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Gender Differentiation in Hypertension among Rural Bengali Adults in Birbhum District of West Bengal, India

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ABSTRACT The study intends to determine the differences in blood pressure between men and women, as well as to identify demographic, anthropometric, and socioeconomic predictors of hypertension in rural Bengalis for only Systolic Blood Pressure (SBP), only Diastolic Blood Pressure (DBP), and both (SBP and DBP together). Data on blood pressure and explanatory factors were collected from 7,034 participants aged 18 to 75 years in the Birbhum district of West Bengal. Random sampling technique was used to select the study area and participants. There was a significant difference in blood pressure between men and women up to the age of 55. Men were shown to have a higher prevalence of hypertension, while only SBP was prevalent in both men and women. Body weight and central obesity need to be monitored to control hypertension. Also, educational levels must be enhanced, and lifestyles must be improved to control hypertension in rural adult Bengalis.

INTRODUCTION

Hypertension has become a major public health issue throughout the world, because of its strong association with cardiovascular and renal diseases (Di Palo and Barone 2020). The World Health Organisation (WHO 2020) estimates that 1.13 billion people around the world suffer from hypertension, with two-thirds of those living in low-and-middle income countries (LMICs). India is no exception as an LMIC in South Asia (WHO 2020). The Great India Blood Pressure Survey (2015) of the Cardiological Society of India estimates that about 34.2 percent of men and 23.7 percent of women, aged 18 years and older are hypertensive (Ramakrishnan et al. 2019). Cardiovascular disease is the leading cause of mortality in India, with 25.1 percent of men and 20.8 percent of women being affected by it as reported by the Registrar General of India in 2010-2013, which is higher than the 2001-2003 reports with 20.3 percent of men and 16.9 percent of women (Gupta and Xavier 2018). It has been argued that extensive surveillance is crucial in the management of non-communicable diseases like hypertension (Steyn and Bradshaw 2001).

Studies have claimed that hypertension is a multifactorial trait caused by internal and external factors of the body, some of which are modifiable, such as obesity, dietary habits, lifestyle, and socioeconomic status (WHO 2009; Unger et al. 2020; Litwin and Kułaga 2021). Hypertension is more common as people get older, with more than two out of every three persons over 65 suffering from the condition (Fernández-Llama et al. 2021). Research

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in India has shown that ethnic diversity and environmental factors influence the prevalence of hypertension and blood pressure levels (Anchala et al. 2014; Luhar et al. 2018; Ghosh and Kumar 2019; Thrift et al. 2020). Over 1.2 billion people live in India with 121 languages, among them Bengali (8.03%) ranking as the country's second-most common language, according to 2011 census statistics. The majority of them live in West Bengal, and they come from rural areas and are socioeconomically underprivileged (ORG India 2018).

Objective

The present study examines the difference in blood pressure between men and women among rural Bengalis in the Birbhum district of West Bengal. As well as, to identify demographic, anthropometric, and socioeconomic predictors of only SBP, only DBP, and both (SBP and DBP) hypertension in men and women for the prevention and control of hypertension in rural Bengalis.

METHODOLOGY

Design and Sampling

A cross-sectional survey was conducted among rural Bengalis aged 18 to 75 years from June to December 2019. The total number of participants was 7034, with 3487 men and 3547 women. Participants were selected based on their dialect. The study area, selected by simple random sampling (SRS) technique, was conducted in Bolpur Sriniketan and Sainthia blocks of Birbhum district in the state of West Bengal. Using the SRS technique, 25 out of 156 villages in the Bolpur Sriniketan and 23 out of 216 villages in the Sainthia were chosen from the list of villages according to the Census of India (2011). Households were selected from each of the villages through the SRS technique.

Data Collection and Classification

Demographic Data

The demographic factors consist of age and sex for this analysis. The age of the participants was confirmed on the basis of a birth certificate. School certificates, voter card and *Aadhaar* card were regarded as secondary sources for participants without birth certificates. The participants were divided into three age groups according to Petry (2002), that is, young adults 18 to 35 years, middle-aged adults >35 to 55 years, and elderly adults >55 to 75 years.

Anthropometric Data

Anthropometric data included body height in centimetres, weight in kilograms, waist circumference in centimetres, body mass index (BMI), and waist to height ratio (WHtR). Trained investigators took anthropometric measurements from participants using the guidelines of Weiner and Lourie (1981), Lohman et al. (1988) and Frisancho (2011). Body mass index (BMI) was calculated as, weight in kilogram divided by square of height in meter (kg/m^2). BMI was classified according to the recommended cut-off of WHO, that is, <18.5 for undernutrition, 18.5 to 24.9 for normal, 25 to 29.9 for overweight, and ≥30 for obese (WHO Expert Consultation 2004). Overnutrition was defined in this study for persons having BMI value ≥25, that is, for persons who were either overweight or obese. Central obesity was estimated by WHtR, using the cutoff value ≥0.50 in both sexes (Ashwell and Hsieh 2005).

