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Original article

The Magnitude of Obesity and its relationship to Blood Pressure among Punjabi Residents of Delhi

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ABSTRACT

Background: Body mass index (BMI) is an important tool for assessing nutritional status. Increased cases of obesity, hypertension and cardiovascular diseases particularly among adults in developing countries, requires documentation of relevant data for checkmating these health problems. **Aims & Objective:** The study aimed to determine the association of blood pressure, BMI, and age among Punjabis of Gurmandi area of Delhi. **Materials and Methods**: A total of 148 males and 140 females ranging in age from 18-50 years were studied. The subjects were divided into 4 different age groups to study age trend with respect to blood pressure and BMI as well as gender differences. **Results:** The normal, underweight, obese, and overweight of the BMI range of the male adults were 47.3%, 13.5%; 14.2% and 25% respectively and for females the different categories of BMI were, 43.5% normal, 18.6% obese and 24.3% were overweight. The relationship between BMI, SBP, DBP and age were statistically significant. **Conclusion:** A high magnitude of overweight and obesity was observed.BMI was found to increase with age, with significant gender differences-females having higher mean values than males. Males were taller and heavier(except in the later age groups). More males were overweight whereas more females were obese. Both SBP and DBP increased with age and the gender differences were statistically significant. Prehypertension was more among males as compared to females. The correlation between BMI and blood pressure (SBP,DBP) was positive and statistically significant.

KEYWORDS: Age; Body Mass Index (BMI); Blood Pressure(SBP,DBP); Punjabis

INTRODUCTION

The global estimation of death caused by high blood pressure among middle, and old-age adults in developing countries was about 7.1 million.[1] This amounts to about 13% of the world's mortality rate. About 62% of cerebrovascular diseases and 49% of ischaemic heart diseases were caused by suboptimal BP (systolic 115 mm Hg). Overweight and obesity increase the tendency of high BP, coronary heart diseases, ischaemic stroke, type II diabetes mellitus and certain cancers.[1] About 58% of the global cases of diabetes mellitus and 21% of ischaemic heart diseases were caused by BMI above 21 kg/m2.[1] The hypertension and other cardiovascular diseases, together with infection and malnutrition are on the increase in developing countries.[2]

The prevalence of hypertension was found to be more among men than women in a study conducted among senior citizens of Delhi, India.[3]. Separate studies conducted in Ethiopia and Vietnam, revealed that hypertension was significantly more prevalent among men than women.[3] Relationship between BMI and BP has long been established and being used in epidemiological research. Positive association of BMI and BP had also been reported among Asian populations. [4-6].Relationship between the prevalence of hypertension and age had been studied and higher incidence was reported among the elderly people in Bangladesh and India. [7]

Increased cases of obesity; hypertension and cardiovascular diseases especially in developing countries are quite alarming. There is the need to have combined efforts of medical and non medical sciences to curb the threats of cardiovascular diseases from different ethno- geographical locations on BMI, BP and age as they vary with cultures and

would help as a valuable tool to achieve this goal. The present study aimed at finding the association between BMI, BP and age among Punjabis of Gurmandi Area of Delhi.

MATERIALS AND METHODS

A total of two hundred and eighty eight (288),Punjabi subjects , comprising of 148(51%) males and 140 females, (49%), ranging in age 18-50 years were studied from Gurmandi area of Delhi, after obtaining ethical approval from the Department of Anthropology, Delhi University. Anthropometric measurements including height, weight, and physiological dimensions like blood pressure were taken on each subject. A standardized protocol was followed while taking measurements. [8] BMI (weight/height^2) (Weight in kg, Height in meters) was calculated. BMI was classified according to the proposed criteria of World Health Organization (WHO) (CEO III <16, CEO II=16-16.9, CED I = 17-18.49, underweight < 18.5, normal = 18.5-24.5, overweight = 25.0-29.9, and obese 30.00. [7] In the present study, all the subjects having BMI ≥ 30 were taken as obese.

