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Blood Pressure and Its Relationship with Obesity among the Young Adults Particularly Vulnerable Tribal Groups of West Bengal, India

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Abstract

There are more than 104.3 million tribal people living in India which comprises a total of 705 tribal groups, of which 75 tribal groups have been typically identified as Particularly Vulnerable Tribal Groups (PVTGs). They are different from mainstream society due to their primitive technology, low population growth, low literacy and economic conditions. In West Bengal total numbers of PVTGs are three, e.g. Birhor, Lodha and Toto. Most of them are unfamiliar with term blood pressure and its importance. The present study tries to look at two aspects, the first is the current state of blood pressure among young adult PVTGs in West Bengal, and the second is to find out possible indicators of obesity responsible for high blood pressure in the studied populations. A cross-sectional study was conducted among 536 young adult male and female participants aged 18 to 40 years. Different anthropometric measurements, skinfold thickness and blood pressures were collected by using globally recognized standard techniques. The result reveals that such three PVTGs have a higher percentage of normal blood pressure. There is a prevalence of high blood pressure typically found in the Toto (both male and female) and male Birhor communities. In these populations, central obesity or Waist Height Ratio (WHtR) is one of the significant indicators of obesity for hypertension, since stepwise multiple regression coefficients shows that the beta values are highly significant ($p<0.05$ and $p<0.01$).

Keywords: Particularly Vulnerable Tribal Groups, Blood Pressure, Cardiovascular disease, Central obesity, Obesity indicators.

AMS Classification: 92C50.

1. Introduction

Hypertension turns into a prime health trouble throughout the world, because of its strong association with cardiovascular disease (CVD). Hypertension is the clinical name of high blood pressure. The World Health Organization (WHO) has estimated that, one in every eight deaths occurs due to high blood pressure and so as to hypertension turn into the third killer in the world (WHO/IASO/IOTF, 2000). Nowadays, hypertension exerts as a considerable public health burden on CVD and healthcare systems in India (Srinath et al., 2005). In India 57 percent of all stroke deaths and 24 percent of all coronary heart disease (CHD) death take place for hypertension (Gupta, 2004).

A systematic management of hypertension is essential to any strategy formulated to control hypertension at the community level (Kundu et al., 2017). Different types of health hassles arising primarily due to unawareness or lack of consciousness (Moser, 1992). This fact at present turn into an important subject matter of bio-medical science in developing countries, because most of the people do not have little consciousness toward high blood pressure risks, even they do not check their blood pressure in a single time in their life (Mohan et al., 2013). As a result, in recent years it is increasing abruptly, instead of prevention. It has been argued that a comprehensive surveillance is most important for the management of non-communicable disease like hypertension (Steyn and Bradshaw, 2001).

More than 370 million people in the world belong to different indigenous communities, spread across more than 90 countries, with 70 percent of indigenous people living in Asia (DESA/UN, 2009). As per the census of India 2011, more than 104.3 million people in India belong to tribal communities, accounting for 8.6 percent of the country's total population; and it is the largest indigenous population in the world (MTA-GoI, 2013). Generally these tribal peoples are socio-economically very poor and non-literate. According to Ministry of Tribal Affairs, Government of India, these tribal populations again has a special branch or category called Particularly Vulnerable Tribal Groups (PVTGs), where about 75 tribal communities were considered. The PVTGs have four special characters,

(i) pre-agriculture level of technology, (ii) stagnant or declining population, (iii) extremely low literacy rate and (iv) subsistence level of economy. The West Bengal has total numbers of three PVTGs, e.g. Birhor, Lodha and Toto (MTA GoI, 2013).

These communities have their own social structure, law and order, norms and beliefs, rituals, ethno-medicinal practices; these all aspects have set them apart from the mainstream society (Chakravarty et al., 2005). Birhors are nomadic or semi-nomadic inhabitants of the hill-top and forest, but they are settled recently (Roy, 1925). Lodhas are living in the plane land but near the forest, most of them landless and they prefer to live in rural villages (Chakravarty et al., 2005). Totos are living in the village Totopara of West Bengal; it is situated at the Tading hill slope towards India-Bhutan border, and is surrounded by hilly forest and rivers (Majumdar, 1998). They are mostly dependents on ethno-medicinal health practices. There is a lack of education among them, so they are not very aware of modern medical care. They are also being deprived from modern medical care due to the inaccessibility of the area where they live. The socio-economic condition of most of them is very poor. They do not have proper knowledge about non-communicable diseases like cardiovascular disease, hypertension.

