

## Prevalence of Hypertension and Prehypertension among Young Adult Students of Midnapore Town, Paschim Medinipur, West Bengal, India

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### ABSTRACT

**Background:** Hypertension is one of the most prevalent public health concerns and also one of the prominent factors in affecting the cardiovascular diseases (CVDs), coronary heart diseases (CHDs). It has been termed as ‘Silent Killer’. About 46.0% of adults worldwide with hypertension are unaware that they have the condition. **Methods:** The present study aimed at the investigation on the anthropometric, derived variables and blood pressure variables. It also determined the correlation between anthropometric, derived variables and blood pressure variables. It estimated the prevalence rate of hypertension and prehypertension among the young adult students of Midnapore Town, Paschim Medinipur, West Bengal, India. The cross-sectional study was conducted among 201 young adult male students aged between 18 to 28 years. Height (HT), Weight (WT), Mid upper arm circumference (MUAC), Hip circumference (HC), Waist circumference (WC), Biceps skinfold (BSF), Triceps skinfold (TSF), Subscapular skinfold (SSF) and Suprailiac skinfold (SISF), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and pulse rate measurement were taken using standard procedure. **Results:** The overall prevalence of hypertension was found to be 10.9% among the studied participants and 44.3% was the prehypertension prevalence rate. A significant correlation ( $p < 0.05$ ) was found between blood pressure variables and different anthropometric and derived variables. **Conclusion:** This study demonstrated that there is a very strong prevalence of prehypertension and HTN among the young adult students of Midnapore town. Results of such kind of researches can be helpful in the formulation of appropriate awareness programmes in the universities and colleges.

**Key words:** Hypertension, prehypertension, students, systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate

**B**lood pressure (BP) is defined as the force of blood pushing against the walls of the arteries as the heart pumps blood. High blood pressure or hypertension (HTN) is a classified disease in which the flow of blood in the arteries is higher than normal pressure. It is one of the most prevalent public health concerns and also one of the prominent factors in affecting the cardiovascular diseases (CVDs), coronary heart diseases (CHDs), stroke and renal disease [1]. WHO, 2021 has stated that HTN is a major cause of premature death, worldwide. The relationship between HTN and CVDs is constant and independent of other risk factors. HTN also increases the risk of cardiac arrest and heart failure [2]. HTN may not have symptoms and many people reported that they did not know about their high BP for many years [3]. That is why it has been termed as ‘Silent Killer’ [4-6].

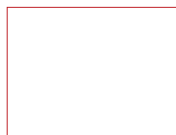
About 46.0% of adults worldwide with HTN are unaware that they have this condition [7]. The JNC VII, 2004 [2] report by US Department of Health and Human Services has classified blood pressure in 4 grades. These are (i) Optimal or normal BP, Systolic BP (SBP)  $< 120$  mmHg and Diastolic BP (DBP)  $< 80$  mmHg; (ii) Prehypertension, SBP 120-139 mmHg or DBP 80-89 mmHg; (iii) HTN stage I, DBP 140-159 mmHg or 90-99 mmHg; (iv) HTN stage II,  $> SBP 160$  mmHg or DBP  $> 100$  mmHg. Prehypertension is not a disease category. It has been designated to identify individuals at high risk of developing HTN. Prehypertensive individuals does not have any need to take drug therapy on their level of BP. Rather they should modify their lifestyle in order to reduce their risk of developing HTN in future. There are 2 types of HTN depending on the etiology. The major type is Primary or Essential HTN, which affects 90- 95% of hypertensive patients and the other type is Secondary HTN.

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The pathogenesis of primary HTN is complicated and multifaceted. Environmental factors and behavioural factors such as lifestyle, eating habit, excessive salt intake, smoking, stress, alcohol consumption, obesity are main factors for having HTN [6]. Genetic abnormalities such as mineralocorticoid-remediable aldosteronism, 11 beta-hydroxylase and 17 alpha-hydroxylase deficiencies and Liddle's syndrome can result in rare forms of HTN [2]. Other factors like hyperactivity of renin-angiotensin-aldosterone system and sympathetic nervous system, abnormal production of natriuretic peptides, and deficiency in endothelial vasodilation substances may be involved in essential HTN [8]. The causes of secondary HTN include renal disease, obstructive sleep apnea, primary aldosteronism, Cushing's syndrome [6].