Socioeconomic Data

The National Family Health Survey (NFHS-4) guidelines were used to obtain socioeconomic data, which included information on religion, caste, the highest educational level, and earnings activities (NFHS-4 India 2017). The wealth index was derived through principal component analysis (PCA) using NFHS recommendations.

Blood Pressure Data

Blood pressure (in mmHg) was measured 30 minutes after breakfast in the morning, by using an accurate mercury sphygmomanometer and stethoscope. In order to record the blood pressure, participants were seated in a chair for at least 5 minutes with their backs supported and their arms bared and supported at heart level. Hypertension was defined as systolic blood pressure (SBP) ≥140 mm Hg and/or diastolic blood pressure (DBP) ≥90 mm Hg, based onthe European Society of Hypertension and the European Society of Cardiology guideline (ESH/ESC 2003; Khatib and El-Guindy 2005).

Ethical Considerations

Institutional ethical clearance was obtained from the ethical review board of the Searching for Alternative Benevolence (SAB), Burdwan in West Bengal for this survey. The data collected for this study was not physically or psychologically harmful. The involvement of the participants in this study was completely voluntary. The authors provided all relevant information about the purpose of the study before collecting data. Written consent was obtained from the participants and in the case of a non-literate person, a thumb impression was taken in front of one of his or her believing persons. The study followed the "National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017)" provided by the Indian Council of Medical Research (ICMR 2017).

Statistical Analysis

Initial descriptive statistics tables in this paper presented mean and standard deviation (SD) values for continuous variables and frequencies and percentages forcategorical variables. Associations between categorical variables were tested using contingency tables and the Chi-square (χ^2) test. Yates' corrected Chi-square test was applied if there was any cell in the contingency table having an expected frequency less than 5. Comparisons of continuous variables between and among groups were performed by t-test and analysis of variance (ANOVA), respectively. Binary logistics regression (BLR) was used to identify significant predictors of hypertension. Independent variables were selected after due multicollinearity test and the variance inflation factor (VIF) was considered to be less than 10. The p-value was determined to be significant at level less than 0.05 based on two-tailed tests. Data were analysed by using the Statistical Package for the Social Sciences (SPSS version 25.0).

RESULTS

Differences in Blood Pressure between Men and Women

A total of 49.57 percent of men and 50.43 percent of women participated in the analysis. The mean SBP was 127.55 mmHg (SD 17.51) in men and 122.71 (SD 19.38) in women, while DBP was 75.13 (SD 11.13) in men and 73.17 (SD 10.99) in women. The mean age of men and women were 40.63 years (SD 14.84) and 40.86 years (SD 13.92), respectively. Levels of SBP and DBP have been found to rise steadily as people become older (Table 1). In comparison to the upper age groups, men and women with the lowest SBP and DBP were found to be between the ages of 18 and 20 years. Systolic and Diastolic pressure were significantly different (t-value, $p < 0.01$) in each age group between men and women, except for SBP of older adults (Table 2). Men have higher mean values of SBP and DBP than women until they reached the age of 55 years. On the other hand, ANOVA reveals a significant difference (F value, $p<0.01$) in blood pressures (SBP and DBP) across age groups.

Men were found to have greater prevalence of systolic and diastolic hypertension than women, as indicated in Table 3. Systolic hypertension

Table 1: Blood pressure distribution according to age between men and women

Age in years	*Men*			*Women*		
	n	*SBP Mean (SD)*	*DBP Mean (SD)*	*n*	*SBP Mean (SD)*	*DBP Mean (SD)*
18-19	185	119.18 (12.53)	67.41 (9.44)	150	110.67 (10.80)	64.57 (9.14)
20-24	478	122.29 (11.57)	69.55 (9.02)	369	112.00 (10.39)	66.48 (8.18)
25-29	397	122.50 (10.84)	71.68 (8.68)	357	112.91 (10.42)	68.56 (8.62)
30-34	290	122.87 (11.86)	74.42 (9.62)	433	115.50 (12.24)	71.44 (9.20)
35-39	315	124.93 (15.37)	75.74 (10.42)	409	116.19 (14.15)	72.04 (10.17)
40-44	381	125.25 (14.62)	77.15 (10.43)	422	122.57 (16.60)	75.84 (10.20)
45-49	379	128.16 (17.37)	77.65 (10.80)	421	125.85 (18.44)	75.79 (10.99)
50-54	373	131.48 (19.53)	78.67 (11.52)	345	132.57 (21.92)	78.25 (11.33)
55-59	280	134.36 (21.24)	78.57 (12.06)	255	134.76 (22.55)	78.12 (11.69)
60-64	193	140.83 (23.13)	81.20 (12.85)	197	138.47 (22.22)	77.04 (11.07)
65-69	134	139.11 (21.54)	76.31 (11.67)	126	143.87 (19.40)	76.34 (11.08)
70-75	82	144.66 (23.75)	76.84 (11.21)	63	146.99 (24.43)	76.21 (12.81)