In last few decades, cardiovascular health has become more important issue among the young adults, because it is the age of rush and harsh life style, ambiguous social and mental network. As a result, many health problems are found among them, such as obesity (Lahti-Koski et al., 2002). Recently, the rate of obesity has been increased quickly in the young adults of both developed and developing countries (Bhurosy and Jeewon, 2014). Various epidemiological studies indicate obesity has a direct connection with cardiovascular disease and alternatively weight reduction is commonly associated with a decrease in blood pressure (Fahey et al., 2004). U S Department of Health and Human Services (2006) stated that, high blood pressure is now accepted as a disorder of lifestyle and the outcome of dietary indiscretions (excess calories and salt), obesity and lack of exercise. In India, prevalence of obesity is higher among the females and the contemporary lifestyle without health awareness play a leading role for the increase of obesity (Maiti et al., 2013). For this matter, obesity and hypertension both are the significant public health challenge among the young adult population of the developing countries (Mukhrerjee et al., 2018).

In such a situation, it is very important for the three vulnerable tribal communities in West Bengal to identify their current blood pressure status. The reason is that as far as our knowledge, no one has done research on these three communities together before on this topic. This study will provide an initial idea of the blood pressure status of the poor young adult vulnerable tribes in West Bengal.

The study seeks to know the current status of blood pressure among the young adult PVTGs of West Bengal. An additional objective is to find out the relationship between blood pressure and various obesity indicators and to identify the effective obesity indicator for hypertension in the studied population.

2. Materials and Methods

2.1. Sampling

A cross-sectional survey was conducted in April 2017 to March 2019 among young adult male and female Particularly Vulnerable Tribal Groups (PVTGs) of West Bengal, aged from 18 to 40 years. Total 536 research participants were selected from Birhor, Lodha and Toto community of West Bengal, among them 218 was male and 318 was female. The study areas were selected by deliberate sampling technique, and the participants were selected by random sampling technique. These three PVTGs were distributed on several parts of West Bengal, but in this study, areas were selected on the basis of their higher concentration of their residential zone. For this purpose, Birhors were selected from the district Purulia, Lodhas were selected from the district West Medinipur and Totos from the district Alipurduar in West Bengal. Random sampling technique was used for village selection under the districts then total enumeration was done for household survey in the selected villages. According to census of India 2011, the population size of Birhors and Totos were very small in West Bengal e.g. Birhors were 2,241, and Totos were 1,387; whereas Lodhas (Kheria/Kharia) were 1,08,707, and it is the largest PVTG of West Bengal.

2.2. Data collection

The schedule was prepared for the household survey to collect data from the participants, including age, sex, anthropometric measurements and blood pressures. Data were collected after obtaining written and oral consent in their

familiar language prior to each interview and measurement, in the presence of the traditional village headman, since most of them were non-literate.

2.2.1. Blood pressure measurements

Blood pressure (in mmHg) was measured by using an error free accurate mercury sphygmomanometer and stethoscope. The blood pressure was measured at morning, specifically 30 minutes after breakfast. 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. When participant was sitting in such a posture, their systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken (on nearest ±1.0 mmHg). High blood pressure was defined as SBP ≥130 mmHg and/or DBP ≥85 mmHg, hypertension was defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, and Isolated systolic hypertension was defined as SBP ≥140 mmHg and/or DBP <90 mmHg as per European Society of Hypertension and the European Society guideline (ESH/ESC, 2003; Khatib and El-Guindy, 2005). The mean arterial pressure (MAP) was obtained by applying the following simple equation, MAP = DBP + {1/3(PP)}, where PP (pulse pressure) = SBP – DBP (Pocock and Richards, 2009). High MAP considered as 99.01 to 105.67 and hypertension MAP considered as ≥105.68 (Kundu et al., 2017).