There are various factors which can positively affect HTN. Among them obesity or weight of an individual is one of the most prominent factors. The association between blood pressure and body weight has been positively demonstrated many decades ago through the Framingham Heart Study in the 1960s in the US. From then studies conducted in different countries like China, Korea, Hong Kong, Nigeria, India also reported this association [9].

According to World Health Organization [7] approximately 1.28 billion adults aged 30-79 years worldwide have hypertension, most of them living in low and low-middle income countries. The WHO African region has the highest prevalence of hypertension (27.0%), while the WHO regions of the Americas have the lowest prevalence of hypertension (18.0%). It varies across regions and country income groups. According to Law et al., 2009 [51] HTN affects approximately one quarter of the world's adult population and the estimated value of HTN will increase to 29.0% by 2025. The WHO has estimated that a suboptimal BP (SBP > 115mmHg) is globally accountable for 62.0% of cerebrovascular disease and 49.0% of ischemic heart disease [10].

An estimated value of hypertensive patients worldwide will be 29.2% by the year 2025 [11]. In a 2010 study by Mittal et al. it has been found that HTN is present in approximately 35.0% of Latin American population; 20.0-30.0% of Chinese and Indian population, and 14.0% of sub-Saharan African countries [12]. In developing world, the main factors contributing to rising case of HTN are rapid urbanization, changing lifestyle, racial ethnic differences, nutritional status, and birth weight [12]. In the South Asian Association for Regional Cooperation (SAARC) countries the overall prevalence of HTN is 27.0% and prehypertension is 29.6%. In developing countries such as, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka the prevalence rates of HTN are 17.9%, 23.9%, 31.4%, 31.5%, 33.8%, 25.0%, 20.9%, respectively [13]. In developed countries like China, US, UK and Germany HTN prevalence rates are 23.2%, 45.4%, 16.9% and 32.0%, respectively [14,15,16,17].

In India the prevalence rate of HTN is 30.7%. Both the SBP and DBP is higher among men than women [18]. In India among 15 to 49 years of age the prevalence rate is 11.3%, where in the urban population has marginally higher rate (12.5%) than rural population (10.6%) [19]. According to WHO about 12.0% people with HTN in India have their BP under control. A nationwide study in India showed the prevalence of HTN among 15-49 years old adult males is higher (13.8%) than females (8.8%) aged between 15-54 years [20]. Among the rural community of central India, the prevalence rate of HTN is 19.0%, where females (23.4%) show higher prevalence rate than males (14.4%) [21]. Where as in north Indian states such as Delhi the HTN prevalence rate is much lower only 14.1%; age, education and cholesterol levels were found to be independent factors of HTN [22]. In eastern rural India (West Bengal) the HTN prevalence rate is 24.7% among women [23].

According to Govt. of West Bengal's Health & Family Welfare Department West Bengal has approximately one crore adults with HTN with a prevalence rate of 22.0%. Midnapore district has a prevalence rate of 19.2% among males and 5.2% among females for hypertension [24]. In Hooghly district of West Bengal, the prevalence rate of HTN is 21.8% among adult males [25]. In Paschim Medinipur the prevalence rate is higher among females (52.5%) than males (27.3%) [3].

As there are many studies on blood pressure among older adults in various regions of the world. But in India, there are very scanty information on HTN among the typical age group of young adult male students who are generally between 18 to 30 years of age. Students of this age group suffers from various stressors like depression, anxiety, academic stress, financial stress, health-related and self-imposed stress [26], also from nutritional problems, exercising activities and social support which influence the academic performance. We need to conduct more such studies to evaluate and put necessary intervention if needed. The objective of this study was to study the prevalence rate of HTN and its association with anthropometric and derived variables among the young adult male students of Midnapore District, Paschim Medinipur, West Bengal.