Table 2: Difference of mean blood pressures between men and women

Age groups	*Blood pressure*	*Men*	*Women*	*t-value*	*p-value*
		Mean (SD)	*Mean (SD)*		
Young Adults	SBP	122.07 (11.73)	113.34 (11.32)	19.99	<0.001
	DBP	71.07 (9.45)	68.61 (9.15)	6.96	<0.001
Middle-Aged Adults	SBP	128 (17.17)	124.88 (19.23)	4.69	<0.001
	DBP	77.6 (10.87)	75.73 (10.93)	4.70	<0.001
Older Adults	SBP	138.68 (22.78)	138.9 (22.21)	-0.17	0.864
	DBP	78.52 (12.31)	76.99 (11.42)	2.25	0.024
Variation within age groups		F (p-value)	F (p-value)		
ANOVA	SBP	222.58 (<0.001)	477.83 (<0.001)		
	DBP	174.78 (<0.001)	221.60 (<0.001)		

was shown to be more common in both men and women, with systolic hypertension 19.0 percent and 16.3 percent, diastolic hypertension 9.5 percent and 7.1 percent, respectively. Most hypertensive people possess Type 1 hypertension (only systolic), followed by Type 3 hypertension (both systolic and diastolic) and Type 2 (only diastolic).There were 20.6 percent of men and 17.2 percent of women, who were suffering from hypertension considering all the three types (T1H, T2H and T3H).The frequency distributions of blood pressure between men and women differed significantly for systolic, diastolic, and combined hypertension, (χ^2, $p < 0.01$).

Distribution of Hypertension Based on Explanatory Factors

Table 4 shows that hypertension differed significantly (χ^2, $p < 0.05$) from each of the socio-demographic and anthropometric explanatory factors for both men and women, except for religion in women. People's susceptibility to hypertension increased with age, as seen in the age range considered here. In both sexes, hypertension was more common in the overweight/obese category of BMI, and central obese category of WHtR. The prevalence of hypertension in men was higher among those who belonged to the Hindu religious community, were less educated, belonged to the higher wealth index, or worked in agricultural and salaried services. In the case of women, the tendency for hypertension was higher for those who belong to the general caste group, was less educated, belonged to the higher wealth index or worked in agriculture and salaried service.

Men were seen to be more prone to being underweight, while women were more prone to central obesity. Almost three-quarters of the participants belonged to the Hindu religious community. More than two-fifths of the participants were general castes, followed by Scheduled Castes (SC) and Other Backward Classes (OBC). More than a third of the participants had completed primary and upper-primary school. The upper and upper-middle wealth index groups accounted for about half of the participants. Moreover, about

Table 3: Distribution of blood pressures in men and women

Blood pressure	*Men*		*Women*		*Chi-square*	*p value*
	n	*%*	*n*	*%*		
Systolic Hypertension						
Yes	664	19.0	579	16.3	8.93	0.003
No	2823	81.0	2968	83.7		
Diastolic Hypertension						
Yes	332	9.5	253	7.1	13.15	<0.001
No	3155	90.5	3294	92.9		
Combined Hypertension						
Type 0 - No hypertension (T0H)	2768	79.4	2935	82.8	17.47	0.001
Type 1 - Only systolic hypertension (T1H)	387	11.1	359	10.1		
Type 2 - Only diastolic hypertension (T2H)	55	1.6	33	0.9		
Type 3 - Systolic and diastolic hypertension (T3H)	277	7.9	220	6.2		

Table 4: Distribution of hypertension types based on the classification of explanatory factors in men and women