2.2.2. Anthropometric measurements

The anthropometric measurements were taken from the research participants on the basis of ISAK guidelines (Stewart et al., 2011). Total eight anthropometric measurements were collected from each studied participants. The measurements are: (i) body stature (in cm), measured by anthropometer (on nearest ±0.1 cm), (ii) body mass or weight (in kg), measured by a reliable portable weighing machine (on nearest ±0.1 kg), (iii) waist and (iv) hip circumference (in cm), measured by an inelastic tape (on nearest ±0.1 cm), four skinfolds (v) triceps, (vi) suprailiac, (vii) subscapular and (viii) mid-thigh skinfolds (in mm), measured by Holtain skinfold caliper (on nearest ±0.1 mm).

Obesity indicators were calculated by using internationally accepted formulas. Body mass index (BMI) was calculated as, weight in kilogram divided by height in meter square (kg/m^2). Regional fat distribution was estimated on the basis of

Waist Hip Ratio (WHR) and central obesity was estimated based on Waist Height Ratio (WHtR). The following particular formula was used to calculate the percentage of body fat (PBF), and this formula reduces the error of age in case of each study participant, the formula: PBF for male = 20.94878 + (age × 0.1166) – (Ht × 0.11666) + (Σ4 × 0.42696) – ($\Sigma 4^2$ × 0.00159), and PBF for female = 22.18945 + (age × 0.06368) + (BMI × 0.60404) – (Ht × 0.14520) + (Σ4 × 0.30919) – ($\Sigma 4^2$ × 0.00099562), Where Ht means body stature (in cm), and Σ4 means the sum of four skinfolds i.e. triceps, suprailiac, subscapular and mid-thigh (in mm) skinfolds (Peterson et al., 2003). Fat Mass (FM, kg) calculated as {(PBF/100) × Body weight in kg} and Fat Free Mass (FFM, kg) calculated as {Body weight (in kg) – Fat Mass (in kg)} (Eston et al., 2009). Regional fat distribution and central obesity were assessed by calculating the WHR and the WHtR respectively. Fat mass index (FMI) was estimated to know about the amount of fat per square meter body surface, FMI calculated as FM in kg divided by height (body stature) in meter square (FM/m^2). Similarly, fat free mass index (FFMI) was calculated as FFM in kg divided by height (body stature) in meter square (FFM/m^2).

2.3. Statistical analysis

All the collected data were analyzed by using the Statistical Package for the Social Science (SPSS version 25.0). For descriptive statistical analysis mean, standard division and percentage were calculated. Analysis of variance (ANOVA), correlation coefficient and stepwise multiple regression coefficient were used as inferential statistical analysis. All these statistical analysis tries to understand the differences of mean (for ANOVA) and the relation between blood pressure and obesity indicators (correlation and regression).

2.4. Ethical considerations

The relevant authorities and local community leaders were properly informed about the purpose and objective of the present study. Ethical approval was obtained from the ethics committee of the West Bengal State University.

3. Results and Discussion

Results of the study have been divided into two sections; one is a general description of the current state of blood pressure in young adult PVTG of West Bengal and another is to observe the relationship between blood pressures and obesity indicators. The descriptive statistics of the current study show the following overviews; all the data are expressed as mean (SD). For male and female participants mean SBP obtained as 120.25 (12.10) and 118.98 (14.20) respectively; DBP obtained as 80.73 (10.33) and 78.94 (11.92) respectively; and MAP obtained as 93.91 (10.09) and 92.29 (11.98) respectively.

3.1. Blood pressure condition among the young adult PVTGs of West Bengal:

Table 1: Differences of mean SBP, DBP and MAP among the studied participants

	SBP		**DBP**		**MAP**	
PVTGs	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Birhor	123.17 (13.25)	116.92 (16.35)	95.58 (11.60)	79.29 (12.72)	95.58 (11.60)	91.84 (13.34)
Lodha	117.05 (11.56)	116.10 (11.29)	79.02 (8.41)	76.00 (10.48)	91.70 (8.77)	89.37 (9.89)
Toto	121.91 (11.50)	122.49 (25.11)	81.85 (11.12)	81.60 (12.33)	95.21 (10.25)	95.23 (12.62)
ANOVA (F value)	5.176**	7.545**	1.906	7.517**	3.395*	7.491**

** Significant $p<0.01$, * Significant $p<0.05$

A summary of blood pressure among young adult male and female participants between three PVTGs is shown in Table 1. The table indicates that, there is a significant difference of mean SBP, DBP and MAP are present between the studied PVTGs, because F values are highly significant ($p<0.01$ and $p<0.05$), with the exception of male DBP. A difference in mean blood pressures between male and female is going to be noticed in terms of three PVTGs. Among the male participants, Birhors has the highest blood pressures, followed by Totos; and in the case of female the opposite results are seen, with the highest blood pressures found in Totos followed by Birhors. It is not possible to answer in this study exactly why such differences have been made it requires a more in-depth study. But there is no doubt that their way of life, ecological zones and even their food habits are different. So it can be said otherwise that, these factors may have an effect on their blood pressures.

