25.4)	977 (32.2)	1753 (57.8)
Primary	3591 (30.0)	823 (22.9)	1754 (48.8)
Secondary	3545 (29.6)	710 (20.0)	1675 (47.2)
Higher	1790 (15.0)	355 (19.8)	862 (48.2)
Occupational Status			
Not Working	4619 (38.6)	1213 (26.3)	2340 (50.7)
Working	7340 (61.4)	1653 (22.5)	3704 (50.5)
Wealth Status			
Poor	4669 (39.0)	1026 (22.0)	2166 (46.4)
Middle	2468 (20.6)	582 (23.6)	1266 (51.3)
Rich	4882 (40.3)	1259 (26.1)	2612 (54.2)

	BDHS 2017-18		
Smoking Habit			
No	10271 (85.9)	2405 (23.4)	5140 (50.0)
Yes	1688 (14.1)	461 (27.3)	904 (53.6)

Table 2 summarizes the prevalence of hypertension among the participants according to the two guidelines and the changes in prevalence the new guideline has resulted. According to the JNC 7 guideline, the prevalence of hypertension was (24.0% [95% CI: 22.4% to 25.6 and with 2017 ACC/AHA guideline the prevalence was found to twice the higher(50.5% [95% CI: 49.2–51.8%]) to that reported by JNC 7 guideline. The prevalence for hypertension as per JNC 7 guidelines was (23.8% [95% CI: 22.4–25.3%]) among women and (18.1% [95% CI: 17.3%-19.0%]) among men, which was considerably increased when the new guideline was applied. A similar result was also observed when considered in terms of age, BMI, and wealth status.

Table 2
Weighted Prevalence of Hypertension in According to Selected Demographic Characteristics

	BDHS 2017	BDHS 2017	
	Prevalence of Hypertension per JNC 7, % (95% CI)	Prevalence of Hypertension per 2017 ACC/AHA, % (95% CI)	Difference, % (95% CI)
Administrative Divisions			
Barisal	27.9 (24.9–31.1)	52.9 (49.3–56.5)	25.0 (24.4–25.4)
Chittagong	24.6 (22.4–27.0)	51.8 (49.2–54.5)	27.2 (26.8–27.5)
Dhaka	20.4 (18.1–22.8)	45.4 (41.9–48.9)	25.0 (23.8–26.1)
Khulna	26.8 (24.0-29.8)	56.0 (52.8–59.1)	29.2 (28.8–29.3)
Rajshahi	25.4 (22.7–28.4)	52.5 (48.9–56.2)	27.1 (26.2–27.8)
Rangpur	28.2 (26.0-30.6)	55.2 (52.0-58.3)	27.0 (26.0-27.7)
Sylhet	21.2 (18.8–23.8)	46.9 (43.1–50.7)	25.7 (24.3–26.9)
Mymensingh	18.8 (16.5–21.4)	45.0 (42.0-47.9)	26.2 (25.5–26.5)
Place of Residence			
Urban	24.1 (22.4–25.9)	52.6 (50.4–54.9)	28.5 (28.0–29.0)
Rural	23.9 (22.8–25.1)	49.8 (48.2–51.3)	25.9 (25.4–26.2)
Sex of the Participants			
Male	23.8 (22.4–25.3)	52.1 (50.2–53.9)	28.3 (27.8–28.6)
Female	24.1 (23.0-25.2)	49.4 (47.9–50.9)	25.3 (24.9–25.7)
Age of the Participants, y			
18–24	7.6 (6.5–8.8)	30.7 (28.8–32.8)	23.1 (22.3–24.0)