Explanatory factors	*Hypertension in men*					*Hypertension in women*				
	Type 0	*Type 1*	*Type 2*	*Type 3*	*Total*	*Type 0*	*Type 1*	*Type 2*	*Type 3*	*Total*
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Age Groups										
Young adults	1283 (46.4)	80 (20.7)	16 (29.1)	28 (10.1)	1407 (40.3)	1344 (45.8)	11 (3.1)	11 (33.3)	16 (7.3)	1382 (39.0)
Middle-aged adults	1117 (40.4)	149 (38.5)	34 (61.8)	146 (52.7)	1446 (41.5)	1268 (43.2)	154 (42.9)	18 (54.5)	137 (62.3)	1577 (44.4)
Older adults	368 (13.3)	158 (40.8)	5 (9.1)	103 (37.2)	634 (18.2)	323 (11.0)	194 (54.0)	4 (12.1)	67 (30.5)	588 (16.6)
χ^2 (p value)	344.96 (<0.001)					613.39 (<0.001)				
Body Mass Index										
Undernutrition	1097 (39.6)	95 (24.5)	7 (12.7)	56 (20.2)	1255 (36.0)	930 (31.7)	96 (26.7)	3 (9.1)	35 (15.9)	1064 (30.0)
Normal	1488 (53.8)	233 (60.2)	40 (72.7)	177 (63.9)	1938 (55.6)	1566 (53.4)	195 (54.3)	15 (45.5)	137 (62.3)	1913 (53.9)
Overnutrition	183 (6.6)	59 (15.2)	8 (14.5)	44 (15.9)	294 (8.4)	439 (15.0)	68 (18.9)	15 (45.5)	48 (21.8)	570 (16.1)
χ^2 (p value)	114.08 (<0.001)					53.25 (<0.001)				
Waist Height Ratio										
Normal	2209 (79.8)	230 (59.4)	29 (52.7)	137 (49.5)	2605 (74.7)	1809 (61.6)	154 (42.9)	8 (24.2)	82 (37.3)	2053 (57.9)
Central obesity	559 (20.2)	157 (40.6)	26 (47.3)	140 (50.5)	882 (25.3)	1126 (38.4)	205 (57.1)	25 (75.8)	138 (62.7)	1494 (42.1)
χ^2 (p value)	193.37 (<0.001)					103.67 (<0.001)				
Religion										
Hindu	1946 (70.3)	299 (77.3)	48 (87.3)	216 (78.0)	2509 (72.0)	2109 (71.9)	274 (76.3)	19 (57.6)	154 (70.0)	2556 (72.1)
Muslim	822 (29.7)	88 (22.7)	7 (12.7)	61 (22.0)	978 (28.0)	826 (28.1)	85 (23.7)	14 (42.4)	66 (30.0)	991 (27.9)
χ^2 (p value)	20.51 (<0.001)					7.20 (0.066)				
Caste										
General caste	1139 (43.0)	190 (51.1)	21 (40.4)	121 (45.3)	1471 (44.1)	1244 (44.7)	180 (50.7)	20 (60.6)	114 (53.8)	1558 (46.0)
Other backward classes	358 (13.5)	48 (12.9)	4 (7.7)	29 (10.9)	439 (13.1)	351 (12.6)	33 (9.3)	7 (21.2)	22 (10.4)	413 (12.2)
Scheduled caste	1150 (43.4)	134 (36.0)	27 (51.9)	117 (43.8)	1428 (42.8)	1191 (42.7)	142 (40.0)	6 (18.2)	76 (35.8)	1415 (41.8)
χ^2 (p value)	12.92 (0.044)					19.79 (0.003)				
Education										
Non literate	717 (25.9)	104 (26.9)	14 (25.5)	87 (31.4)	922 (26.4)	1191 (40.6)	196 (54.6)	10 (30.3)	126 (57.3)	1523 (42.9)
Primary and upper primary	936 (33.8)	95 (24.5)	19 (34.5)	92 (33.2)	1142 (32.8)	907 (30.9)	106 (29.5)	16 (48.5)	59 (26.8)	1088 (30.7)
Secondary and higher secondary	739 (26.7)	119 (30.7)	8 (14.5)	65 (23.5)	931 (26.7)	648 (22.1)	39 (10.9)	5 (15.2)	32 (14.5)	724 (20.4)
Under Graduate and beyond	376 (13.6)	69 (17.8)	14 (25.5)	33 (11.9)	492 (14.1)	189 (6.4)	18 (5.0)	2 (6.1)	3 (1.4)	212 (6.0)
χ^2 (p value)	28.72 (0.001)					65.23 (<0.001)				
Wealth Index										
Lower	260 (9.4)	36 (9.3)	5 (9.1)	17 (6.1)	318 (9.1)	290 (9.9)	44 (12.3)	2 (6.1)	26 (11.8)	362 (10.2)
Lower middle	502 (18.1)	44 (11.4)	13 (23.6)	48 (17.3)	607 (17.4)	518 (17.6)	53 (14.8)	3 (9.1)	32 (14.5)	606 (17.1)
Middle	513 (18.5)	55 (14.2)	9 (16.4)	34 (12.3)	611 (17.5)	518 (17.6)	43 (12.0)	6 (18.2)	35 (15.9)	602 (17.0)

Continued ....