Table 2a: Blood pressure category of Birhor participants

Blood pressure category	**SBP**		**DBP**		**MAP**	
	Male (%)	**Female (%)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Optimal	23 (56.10)	35 (68.63)	24 (58.53)	30 (58.82)	16 (39.02)	29 (56.86)
Normal	4 (9.76)	10 (19.61)	2 (4.88)	7 (13.73)	12 (29.28)	12 (23.54)
High Normal	10 (24.39)	2 (3.92)	3 (7.32)	6 (11.76)	6 (14.63)	5 (9.80)
Hypertension	4 (9.75)	4 (7.84)	12 (29.27)	8 (15.69)	7 (17.07)	5 (9.80)
Total	41 (100)	51 (100)	41 (100)	51 (100)	41 (100)	51 (100)

Isolated Systolic Hypertension, Male – 0 and Female – 2

Table 2b: Blood pressure category of Lodha participants

Blood pressure category	SBP		DBP		MAP	
	Male (%)	**Female (%)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Optimal	61 (72.62)	86 (67.71)	55 (65.48)	90 (70.86)	50 (59.52)	81 (63.78)
Normal	12 (14.29)	24 (18.90)	12 (14.29)	9 (7.09)	18 (21.43)	22 (17.33)
High Normal	9 (10.71)	13 (10.24)	8 (9.52)	13 (10.24)	11 (13.10)	18 (14.17)
Hypertension	2 (2.38)	4 (3.15)	9 (10.71)	15 (11.81)	5 (5.95)	6 (4.72)
Total	84 (100)	127 (100)	84 (100)	127 (100)	84 (100)	127 (100)

Isolated Systolic Hypertension, Male – 0 and Female – 4

Table 2c: Blood pressure category of Toto participants

Blood pressure category	SBP		DBP		MAP	
	Male (%)	**Female (%)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Optimal	47 (52.22)	73 (54.47)	47 (52.22)	73 (54.48)	39 (43.33)	68 (50.75)
Normal	21 (23.33)	28 (20.90)	12 (13.34)	12 (8.96)	24 (26.67)	22 (16.41)
High Normal	16 (17.78)	16 (11.94)	10 (11.11)	13 (9.70)	15 (26.67)	20 (14.93)
Hypertension	6 (6.67)	17 (12.69)	21 (23.33)	36 (26.86)	12 (13.33)	24 (17.91)
Total	90 (100)	134 (100)	90 (100)	134 (100)	90 (100)	134 (100)

Isolated Systolic Hypertension, Male – 3 and Female – 0

The frequency distribution of the blood pressure category among the studied PVTGs has been represented through Table 2a, Table 2b and Table 2c. These

three PVTGs have a higher percentage of *optimal* and *normal* blood pressures categories in both sexes. But overall *high normal* and *hypertension* categories are not considerably low in the percentage, enough to be agonizing. In the case of SBP and DBP, the percentages of blood pressure categories are different in male and female participants, this circumstances does not accurately highlight the overall status of blood pressure. Mean arterial pressure (MAP) for this matter is considered here as a cumulative outcome result of SBP and DBP. Birhors have maximum percentages of higher SBP (24.39+9.75 = 34.14) and higher DBP (7.32+29.27 = 36.59) among the males, another major fact is that their percentage of diastolic hypertension is much higher (29.27) than the rest of the males. Among the females, Totos have the highest percentage of higher SBP (11.94+12.69 = 24.63) and higher DBP (9.70+26.86 = 36.56), major fact is that their percentage of diastolic hypertension is much higher (26.86) than the rest of the females. In the case of Lodhas, the sum of *high normal* and *hypertension* is about 20 percent or less, that is lower than the other two PVTGs. The maximum percentages of higher MAP are found in the Totos for both males and females, males account for 40 percent (26.67+13.33) and females account for 32.84 percent (14.93+17.91).