	BDHS 2017	BDHS 2017	
25–34	13.9 (12.5–15.3)	43.2 (41.0-45.4)	29.3 (28.5–30.1)
35–44	25.3 (23.4–27.3)	54.8 (52.6–57.1)	29.5 (29.2–29.8)
45–54	33.8 (31.0-36.6)	62.6 (59.7–65.4)	28.8 (28.7–28.8)
55–64	39.5 (36.7–42.4)	63.7 (60.7–66.6)	24.2 (24.0-24.2)
≥ 65	49.9 (46.7–53.1)	69.5 (66.3–72.5)	19.6 (19.6–19.4)
BMI Level			
Underweight (< 18.5 kg/m^2)	16.3 (14.7–18.1)	34.9 (32.6–37.3)	18.6 (17.9–19.2)
Normal (18.5–24.9 kg/m^2)	21.1 (20.1–22.3)	47.7 (46.2–49.2)	16.6 (26.1–16.9)
Overweight (25.0-29.9 kg/m^2)	36.3 (34.1–38.6)	67.8 (65.6–70.0)	31.5 (31.5–31.4)
Obesity (≥ 30.0 kg/m^2)	36.3 (32.1–40.8)	73.4 (68.9–77.5)	37.1 (36.8–36.7)
Education Level			
No Education	32.2 (30.3–34.2)	57.8 (55.7–59.9)	25.6 (25.4–25.7)
Primary	22.9 (21.4–24.6)	48.8 (46.8–50.9)	25.9 (25.4–26.3)
Secondary	20.0 (18.5–21.7)	47.2 (45.3–49.1)	27.2 (26.8–27.4)
Higher	19.9 (17.9–22.0)	48.1 (45.4–50.9)	28.2 (27.5–28.9)
Occupational Status			
Not Working	26.3 (24.9–27.7)	50.7 (48.9–52.4)	24.4 (24.0-24.7)
Working	22.5 (21.3–23.8)	50.5 (48.9–52.0)	28.0 (27.6–28.2)
Wealth Status			

	BDHS 2017	BDHS 2017	
Poor	22.0 (20.6–23.4)	46.4 (44.6–48.2)	24.4 (24.6–24.8)
Middle	23.6 (21.6–25.6)	51.3 (48.8–53.7)	27.7 (27.2–28.4)
Rich	26.1 (24.6–27.6)	54.2 (52.3–56.0)	28.1 (27.7–28.4)
Smoking Habit			
No	23.4 (22.4–24.5)	50.0 (48.7–51.4)	26.6 (26.3–26.9)
Yes	27.3 (25.0-29.7)	53.5 (50.7–56.3)	26.2 (25.7–26.6)

Table 3 describes the factors associated with developing more risk of having hypertension under the two guidelines after adjusting all confounders. As per the two guidelines, these factors more aged, higher BMI and living in Rangpur division were identified as significant risk factors. According to ACC/AHA guideline but not JNC 7 guideline, people living in urban areas were identified as significant. Alternatively, smoking reduced the risk of hypertension found in both guidelines.

Table 3
Factors associated with Hypertension in According to Selected Demographic Characteristics

	JNC 7		ACC/AHA 2017	
	AOR	p-value	AOR	p-value
Administrative Divisions				
Sylhet (RC)	1		1	
Barisal	1.24 (0.95–1.61)	0.109	1.23 (0.90–1.41)	0.293
Chittagong	1.03 (0.83–1.28)	0.788	1.01 (0.85–1.21)	0.874
Dhaka	0.81 (0.65-1.00)	0.045	0.75 (0.63–0.89)	0.001
Khulna	1.09 (0.87–1.37)	0.454	1.17 (0.97–1.41)	0.110
Rajshahi	1.20 (0.96–1.49)	0.113	1.14 (0.95–1.37)	0.151
Rangpur	1.42 (1.13–1.78)	0.002	1.33 (1.11–1.61)	0.003
Mymensingh	0.78 (0.61–1.01)	0.055	0.87 (0.71–1.07)	0.184
Place of Residence				
Rural (RC)	1		1	
Urban	1.03 (0.92–1.16)	0.586	1.11 (1.01–1.22)	0.035
Sex of the Participants				
Male (RC)				
Female	1.09 (0.98–1.22)	0.126	0.87 (0.81–0.97)	0.009
Age of the Participants, y				
18–24 (RC)	1		1	
25–34	1.76 (1.46–2.13)	< 0.001	1.49 (1.32–1.68)	< 0.001
35–44	3.88 (3.21–4.69)	< 0.001	2.36 (2.07–2.69)	< 0.001
45–54	6.37 (5.22–7.77)	< 0.001	3.51 (3.02–4.08)	< 0.001
55–64	9.05 (7.36–11.12)	< 0.001	4.08 (3.48–4.79)	< 0.001
≥ 65	15.23 (12.28–18.88)	< 0.001	5.82 (4.88–6.94)	< 0.001
BMI Level				
Normal (18.5–24.9 kg/m^2) (RC)	1		1	
Underweight (< 18.5 kg/m^2)	0.60 (0.52–0.69)	< 0.001	0.52 (0.47–0.58)	< 0.001