Explanatory factors	Hypertension in men					Hypertension in women				
	Type 0	*Type 1*	*Type 2*	*Type 3*	*Total*	*Type 0*	*Type 1*	*Type 2*	*Type 3*	*Total*
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Upper middle	753 (27.2)	100 (25.8)	10 (18.2)	79 (28.5)	942 (27.0)	797 (27.2)	89 (24.8)	12 (36.4)	60 (27.3)	958 (27.0)
Upper	740 (26.7)	152 (39.3)	18 (32.7)	99 (35.7)	1009 (28.9)	812 (27.7)	130 (36.2)	10 (30.3)	67 (30.5)	1019 (28.7)
χ^2 (p value)	47.25 (<0.001)					23.05 (0.027)				
Earning Activities										
Self-employment	177 (6.4)	28 (7.2)	6 (10.9)	29 (10.5)	240 (6.9)	194 (6.6)	23 (6.4)	6 (18.2)	9 (4.1)	232 (6.5)
Agriculture	230 (8.3)	34 (8.8)	3 (5.5)	36 (13.0)	303 (8.7)	232 (7.9)	34 (9.5)	5 (15.2)	33 (15.0)	304 (8.6)
Business	418 (15.1)	55 (14.2)	6 (10.9)	39 (14.1)	518 (14.9)	404 (13.8)	50 (13.9)	3 (9.1)	27 (12.3)	484 (13.6)
Salaried service	304 (11.0)	71 (18.3)	15 (27.3)	40 (14.4)	430 (12.3)	370 (12.6)	62 (17.3)	5 (15.2)	29 (13.2)	466 (13.1)
Pension	146 (5.3)	50 (12.9)	1 (1.8)	21 (7.6)	218 (6.3)	208 (7.1)	51 (14.2)	1 (3.0)	21 (9.5)	281 (7.9)
Wage labour	1493 (53.9)	149 (38.5)	24 (43.6)	112 (40.4)	1778 (51.0)	1527 (52.0)	139 (38.7)	13 (39.4)	101 (45.9)	1780 (50.2)
χ^2 (p value)	99.30 (<0.001)					57.83 (<0.001)^y				

y = Yates' corrected chi-square

half of the men and women were involved in wage earning. All these explanatory variables were treated as categorical variables in binary logistic regression.

Effects of Explanatory Factors on Hypertension in Men and Women

The influence of explanatory factors on the different forms of hypertension (T1H, T2H, T3H) among men and women has been shown in Tables 5 and 6. The blood pressure category of T1H, T2H and T3H were the binary dependent variables in the binary logistic regression models. Each hypertension type was selected as the tested category and given code '1' and non-hypertension group was selected as the reference category and given code '0'.The model fits the data well, according to the Omnibus chi-square, for men (T1H: 198.60, T2H: 50.76, T3H: 221.14), and for women (T1H: 456.67, T2H: 38.43, T3H: 183.44), with a significant level p<0.01. The regression models for each kind of hypertension were significant (p<0.01), with the correct percentage of prediction for men T1H, T2H, T3H being 88.8 percent, 98.4 percent, 92.0 percent, and for women T1H, T2H, T3H being 89.5 percent, 99.0 percent, 93.7 percent respectively.

Predictors of Hypertension in Men

Age was found to be a significant positive predictor of T1H and T3H, indicating that older men were more likely to suffer from T1H and T3H (Table 5). All kinds of hypertension were negatively affected by undernutrition (<18.5 kg/m²), while overnourished (≥25.0 kg/m²) men were 1.63 times more likely to develop T1H than normal men (18.5 to 24.9 kg/m²).Central obesity (determined by WHtR) was positively associated with T2H and T3H, and centrally obese men were 2.30 and 1.99 times more likely to suffer from T2H and T3H, respectively. Religious Hindus were 1.52 times more likely to suffer from T1H than religious Muslims. The T3H was 1.84 and 1.72 times more likely to occur in those who were non-literate and in those who had completed primary-and-upper primary school education, respectively. A lower risk of T3H was found in the middle category of the wealth index (AOR 0.60, p 0.049). All earning activities except

Table 5: The logistic regression model indicates the role of explanatory factors on hypertension in men