The patient with harmful blood pressure is also found among the PVTGs i.e. Isolated Systolic Hypertension (ISH, SBP >140 and DBP <90), it is considered as an out layer of the normal blood pressure's category. SBP tends to increase with age, but usually it is uncommon in young people. But why this abnormal blood pressure condition (ISH) has been found in them is a matter of concern. There are two and four female ISH patients from Birhor and Lodha communities, and three male ISH patients from Toto community. All these tables are showing that most of the PVTGs belong to the normal category of blood pressure, but hypertension is still symptomatic and not unusually mild.

3.2. Relation between Blood pressure and Obesity indicators

Table 3a: Correlation between Blood pressures and Obesity indicators among the male participants

Obesity indicators	Mean (SD)	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)
Body Mass Index	20.77 (2.80)	0.208*	0.197*	0.218**
Waist Hip Ratio	0.89 (0.06)	0.083	0.211*	0.177
Waist Height Ratio	0.45 (0.04)	0.165	0.230*	0.223**
Percent of body fat	18.81 (5.08)	0.045	0.129	0.106
Fat Mass	10.83 (4.28)	0.136	0.191*	0.185
Fat Free Mass	45.78 (7.08)	0.215*	0.144	0.184
Fat Mass Index	3.98 (1.54)	0.112	0.176	0.165
Fat Free Mass Index	16.78 (1.85)	0.223**	0.152	0.193*

Significant, *P<0.05, **P<0.01

Table 3b: Correlation between Blood pressures and Obesity indicators among the female participants

Obesity indicators	Mean (SD)	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)
Body Mass Index	20.74 (3.64)	0.322**	0.345**	0.356**
Waist Hip Ratio	0.83 (0.07)	0.246**	0.302**	0.298**
Waist Height Ratio	0.46 (0.06)	0.326**	0.391**	0.388**
Percent of body fat	28.57 (5.69)	0.268**	0.285**	0.295**
Fat Mass	14.18 (5.31)	0.331**	0.365**	0.372**
Fat Free Mass	34.18 (5.57)	0.269**	0.293**	0.301**
Fat Mass Index	6.10 (2.27)	0.308**	0.337**	0.345**
Fat Free Mass Index	14.68 (1.68)	0.287**	0.307**	0.317**

Significant, *P<0.05, **P<0.01

Table 3a and Table 3b reveal the results of the correlation between blood pressure and several anthropometric variables, respectively for male and female participants, considered for the present study. The correlation coefficient between blood pressure and obesity indicators (Table 3a) among young adult male

participants shows that SBP significantly correlated with BMI, FFM and FFMI; DBP significantly correlated with BMI, WHR, WHtR and FM; and MAP significantly correlated with BMI, WHtR and FFMI. On the other hand, among the young adult female participants, the correlation coefficients between blood pressure and obesity indicators (Table 3b) reveal that, SBP, DBP and MAP significantly correlated with all the obesity indicators. It has also been observed from both tables that the correlation between SBP and DBP is not the same for different obesity indicators hence MAP is taken into consideration. MAP shows the strongest and maximum correlation with WHtR in both sexes. Another notable point is that there is a disparity noticed between males and females in the association of blood pressure and obesity indicators.

Table 4: Multiple regression (stepwise) between Blood pressures as dependent variable and Obesity indicators are as independent variables

Sex	Blood pressures	Predictors	B	R^2 change	t value	p value
Male	SBP	WHtR	0.165	0.027	2.441	0.015
	DBP	WHtR	0.230	0.053	3.456	0.001
	MAP	WHtR	0.223	0.050	3.343	0.001
Female	SBP	WHtR	0.326	0.106	5.952	0.001
	DBP	WHtR	0.391	0.079	7.329	0.001
	MAP	WHtR	0.388	0.150	7.261	0.001

The results of stepwise multiple regression coefficients are stated in table 4, which includes six linear multiple regression coefficients in compact. In this table, all the obesity indicators are selected as independent variables as well as SBP, DBP and MAP are selected consistently as dependent variables. The beta value (β) refers that, from all the independent variables only WHtR is significantly ($p<0.01$) predicting SBP, DBP and MAP among the studied participants. On the basis of R^2 change, the model predicts that the percentage of variance (R^2) is 2%, 5% and 5% respectively for males and 10%, 7% and 15% respectively for females for SBP, DBP and MAP with an independent variable.