	JNC 7		ACC/AHA 2017	
Overweight (25.0-29.9 kg/m^2)	2.30 (2.05–2.58)	< 0.001	2.39 (2.15–2.65)	< 0.001
Obesity (≥ 30.0 kg/m^2)	2.16 (1.74–2.67)	< 0.001	3.13 (2.52–3.88)	< 0.001
Education Level				
Secondary Education (RC)	1		1	
No Education	0.98 (0.85–1.13)	0.814	1.09 (0.97–1.23)	0.164
Primary	0.94 (0.83–1.07)	0.353	0.97 (0.88–1.08)	0.593
Higher	1.06 (0.91–1.24)	0.464	1.05 (0.92–1.19)	0.495
Occupational Status				
Not Working (RC)	1		1	
Working	0.86 (0.77–0.96)	0.008	0.96 (0.87–1.05)	0.345
Wealth Status				
Middle (RC)	1		1	
Poor	0.97 (0.85–1.10)	0.646	0.87 (0.78–0.97)	0.012
Rich	1.04 (0.91–1.19)	0.551	1.01 (0.90–1.13)	0.874
Smoking Habit				
No (RC)	1		1	
Yes	0.79 (0.70–0.90)	< 0.001	0.85 (0.75–0.95)	0.004

Figure 1 exerts the results of single-adjusted models where people age (≥ 65) showed the strongest association with developing hypertension (OR = 12.15, 95% CI: 10.04–14.69, p < 0.001) followed by age (55–64; 45–54 and 35–44) showed greater odds of having hypertensive according to JNC 7 guidelines. Whereas the magnitude of associations as per 2017 ACC/AHA guidelines shows the highest odds age (≥ 65), followed by age bracket (55–64 and 45–54), obese people have had the highest odds of having hypertensive (OR = 3.04, 95% CI: 2.47–3.73, p < 0.001).

Discussion

The current study presented the unique findings based on recently published BDHS (2017-18 (BDHS) data released by Bangladesh's government in 2020. We are very few studies that have examined the prevalence of hypertension according to the new guideline and have compared with previous JNC 7 guidelines[6,11]. These studies found an absolute change in hypertension prevalence after applying the

new 2017 ACC/AHA guidance. The benefit of earlier detecting individuals with hypertension would reduce complications associated with hypertension and cardiovascular morbidity.

Our findings depicted the change in the estimated prevalence of hypertension in Bangladesh as per JNC 7 guidelines and the new 2017 ACC/AHA guidelines developed to classify prehypertension and hypertension status among the human populations. Under these two guidelines, we have found differences in the prevalence rate at the national and individual levels. In the year 2011, according to the new lower blood pressure threshold recommended by 2017 ACC/AHA guidelines, (43.3%) prevalence of hypertension observed in Bangladesh at the national level while (20.9%) documented in the previous recommendation of JNC 7[6,31,32]. Our study shows, the prevalence of hypertension augmented alarmingly in both conditions observed (24.0%) according to JNC 7 and (50.5%) in 2017 ACC/AHA guidelines. The prevalence of hypertension according to JNC 7 was (20.9%) in 2011[6,31,32], and at least (3.1%) increased found in our present study (24.0%) same fashion observed in the new guidelines 2017 ACC/AHA were at least (7.2%) hypertension prevalence increased. In addition, regardless of the respondents' background status, these findings show the prevalence has been increasing among female participants alarmingly based on the previous studies[6,31]. When hypertension has been classified based on the 2017 ACC/AHA guideline's thresholds, a substantial rise of the prevalence observed for all countries such as Nepal, the USA[11,33] and Bangladesh[12] despite different socioeconomic characteristics. This depicts the alarming increase in the prevalence of hypertension which requires the need of urgent attention from all the stakeholders who are interested in prevention and control of hypertension in Bangladesh.

Interesting, our findings reported a similar prevalence of hypertension among male and female participants. If we compare the finding based on the previous study, the prevalence rate increased among female participants more than male counterparts[12,27]. The plausible explanation could be biological and behavioural characteristics among the females might have increased over the period. This fact is supported by the previous evidence that females have a higher risk of obesity and diabetes compared with men[34,35]. This needs females to require more awareness and public health information to control hypertension and minimize adverse complications[27]. Our study findings reported that people with higher socioeconomic status had higher odds of having hypertension. The higher wealth status participants can generally purchase more consumable resources with a large amount of calorie intake, making them overweight or obese, putting them at a greater risk of being hypertensive than those lower wealth status[36,37]. This suggests the need for prevention and control program for hypertension in urban areas of Bangladesh.