## MATERIALS AND METHODS

### Study area and participants

The present cross-sectional study was conducted during May 2022, among the young adult male students of Midnapore District, Paschim Medinipur, West Bengal. The study was conducted among 201 adult males aged between 18 to 28 years. The study participants were selected using the purposive sampling method. A well-structured schedule has been administrated to collect information on age (in years),

socio-economic status etc. from the participants. The objectives and methods of the study were explained to each participant before data collection. Verbal consent has been taken from each participant before commencing of the study. All of the participants of this cross-sectional study were from various blocks of the Paschim and Purba Medinipur. And they all are currently living in different messes of Midnapore town. Some of them are studying in Midnapore City College, Midnapore College (Autonomous) and most of the study participants are studying in Vidyasagar University.

Data were collected from different messes of Midnapore town. All the participants were apparently free from any physical deformity. They were not suffering from any diseases during the time of data collection. Only those individuals who were not taking medication for hypertension have been included in the present study. Age (in years) of the individuals were recorded from the identity card provided by their college/university. The objectives and the methods of the present study were explained to them in a simple and detailed manner and finally 201 adult males agreed to take part in the study.

### Anthropometric measurements

Anthropometric measurements were taken as per standard techniques (Lohman et al., 1988) [27]. Height (HT), weight (WT), mid upper arm circumference (MUAC), hip circumference (HC), waist circumference (WC), biceps skinfold (BSF), triceps skinfold (TSF), subscapular skinfold (SSF) and suprailliac skinfold (SISF) measurement were taken. Height was measured using Martin's anthropometric rod to the nearest 0.1 cm. Weight was taken using a standard spring balance weighing machine to the nearest 0.5 kg. Different circumferential measurements were taken using non-stretchable measuring steel tape and was recorded to nearest 0.1 cm. All of the skinfold measurements were recorded to the nearest 0.2 mm.

### Measurement of blood pressure

Systolic blood pressure (SBP), Diastolic blood pressure (DBP) and pulse rate were measured on the left arm of all the study participants using an Omron HEM 7120 (Japan) digital blood pressure monitor. The participants were seated at least for five minutes in the chair before the measurement. The left arm of the participants was being supported at the level of the heart, resting on an arm rest. The cuff was placed on nearly 2cm above the brachial artery. The measurement of blood pressure for all the participants were taken three times and the average of the three values was adopted.

### Assessment of blood pressure

To evaluate the Mean arterial pressure (MAP) the following formula was used:  $MAP = DBP + 1/3 \times (SBP - DBP)$ .

**Table 1: Classification of blood pressure (JNC-VII, 2004)**

Blood pressure Category	SBP (mmHg)/ DBP (mmHg)
Normal	<120 and <80
Prehypertension	120 – 139 or 80 - 89
Hypertension stage I	140 – 159 or 90 - 99
Hypertension stage II	>160 or >100

### Assessment of nutritional status

The Waist-hip ratio (WHR), Waist-height ratio (WHtR), Conicity index (CI) was derived using following standard equations:

$$WHR = \text{Waist circumference (cm)} / \text{hip circumference (cm)}$$

$$WHtR = \text{Waist circumference (cm)} / \text{height (cm)}$$

$$CI = \text{Waist circumference (m)} / 0.109 \times \sqrt{\text{weight (kg)} / \text{height (cm)}}^{28}$$

### Statistical analysis

All statistical analysis were undertaken using SPSS for windows (version 26.0). A p-value of  $p < 0.05$  was considered to be statistically significant. Correlation analysis was employed to determine the association between the anthropometric and derived variables and blood pressure variables (SBP, DBP and MAP).

## RESULTS

Table 2 shows the details of anthropometric (both simple as well as derived) and BP variables of all the study participants.

**Table 2: Anthropometric, derived and blood pressure variables (mean  $\pm$  SD) among the studied participants**

Variables	Mean + SD
Age (years)	22.23 + 1.78
HT (cm)	166.69 + 6.26
WT (cm)	60.23 + 10.44
WC (cm)	77.58 + 11.60
HC (cm)	90.63 + 7.43
MUAC (cm)	25.73 + 2.90
BSF (mm)	6.86 + 3.18
TSF (mm)	12.12 + 5.00
SISF (mm)	15.72 + 7.80
SSF (mm)	17.16 + 7.00
BMI (kg/m <sup>2</sup> )	21.72 + 3.38
WHR	0.86 + 0.11
WHtR	0.47 + 0.06
CI	1.19 + 0.14
MAP	91.78 + 9.72
SBP (mmHg)	121.48 + 11.56
DBP (mmHg)	76.93 + 10.20
Pulse Rate	83.13 $\pm$ 14.16