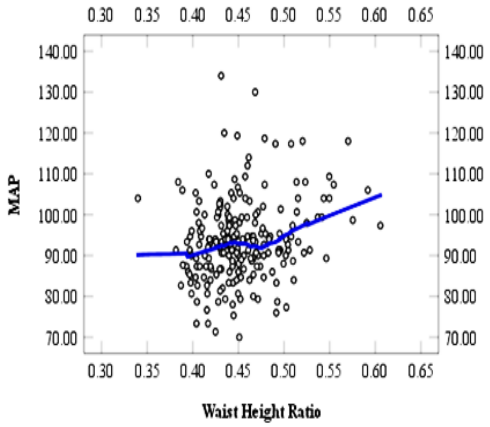

Figure 1: Comparetive distribution of Mean Arterial Pressure and Waist Height Ratio among the young adult male PVTGs of West Bengal

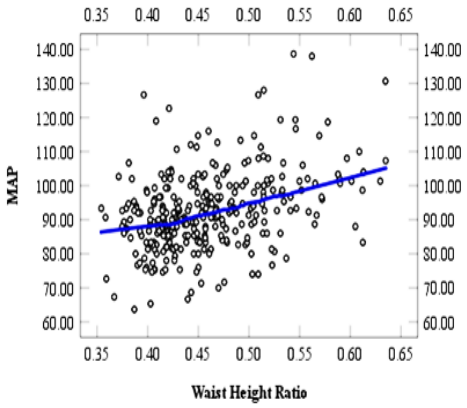

Figure 2: Comparetive distribution of Mean Arterial Pressure and Waist Height Ratio among the young adult female PVTGs of West Bengal

It is now clear WHtR is an important factor in increasing blood pressure, and that WHtR is an indicator of regional obesity or central obesity. The relationship of MAP with WHtR between male and female participants is presented in Figure 1 and Figure 2, respectively. Here, MAP used for the assessment of blood pressure, because MAP is the better indicator for the analytical interpretation as compare to SBP and DBP separately as it yield different results. Both the figures describe the scattered plot along with a Loess-Gaussian curve and its confidence interval is 95% level. More or less both figures show MAP increased positively with increasing WHtR among male and female participants.

4. Conclusions

In the developing countries like India, one of the major challenging health issues is hypertension, because this global burden of non-communicable disease is increasing dramatically. Even the vulnerable tribal groups in West Bengal have not been left out of this global problem, and this study found evidence of that. Hypertension or high blood pressure is basically a multifactorial trait; multiple factors are responsible for increasing blood pressures under two main umbrellas, such as biological factors and environmental factors. This study concentrated primarily on obesity as a biological factor. Obesity being one of the major risk factors of chronic non-communicable disease likes hypertension; it is generally measured in terms of different obesity indicators. It is clear from this study that

there is a trend of high blood pressure found among the vulnerable tribal population of West Bengal and its effects are seen even among the young adults.

However, the trend of high blood pressure or hypertension is going to be noticed, though the percentage is small, particularly young adult male Birhors and Totos (male and female) have the highest number of patients with hypertension. Additionally, about 1.68 per cent of the total population (studied PVTGs, 527 + 9) is in the category of Isolated Systolic Hypertension (ISH). The ISH affects on Birhor and Lodha females, as well as Toto males. They will need health checkups or may have a possible heart attack or other medical problem.

This study also explores the association between obesity and blood pressure in young PVTGs of West Bengal, and identifies a particular obesity indicator in the hypertension assessment. The results show that obesity plays a substantial role in elevating blood pressure. Most striking fact is that WHtR has a positive effect on blood pressures in the studied participants (male and female), and also WHtR significantly predicts all the blood pressures (SBP, DBP and MAP). The WHtR specifically indicates a person's central obesity. This study reveals that central obesity is associated with elevated blood pressure, and the Waist Height ratio (WHtR) is a better predictor of obesity for the assessment of hypertension or high blood pressure among young adult PVTGs of West Bengal.

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