



## RESEARCH ARTICLE

### OBESITY: A MAJOR CONTRIBUTOR TO THE DEVELOPMENT OF HYPERTENSION

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#### ABSTRACT

**Background:** To define various categories of obese and nonobese subjects by BMI and physical conditions (underweight and overweight problems) and also to identify obesity-related hypertension in studied people.

**Methods:** A population-based survey was conducted to gather data about obesity and hypertension and their associated risk factors (sociodemographic and biochemical) from 2,453 members of households of studied people. Blood samples were also collected from 114 willing participants for the biochemical analysis. Data were analyzed using 'z' and chi-square test at both 5% and 1% level of significance.

**Results:** The studied people were grouped into many stages like underweight (BMI<18.5kg/m<sup>2</sup>), Normal (BMI=18.5-24.9 kg/m<sup>2</sup>), overweight (BMI=25.0-29.9 kg/m<sup>2</sup>) and Obese (BMI≥30 kg/m<sup>2</sup>). The prevalence of hypertension is very common in overweight and obese (BMI≥25.0) subjects. Both blood pressure (p<0.01) and hypertension (p<0.01) are found to be significantly increased with increasing BMI.

**Conclusions:** The results of this study indicate that the obesity is responsible for the development of hypertension.

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## INTRODUCTION

Obesity results from accumulation of excessive adipose tissue (Yousuf *et al.*, 2010), that possible accounts for 78% and 65% of essential hypertension in men and women as revealed in the Framingham's study (Vasan *et al.*, 2001). The prevalence and distribution of hypertension is high in those people who are suffering from obesity problem (Biswas and Manna, 2011). Hypertension is defined as BP (SBP/DBP) ≥140/90 mmHg (James *et al.*, 2014) whereas preobese (overweight) and obese are identified as BMI≥25.0-29.9 kg/m<sup>2</sup> and BMI≥30.0 kg/m<sup>2</sup> respectively (WHO, 2004). Now-a-days obesity and hypertension are most common diseases throughout the world. There is no doubt that obesity and hypertension is intimately associated with each other and it is largely due to our present life styles. Here we have tried to find out the current prevalence and distribution of hypertension and also to identify the role of obesity for the development of hypertension in the studied people.

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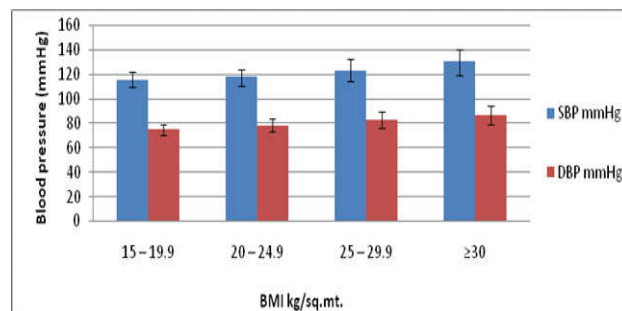
## MATERIALS AND METHODS

A door-to-door population-based survey was conducted in 2,453 people of Scheduled Caste (SC) community of the District Nadia, West Bengal, India to collect data regarding obesity and hypertension like age, sex, weight, height, BP, HR, blood sugar, lipid profile etc. According to JNC 8 report, hypertension is defined as blood pressure (SBP/DBP) ≥ 140/90mmHg. On the other hand, BMI is defined as weight in kilograms divided by height in meter squared (kg/m<sup>2</sup>), is an easily obtained measure that is now widely used, as it has a high correlation with excess body fat or adiposity (Yusuf *et al.*, 2010). BMI was used to define obesity in various studies throughout the world (WHO, 2000; NIH, 1998; WHO, 2004) but there is no such evidence to categorized obese and nonobese people in SC community of India. Here we have tried to establish a classification of various categories of obese and nonobese subjects depending on both BMI and physical conditions (i.e., underweight and overweight problems). After defining obesity we observed the relationship between obesity and hypertension in the studied people. Blood pressure in different BMI groups were also compared with control group (the group of people with normal hypertensive factors like

blood pressure, BMI, WHR, serum lipid profile and glucose level, take low salt and fat diet, do exercise regularly etc.). Data were analyzed using 'z'-test and chi-square test at both 5% and 1% level of significance.

## RESULTS

Here we studied on 2,453 adult people of SC community of India to find out the exact definition of various categories of obese and nonobese people using both BMI and physical conditions (underweight problems: Hypotension or low blood pressure, malnutrition, infertility, osteoporosis, weakness, Anemia, Poor immunity power etc. and overweight problems: Cardiovascular diseases, weakness, diabetes mellitus type-2, osteoarthritis, infertility, low back pain, gout etc.) in the following way (Table-1).



**Fig. 1. Body mass index-wise distribution of blood pressure within the studied people. Data were presented as Average  $\pm$  SD**

The prevalence of hypertension (SDH) in different BMI groups like 15-19.9, 20-24.9, 25-29.9 and  $\geq 30$  kg/m<sup>2</sup> were 8.09%, 14.34%, 26.80% and 29.05% respectively (Table 2).