Explanatory factors	*Type 1 hypertension*		*Type 2 hypertension*		*Type 3 hypertension*	
	AOR (95% CI)	*p-value*	*AOR (95% CI)*	*p-value*	*AOR (95% CI)*	*p-value*
Age Groups						
Young adults	*Reference*		*Reference*		*Reference*	
Middle aged adults	1.61 (1.19, 2.19)	0.002	1.38 (0.70, 2.72)	0.352	4.077 (2.63, 6.31)	<0.001
Older adults	4.30 (3.08, 6.00)	<0.001	0.52 (0.17, 1.57)	0.245	7.17 (4.46, 11.53)	<0.001
Body Mass Index						
Normal	*Reference*		*Reference*		*Reference*	
Undernutrition	0.71 (0.53, 0.96)	0.024	0.39 (0.16, 0.94)	0.037	0.67 (0.47, 0.97)	0.034
Overnutrition	1.63 (1.11, 2.38)	0.012	0.71 (0.28, 1.80)	0.472	1.38 (0.91, 2.09)	0.131
Waist Height Ratio						
Normal	*Reference*		*Reference*		*Reference*	
Central obesity	1.20 (0.89, 1.62)	0.244	2.30 (1.16, 4.57)	0.017	1.99 (1.43, 2.78)	<0.001
Religion						
Muslim	*Reference*		*Reference*		*Reference*	
Hindu	1.52 (1.07, 2.19)	0.019	2.23 (0.82, 6.10)	0.118	1.38 (0.91, 2.08)	0.131
Caste						
General caste	*Reference*		*Reference*		*Reference*	
OBC	1.12 (0.77, 1.64)	0.556	0.87 (0.27, 2.75)	0.808	0.92 (0.57, 1.47)	0.714
Scheduled caste	0.76 (0.56, 1.05)	0.099	1.07 (0.49, 2.32)	0.871	1.16 (0.80, 1.68)	0.427
Education						
UG and beyond	*Reference*		*Reference*		*Reference*	
Non literate	1.29 (0.79, 2.09)	0.305	0.69 (0.22, 2.19)	0.532	1.84 (1.03, 3.31)	0.040
Primary and UP	0.99 (0.65, 1.49)	0.944	0.76 (0.29, 2.00)	0.583	1.72 (1.04, 2.85)	0.035
Secondary and HS	1.36 (0.95, 1.95)	0.093	0.40 (0.16, 1.04)	0.061	1.25 (0.78, 2.01)	0.347
Wealth Index						
Upper	*Reference*		*Reference*		*Reference*	
Lower	1.48 (0.86, 2.52)	0.154	2.10 (0.52, 8.43)	0.296	0.57 (0.29, 1.14)	0.113
Lower middle	0.89 (0.55, 1.44)	0.633	2.32 (0.79, 6.83)	0.126	0.93 (0.56, 1.54)	0.764
Middle	1.15 (0.75, 1.76)	0.520	1.35 (0.45, 4.05)	0.591	0.60 (0.36, 0.99)	0.049
Upper middle	1.08 (0.78, 1.50)	0.642	0.85 (0.33, 2.19)	0.737	0.92 (0.63, 1.35)	0.682
Earning Activities						
Self-employment	*Reference*		*Reference*		*Reference*	
Agriculture	0.91 (0.52, 1.61)	0.755	0.52 (0.12, 2.15)	0.364	1.00 (0.57, 1.78)	0.991
Business	0.86 (0.52, 1.43)	0.565	0.46 (0.14, 1.49)	0.194	0.48 (0.28, 0.82)	0.008
Salaried service	1.22 (0.73, 2.04)	0.446	1.08 (0.36, 3.23)	0.897	0.53 (0.30, 0.94)	0.031
Pension	1.48 (0.85, 2.59)	0.170	0.18 (0.02, 1.65)	0.130	0.49 (0.25, 0.95)	0.035
Wage labour	0.89 (0.56, 1.43)	0.633	0.44 (0.16, 1.19)	0.105	0.58 (0.36, 0.95)	0.029

HS- Higher Secondary, UG - Undergraduate, UP - Upper Primary, OBC - Other backward classes

agriculture were significantly less likely to have T3H that is for business 0.48 times, formal sector and salaried service 0.53 times, pension 0.49 times, and wage labour 0.58 times, respectively.

Predictors of Hypertension in Women

Age was a significant positive predictor of T1H and T3H in women, indicating that older women were more likely to develop T1H and T3H than younger women (Table 6). Women who were undernourished were 0.58 times less likely to develop T3H, while overnourished women were 2.47 times more likely to develop T2H. Central obesity was positively associated with T1H and T3H, as centrally obese women were 1.52 and 1.64 times more likely to have T1H and T3H, respectively. When a woman belonged to the Scheduled Castes category, her chances of developing T3H were significantly reduced

Table 6: The logistic regression model indicates the role of explanatory factors on hypertension in women