The prevalence of hypertension was higher among those living in urban areas, which is in line with previous studies where urban people were reported more hypertensive[6,27,38,39]. The possible reason could be prevailing unhealthy lifestyle factors such as less physical activity, consumption of unhealthy diets among the urban populations might have contributed to the disease burden[40–42]. However, this finding warrants further detailed investigation of causes for the increased prevalence or odds of hypertension in several Bangladesh divisions[27]. This finding suggests the need to understand the social inequalities

among the rural and urban community, which may have played a role in such variation. Understanding the inequalities mentioned earlier may help design the comprehensive hypertension prevention and control program for Bangladesh peoples.

There is another explanation that would help understand why the prevalence of hypertension is high in urban areas. The study found that higher educated and higher wealth status of people are likely lives in urban areas, resulting from having a sedentary lifestyle such as low physical activity. A lack of open spaces for playing games or physical activity might result in the high-risk prevalence of hypertension[27]. Since most urban participants are educated, and these had a higher prevalence of hypertension. Thus our study recommends that educated individuals in urban areas need to receive more public health awareness information to control raised blood pressure levels[27].

This study identified the potential risk factors of hypertension using both JNC 7 and 2017 ACC/AHA guideline alongside to the estimation of the prevalence. People of older age 25 to more, female, overweight, and obese had relatively higher odds, which is in line with previous studies elsewhere[6,11,43–45]. Notably, in the current study, administrative divisions, and place of residence were also found significantly associated with hypertension inline with suggest 2017 ACC/AHA guidelines. People from Rangpur division found higher odds in the two guidelines. Much is unknown why the people from Rangpur division owned higher risk of being hypertensive; however, the reason may be because of socioeconomic inequalities such as limited resources, income inequality, low level of education and social safety net programs, poor connectivity with the urban centres, insufficiency or absence of public infrastructure[46,47].

The new 2017 ACC/AHA guideline recommends treating stage 1 hypertension with changing lifestyle measures and taking antihypertensive medicines to prevent future cardiovascular disease risks[11]. Our study findings are significant because it shows that above fifty per cent of adults with hypertension or elevated blood pressure according to the new 2017 ACC/AHA classification require active lifestyles and healthy dietary habits. Public health programs should adequately address this emerging problem; in Bangladesh, emphasis should be paid to prevention and self-management of a condition not only for those with hypertension but also for all adults[11]. Therefore, it is essential to estimate the prevalence based on both thresholds to control this hypertension burden, which might exacerbate cardiovascular disease. These findings might help future researchers and appropriate authority design any programs and policies regarding control and prevent hypertension burden and overcome this massive public health challenge.

The strengths and weaknesses of this study are accredited. The strength that lies in this study is the generalizability of the findings for Bangladesh since this survey covered nationally representative data covering all divisions. Along with appropriate statistical methods to estimate the weighted prevalence of hypertension from the sample. This study is the first epidemiological study that analyzed the most recent round data sets based on JNC 7 and 2017 ACC/AHA, which present the exact prevalence that might aid the authorities in taking up initiatives to prevent hypertension.

The limitations of the study are appropriately acknowledged. Due to a cross-sectional setup, no causality can not be established, and the individuals' blood pressure was measured three times in a single day. However, both guidelines recommend longitudinal measurement of blood pressure levels to diagnose hypertension[11]. This survey also used an automated device, though both guidelines recommend recording blood pressure with a sphygmomanometer[31,48,49].

Conclusions

The present study highlighted that the prevalence of hypertension was almost doubled according to the 2017 ACC/AHA guideline compared to the JNC7 guideline. The policymakers and public health practitioners should consider the new guideline and make new strategies to increase awareness among the adult population in Bangladesh. The study finding also points towards addressing the already established modifiable risk factors of hypertension such as overweight/obesity, high-income status and urban residence, which are also identified as the risk factors according to both guidelines.