**Table 1. Classification of obese and nonobese by BMI and physical conditions (i.e., Underweight and Overweight problems) in adults SC people**

Sl. No.	Classification	BMI (kg/m <sup>2</sup> )	Related physical conditions (Underweight and overweight problems)
1.	Underweight (UW)	$\leq 18.5$	Most of them are with various underweight problems
2.	Normal Optimum (OP)	18.5-21.9	No underweight and overweight problems occur in this group & they are physically fittest group
	High normal (HN)	22-24.9	No underweight problems. Very few of them can feel (but do not suffer) least overweight problems
3.	Pre-obese or Overweight (PO/OW)	25-29.9	Some of the people already get into few overweight problems
	Class-I = Acute obesity (AO)	30-34.9	Most of them get into some overweight problems and some of them are under treatment
4.	Obese		
	Class-II = Pre-extreme obesity (PEO)	35-39.9	Most of them are suffering from some overweight problems & most of them are under treatment.
	Class-III = Extreme or severe obesity (EO/SO)	$\geq 40$	All of them are suffering from severe overweight problems & all are under regular treatment

**Table 2. Overall and BMI-wise prevalence of various categories of hypertension in the studied people**

Anthropometric factors	Number	Normal (%)	Prevalence of hypertension (%)			
			ISH	IDH	PH	SDH
Total population surveyed (N)	2,453	50.02	6.48	7.54	20.09	15.85
BMI (Kg/m <sup>2</sup> )						
15-19.9	803	63.38	5.23	4.60	18.67	8.09
20-24.9	976	54.71	5.12	5.87	19.97	14.34
25-29.9	526	26.80	9.69	13.30	23.38	26.80
$\geq 30$	148	29.05	10.81	14.18	16.89	29.05

ISH: Isolated systolic hypertension, IDH: Isolated diastolic hypertension, PH: Pre-hypertension, SDH: Systolic and diastolic hypertension

**Table 3. Variation of blood pressure in relation to BMI in the studied people**

Anthropometric factors	SBP $\pm$ SEM	z -value	DBP $\pm$ SEM	z -value
Control	117.13 $\pm$ 0.51	-	78.35 $\pm$ 0.41	-
BMI (Kg/m <sup>2</sup> )				
15-19.9	115.67 $\pm$ 1.62	0.90	76.11 $\pm$ 1.18	1.89
20-24.9	117.70 $\pm$ 1.01	0.56	78.29 $\pm$ 0.51	0.11
25-29.9	122.30 $\pm$ 2.08	2.48*	82.80 $\pm$ 0.76	5.98**
$\geq 30$	130.20 $\pm$ 1.07	12.21**	89.74 $\pm$ 1.06	10.74**

\*=Significant at 5% level and \*\*= Significant at 1% level

**Table 4. Increased BMI wise distribution of hypertension in the studied people**

BMI groups	15-19.9	20-24.9	25-29.9	$\geq 30$	Total
Hypertensive	65	140	141	43	389
Non-hypertensive	738	836	385	105	2,064
total	803	976	526	148	N=2,453

$\chi^2 = 104.509$ , d.f. = 3, p < 0.01

There was a significant increase of blood pressure in overweight (BMI $\geq$ 25-29.9 kg/m<sup>2</sup>, p<0.05 for SBP and p<0.01 for DBP) and obese (BMI $\geq$ 30kg/m<sup>2</sup>, p<0.01 for both SBP and DBP) people compared to the control group (Table 3 and Figure 1). Chi-square test showed that there was a significant association between prevalence of hypertension with increasing BMI ( $\chi^2 = 104.509$ , d.f.= 3, p < 0.01) in the studied people (Table 4).

## DISCUSSION

Obesity and hypertension may be regarded as lifestyle diseases as because both the diseases were greatly associated with our daily life. Although various kinds of factors are associated for the development of hypertension, we have tried to show the obesity related hypertension in the studied people. The overall rate of hypertension is 15.85%. Male (15.85%) shows higher hypertensive rate than female (14.35%). These kind of works were also reported by some other workers (Jajoo *et al.*, 1993 ; Joshi *et al.*, 2000). The association between obesity and hypertension has been established and extensively documented throughout the world. Few studies have examined the relationship between obesity and hypertension as a part of global cardiovascular risk factors in India (Malhotra *et al.*, 1999 ; Das *et al.*, 2005 ; Biswas and Manna, 2015). This study recorded high prevalence of hypertension in overweight and obese people. A positive association was observed between body mass index and development of blood pressure. The persons having BMI $\geq$ 25.0 kg/m<sup>2</sup> showed higher risk of hypertension (26.80%) due to gradual development of blood pressure. Similar findings were reported by a number of studies on hypertension, where these studies also marked that the prevalence of hypertension was also higher in those candidates who were suffering from obesity problems (Jajoo *et al.*, 1993 ; Joshi *et al.*, 2000). However, some other studies show that the magnitude of weight gain is almost invariably associated with an increase risk of developing hypertension , and that modest loss of weight is associated with the reduction of blood pressure in obese subjects (Weng *et al.*, 2010 ; Kotsis *et al.*, 2010 ; Kochen *et al.*, 2010).

## Conclusions

The overall crude prevalence of hypertension in this study was 15.85%. From this study it can be concluded that the incidence of Hypertension and the development of blood pressure in the studied people were gradually increased with increase of body mass index (BMI).

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