Explanatory factors	*Type1 hypertension*		*Type 2 hypertension*		*Type 3 hypertension*	
	AOR (95% CI)	*p-value*	*AOR (95% CI)*	*p-value*	*AOR (95% CI)*	*p-value*
Age Groups						
Young adults	*Reference*		*Reference*		*Reference*	
Middle aged adults	11.06 (5.90, 20.76)	<0.001	0.99 (0.43, 2.26)	0.980	5.85 (3.34, 10.23)	<0.001
Older adults	44.86 (23.44, 85.86)	<0.001	0.64 (0.18, 2.36)	0.504	7.15 (3.85, 13.30)	<0.001
Body Mass Index						
Normal	*Reference*		*Reference*		*Reference*	
Undernutrition	1.18 (0.84, 1.67)	0.341	0.60 (0.15, 2.44)	0.473	0.58 (0.37, 0.92)	0.020
Overnutrition	0.91 (0.65, 1.29)	0.601	2.47 (1.09, 5.59)	0.031	1.04 (0.71, 1.53)	0.842
Waist Height Ratio						
Normal	*Reference*		*Reference*		*Reference*	
Central obesity	1.52 (1.09, 2.10)	0.013	2.13 (0.74, 6.15)	0.163	1.64 (1.13, 2.40)	0.010
Religion						
Muslim	*Reference*		*Reference*		*Reference*	
Hindu	1.16 (0.80, 1.69)	0.430	1.30 (0.50, 3.35)	0.590	1.20 (0.78, 1.85)	0.417
Caste						
General caste	*Reference*		*Reference*		*Reference*	
OBC	0.88 (0.57, 1.36)	0.556	1.12 (0.44, 2.88)	0.816	0.75 (0.45, 1.24)	0.254
Scheduled caste	0.99 (0.70, 1.42)	0.974	0.36 (0.11, 1.12)	0.077	0.64 (0.41, 0.99)	0.044
Education						
UG and beyond	*Reference*		*Reference*		*Reference*	
Non literate	1.15 (0.59, 2.23)	0.686	1.36 (0.20, 9.11)	0.752	6.34 (1.82, 22.15)	0.004
Primary and UP	0.91 (0.50, 1.67)	0.769	1.89 (0.35, 10.31)	0.460	3.59 (1.07, 12.05)	0.039
Secondary and HS	0.66 (0.35, 1.24)	0.199	0.75 (0.14, 4.10)	0.737	3.57 (1.07, 11.99)	0.039
Wealth Index						
Upper	*Reference*		*Reference*		*Reference*	
Lower	1.19 (0.72, 1.97)	0.495	1.29 (0.23, 7.22)	0.774	1.33 (0.73, 2.44)	0.349
Lower middle	0.93 (0.58, 1.48)	0.751	0.84 (0.18, 3.85)	0.821	0.96 (0.54, 1.68)	0.874
Middle	0.67 (0.43, 1.06)	0.089	1.16 (0.35, 3.91)	0.808	0.90 (0.53, 1.52)	0.687
Upper middle	0.89 (0.63, 1.25)	0.498	1.15 (0.43, 3.06)	0.785	1.03 (0.68, 1.56)	0.887
Earning Activities						
Self-employment	*Reference*		*Reference*		*Reference*	
Agriculture	1.05 (0.57, 1.94)	0.881	0.78 (0.23, 2.73)	0.701	3.83 (1.75, 8.41)	0.001
Business	0.92 (0.52, 1.63)	0.774	0.21 (0.05, 0.88)	0.033	1.36 (0.62, 3.01)	0.442
Salaried service	1.15 (0.65, 2.04)	0.628	0.43 (0.11, 1.68)	0.227	1.71 (0.76, 3.84)	0.195
Pension	0.92 (0.51, 1.67)	0.785	0.14 (0.02, 1.33)	0.088	1.66 (0.71, 3.89)	0.242
Wage labour	0.74 (0.44, 1.25)	0.256	0.50 (0.18, 1.42)	0.194	1.67 (0.81, 3.48)	0.167

HS- Higher Secondary, UG - Undergraduate, UP - Upper Primary, OBC - Other backward classes

(AOR 0.64, p 0.044) compared to the general castes category. Less educated people were more likely to have T3H hypertension.Inthe case of earning activity, those involved in agriculture were 3.83 times more likely to have T3H, while those in business were 0.21 times less likely to have T2H.