Declarations

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Author contributions

M.A.R: had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. M.A.R., S.K.M: conceptualized the topic while M.A.R performed the statistical analysis under the supervision of S.K.M. M.A.R., H.RH., S.K.M produced the first draft of the manuscript. M.A.R., S.K.M., UNY., reviewed and undertook the scientific editing of the manuscript both for statistical correctness and language appropriateness. All four authors read and approved the final version for publication.

Conflict of Interest Disclosures: The authors declare no competing interests.

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Figures

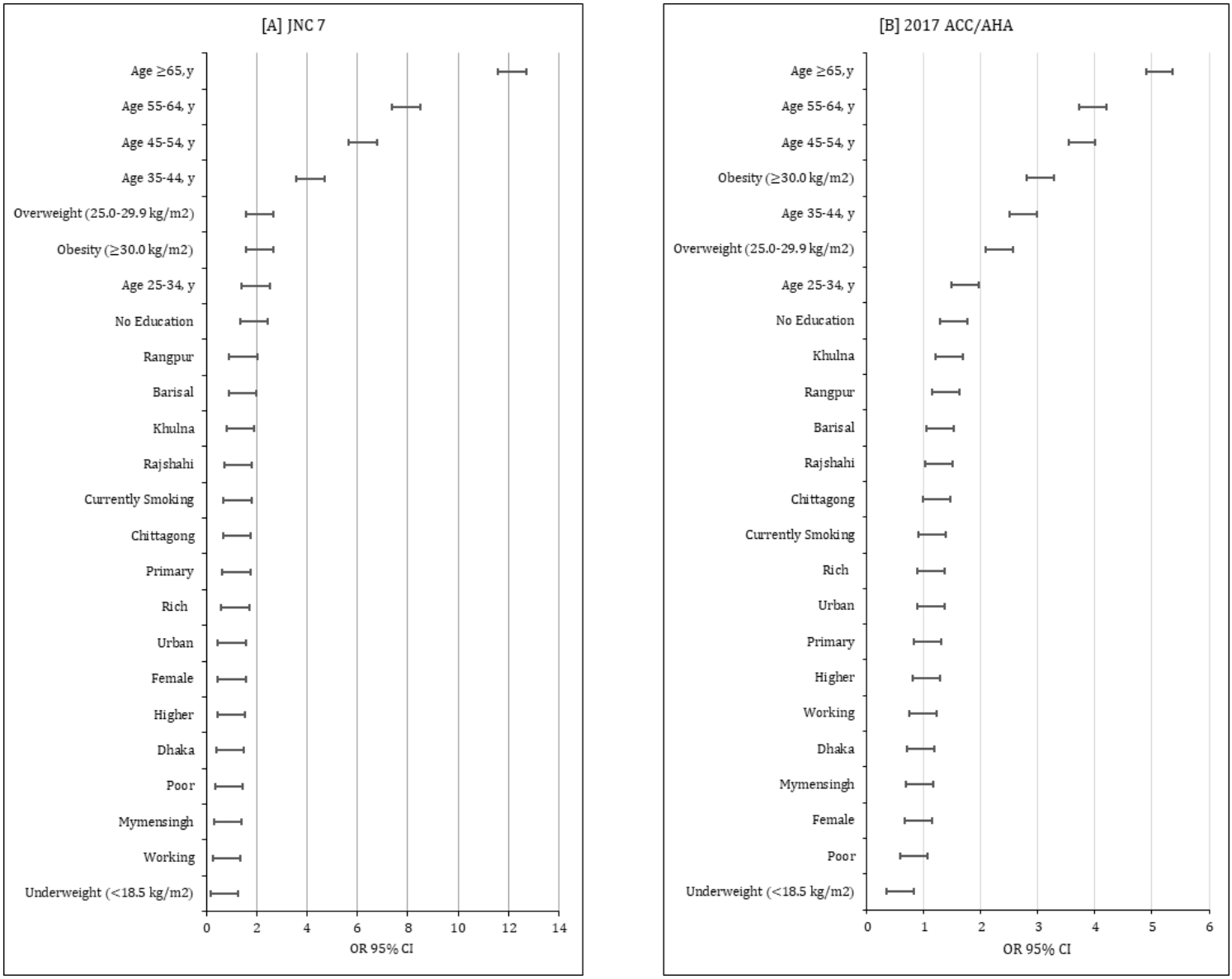

Figure 1

Relative ranking of factors associated with hypertension according to JNC 7 and 2017 ACC/AHA

Supplementary Files

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