**Table 3: Prevalence of BP (mmhg) among studied participants**

Blood pressure category	N	Prevalence
Normal	90	44.9
Prehypertension	89	44.3
Hypertension Stage I	13	6.5
Hypertension Stage II	9	4.5
Total	201	100.0

N- number of participants

Table 3 shows the number and prevalence rate of blood pressure categories among the studied participants. The noticeable amount of similarity between the prevalence rate of normal (44.9%) and prehypertensive (44.3%) participants is remarkable. Overall prevalence rate of hypertension was 10.9%, whereas most of the population (6.5%) is on the stage I of hypertension.

**Table 4: Correlation of anthropometric, derived variables and blood pressure variables among studied participants**

Variables	SBP (mmHg)	DBP (mmHg)
HT (cm)	0.034	-0.047
WT (kg)	0.311**	0.300**
WC (cm)	0.204**	0.235**
HC (cm)	0.344**	0.306**
MUAC (cm)	0.229**	0.230**
BSF (mm)	0.258**	0.287**
TSF (mm)	0.239**	0.271**
SISF (mm)	0.201**	0.212**
SSF (mm)	0.253**	0.273**
BMI (kg/m <sup>2</sup> )	0.344**	0.356**
WHR	0.009	0.070
WHTR	0.199**	0.245**
CI	0.034	0.076

Significant at \*p<0.05, \*\*p<0.01

Table 4 shows the result of correlation analyses among anthropometric (Simple as well as derived) and blood pressure variables. Weight is significantly associated with blood pressure variables (p<0.01). Systolic blood pressure and DBP is also significantly correlated with BMI and WHTR (p<0.01). Mid upper arm circumference is also significant with blood pressure variables (p<0.01). Height, WHR and CI is not significantly associated with SBP and DBP (p>0.05). All of the skinfold measurements (BSF, TSF, SISF, SSF) are significantly associated with DBP and SBP (p<0.05).

## DISCUSSION

The present study has found an overall 10.9% HTN prevalence rate among the young adults of Midnapore town, it

is less than what Karpinos et al., 2013<sup>40</sup> found in US adult male athletes (19.2%). A study in Bangladesh<sup>29</sup> among adult students found the HTN prevalence rate among males 12.1% which is quite similar to the present study. In Saudi Arabia<sup>30</sup> the prevalence rate of HTN is 7.5% among university students, it is quite low from the present study. A study from Gujrat by Chandwani (2010)<sup>31</sup> found the prevalence rate of HTN among males of age group above 20 years is 25.5%. In Bankura, West Bengal Gazi et al. (2015)<sup>32</sup> found 12.0% prevalence rate for HTN which is closer to the present study. The prevalence of HTN is 20.9% among the adult Bengali males from Midnapore<sup>24</sup> which is almost double than what the present study have found (10.9%). The fact that maximum number (44.3%) of young adults (18-28 years of age) are found prehypertensive in the present study is conforming with the worldwide range of prehypertension prevalence rate in young adults, which is around 37.5% to 77.1%<sup>33</sup>.

In the present study there was significant association (p<0.01) between BMI general obesity and BP among the studied individuals. A significant association (p<0.001) has been found between WC and WHtR based central obesity and blood pressure. An increase or decrease in BMI result in the increase or decrease in SBP and DBP and overall BP<sup>34</sup>, this phenomenon is also evident from the present study where a significant relation found between BMI and BP. A study has shown that in Punjab the SBP and DBP both are higher among males than females<sup>35</sup>.

A Swiss study has found that a gain of 1.7 kg/m<sup>2</sup> in BMI, of 4.5 cm in WC or of 3.4% in WHR corresponded to an elevation of 1 mmHg in SBP<sup>36</sup>. Thus, the significant association between central obesity and HTN is well established which is also evident from the present study. The prevalence of central obesity and HTN in developing countries like India has seen an increasing trend. Chanak and Bose (2019)<sup>3</sup> found highly significant relation between central obesity and HTN in Paschim Medinipur region. The present study has shown that there is significant correlation between WC and SBP as well as DBP (p<0.001). Hip circumference is also significantly correlated with other measure of central obesity like SBP, DBP and WHtR. Deshmukh et al., 2006<sup>48</sup>; Nagai et al., 2008<sup>49</sup> and Kaur et al., 2013<sup>50</sup> also demonstrated a high correlation between SBP and WC.