DISCUSSION

The results revealed that hypertension was associated with age, nutritional status, and sociodemographic characteristics among adult Bengalis in Birbhum. The blood pressure was found to be higher among men compared to women and this was significant in young and middle-aged adults. A review article by Ramirez and Sullivan reported similar findings, that there was a gender difference in hypertension, men were more susceptible to high blood pressure than women until the age of 75 (Ramirez and Sullivan 2018). The present study indicates that age has a significant effect on blood pressure, particularly on SBP, which rises quicker than DBP, as people get older. Age was a common

factor of systolic hypertension (T1H) in both men and women (Table 7). A similar finding was reported among the Bengali fishing community, where the study found that age was positively associated with blood pressure in both men and women (Mukherjee et al. 1988). The studies in Japan (Tsutsumi et al. 2001), Sub-Saharan Africa (Addo et al. 2007), China (Wang et al. 2018), and Bangladesh (Hossain et al. 2019) showed the same outcome, in terms of the association between age and blood pressure.

At the same time, BMI wasa common factor of diastolic hypertension (T2H), as lower DBP was found in underweight men, whereas higher DBP was found in overweight and obese women. Overweight and obesity in various regions of Indian communities co-existed with hypertension (Kshatriya and Acharya 2016; Vennu et al. 2019). Obesity was an indicator of hypertension and morbidity, along with other characteristics such as age and socioeconomic status, according to a report on the population of South Asia, including Bengalis in Bangladesh (Hossain et al. 2019). Blood pressure of undernourished Indian tribal groups was much lower than that of obese individuals (Das and Bose 2015). The study in three developing countries, namely, Ethiopia, Vietnam, and Indonesia, found that age and obesity (BMI) were significantly and positively related to blood pressure (Tesfaye et al. 2007).

This studyshowed that both systolic and diastolic hypertension (T3H) were affected by a variety of factors, including age, nutrition, and socioeconomic factors. The persons with lower BMI had less chance of developing Type 3 hypertension. Central obesity (WHtR) was a significant factor in increasing the risk of T3H. Among the elderly population in Egypt, WHtR emerged as the most prevalent and best predictor of high blood pressure (Tawfik 2018). Central obesity (WHtR) and hypertension were found to belinked among people aged 39 to 72 years in South Korea (Choi et al. 2018).Individuals with a lower level of education had a greater chance of developing T3H. Type 3 hypertension was found to be significantly lower in men with the middle wealth index and women in scheduled caste communities.

Socioeconomic variables were found to have a significant impact on blood pressure levels in the current study. Similar results were reported in some other research. The Chicago Heart Association evaluated 27,033 men and women (aged 25-64) and found that persons with less education had a higher prevalence of hypertension, and this was especially evident in the white community (Dyer et al. 1976). Another research in Italy found that education was a significant risk factor for a wide range of multifactorial diseases, including hypertension. Lower educated people were mostly suffering from complicated diseases, compared to higher educated people (Tedesco et al. 2001). Similar findings from the southern part of Italy suggested that education might be the strongest predictor of global cardiovascular risk among hypertensive people. Cardiovascular disease and other metabolic syndromes were mostly observed in people with lower levels of education (Chiara et al. 2017).

CONCLUSION

In conclusion, there were significant differences in blood pressure between rural Bengali men and women in the Birbhum district of West Bengal. Bengalis have a higher prevalence of systolic hypertension. The relationship between age and blood pressure was positive, with systolic pressure increasing at a faster rate than diastolic pressure. Systolic hypertension was strongly associated with age, while diastolic hypertension was strongly associated with body mass index, whereas central obesity was a strong predictor of both systolic and diastolic hypertension.

Table 7: Determination of common predictors for hypertension based on logistic regression

Hypertension	*Predicted factors*		
	Men	*Women*	*Common*
Only systolic	Age, BMI, Religion	Age, WHtR	Age
Only diastolic	BMI, WHtR	BMI, Earning activities	BMI
Both, systolic and diastolic	Age, BMI, WHtR, Education, Wealth index, Earning activities	Age, BMI, WHtR, Caste, Education, Earning activities	Age, BMI, WHtR, Education, Earning activities

RECOMMENDATIONS

Intensive lifestyle changes should be implemented early to reduce central obesity and the risk of hypertension. Public health initiatives aimed at lowering BMI at the population level are expected to have a positive impact on lowering hypertension. Simultaneously, more education on human health should be provided, which are expected to have a greater impact on reducing the burden of high blood pressure in rural Bengal.

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ABBREVIATIONS

ANOVA: Analysis of variance
BMI: Body Mass Index
DBP: Diastolic blood pressure
LMICs: Low-and middle-income countries
mmHg: Millimetres of mercury
NFHS: National Family Health Survey
PCA: Principal component analysis
SBP: Systolic blood pressure
SD: Standard deviation
SRS: Simple random sampling
T0H: No hypertension
T1H: Only systolic hypertension
T2H: Only diastolic hypertension
T3H: Systolic and diastolic hypertension (both)
VIF: Variance inflation factor
WHO: World Health Organisation
WHtR: Waist to Height Ratio

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