## CONCLUSION

Despite these limitations this study demonstrated that there is a very strong prevalence of prehypertension and HTN among the young adult students of Midnapore town. Also, there is a very significant association between overweight/obesity and HTN among the young adult students. HTN and obesity, which are global health burden especially in developing countries such as India. These two conditions result in an increased morbidity and progressive increase in medical costs.

**Table 5: Prevalence of hypertension: worldwide comparison**

Studied population	Studied area	Sample size	Age group (years)	Prevalence (%) of hypertension		Reference
				Male		
Indonesian adults	Indonesia	29,965	18 and above	31.0		Peltzer & Pengpid, 2018 <sup>37</sup>
Saudi population	Saudi Arabia	4758	15-64	27.1		Saeed et al., 2011 <sup>30</sup>
Chinese adults	China	46,239	20 and above	29.2		Gao et al., 2013 <sup>38</sup>
Ethiopian adults	Ethiopia	2153	18 and above	22.0		Nshisso et al., 2012 <sup>39</sup>
Adult athletes	United States	636	18 and above	19.2		Karpinos et al., 2013 <sup>40</sup>
Nigerian adults	Osun state, Nigeria	259	18 and above	5.7		Asekun-Olarinmoye et al., 2013 <sup>41</sup>
Urban population	China	7307	15 and above	22.6		Wang et al., 2018 <sup>14</sup>
Rural population	China	7649	15 and above	27.3		Wang et al., 2018 <sup>14</sup>
Adult students	Paschim Medinipur, India	201	18-28	10.9		Present study

**Table 6: Prevalence of hypertension: nationwide comparison**

Studied population	Studied area	Sample size	Age group (years)	Prevalence (%) of hypertension		Reference
				Male		
Urban adults	Jamnagar, Gujrat	271	20 and above	25.5		Chandwani et al., 2010 <sup>31</sup>
Village population	Uttarakhand	1348	15 and above	30.9		Bansal et al., 2012 <sup>42</sup>
Village population	Kathmandu	1218	21 and above	38.3		Vaidya et al., 2012 <sup>43</sup>
Tribal adults	Kerala	898	20-29	30.5		Meshram et al., 2012 <sup>44</sup>
Village adults	Nadia, West Bengal	1115	20-70	19.2		Biswas & Manna, 2011 <sup>45</sup>
Slum area adults	North 24 Parganas, West Bengal	527	25-24	26.0		Acharyya et al., 2014 <sup>46</sup>
Rural adults	Paschim Medinipur, West Bengal	310	18 and above	27.3		Chanak & Bose, 2019 <sup>3</sup>
Bengalee adults	Midnapore, West Bengal	498	18 and above	20.9		Singh et al., 2014 <sup>24</sup>
Sabar adult males	Purulia	215	18-63	37.7		Das et al., 2019 <sup>47</sup>
Rural males	Bankura	124	18-35	12.0		Gazi et al., 2015 <sup>32</sup>
Adult students	Paschim Medinipur, India	201	18-28	10.9		Present study

Also, these conditions can profoundly affect the pathophysiological mechanisms and which in turn can have impact on the educational level of the students. HTN, which is a lifestyle disease and termed as “silent killer” can cause decrease in concentration and increase in lethargy. In the most important phase of life when students are in a stage that can have a strong impact in their future life, obesity and HTN these two diseases can have the capacity to ruin that phase.

Prehypertension is another alarming situation in the present study, requires much attention because of the age group in which the study was conducted. Though prehypertension is not a disease category but, if lifestyle of prehypertensive adults is not modified then it can surely develop into HTN with increasing age. Males are found overall more prehypertensive than females in most of the world regions. But the sheer presence of prehypertension in this prevalence rate is not ideal at all for young adults who will construct the upcoming generation of this country. HTN increases with age, i.e., it is more prevalent in the older adults than younger ones. Thus, the burden of health is going to be much higher in future than the present situation. Further studies are required to fully comprehend the situation and health impacts of obesity and HTN among young adult student population.

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