Normal blood pressure was taken as < 120 mmHg (SBP) and <80 mmHg (DBP). Blood pressure values of 120-139 mmHg (SBP) and 80-89 mmHg (DBP) were classified as prehypertensive. Stage-I hypertension was taken as 140-159 mmHg (SBP) and 90-99 mmHg (DBP), whereas blood pressure of >160 mmHg (SBP) and >100 mmHg (DBP) were classified as stage II hypertension (JNC2003).

Statistical analysis SPSS version 16.0 statistical software package was used to carry out statistical analysis. Descriptive statistics of mean and standard deviation, standard error were used to examine the data. Pearson product moment correlation was used to find correlation between anthropometric measures and blood pressure. Regression analysis was also carried out to see relationship between the variables. Two samples t-test was carried out to find sexual dimorphism in the BP, BMI, height, and weight.

RESULTS

One-way ANOVA test was done for Height, Weight and BMI, among females and males respectively (Table 1). Among females, post-Hoc test showed significant difference of height between age groups 18-27 and 39-49 yrs , 18-27 and 50 & above ($p<0.05$), 28-38 and 50 & above ($p<0.05$), 39-49 yrs and 50 & above ($p<0.05$)thus showing a significant increase and then decline in height with age, post Hoc test showed significant difference of weight in the age groups 18-27 versus 28-38 yrs ($p<0.05$), 18-27 versus 39-49 yrs ($p<0.05$), 18-27 versus 50 & above ($p<0.05$), 28-38 versus 39-49 yrs ($p<0.05$), 39-49 yrs versus 50 & above ($p<0.05$)also.

Table 1: One Way ANOVA test for Height, Weight and BMI among different age groups (females and males)

Variables	Age groups (years)				F Value
Females					
	18-27	28-38	39-49	50 and above	
Height	156.6 ± 5.95	155.8 ± 5.64	154.3 ± 5.86	148.6 ± 5.09	10.85ǂ
Weight	50.24 ± 8.79	65.29 ± 13.19	66.68 ± 11.50	63.02 ± 10.48	22.22*
BMI	20.44 ± 3.15	26.84 ± 4.95	27.96 ± 4.34	28.45 ± 4.03	37.21*
Males					
Height	168.8 ± 8.07	169.2 ± 7.34	164.8 ±	163.5 ± 4.94	6.08 +
Weight	60.58 ± 11.82	73.6 ± 30.07	73.46 ± 15.00	61.15 ± 12.51	12.32 +
BMI	21.17 ±3.70	25.17 ± 3.63	26.93 ± 4.81	22.89 ± 4.75	16.14 +

*p < 0.05, +p < 0.01, ǂ p < 0.001

The highest mean of the BMI (28.45 kg/m2 ±4.03), was found in the 50 and above years age group among females and 39-49 years age group among males (26.93±4.81) while the least mean of the BMI (20.44 kg/m2 ± 3.15) was recorded in 18-27 years age group. ANOVA test showed significant difference in the mean BMI among all the age groups. Post hoc test showed significant difference in age groups(Table 1).

Significant differences were found for BMI,18-27yrs versus 28-38years ($p<0.05$), 18-27 versus 39-49yrs ($p<0.05$),18-27versus50&above($p<0.05$), 28-38 versus 39-49 years($p<0.05$), 28-38 versus 50&above($p<0.05$), among females.BMI showed significant difference in age groups 18-27 versus 28-38,18-27versus 39-49 years($p<0.05$)and 18-27 versus 50&above ($p<0.05$) 28-38 years and 50&above($p<0.05$), 28-38 versus 39-49 years($p<0.05$), 39-49 versus 50 & above ($p<0.05$) among males.

The highest mean systolic blood pressure was recorded among the age group 50 and above among females and males and mean values being 122.27 mm Hg ±12.06 and 127.68 mm Hg ± 16.02 respectively. The highest mean diastolic blood pressure (81.63 mm Hg ±8.15) was recorded among the age group 50 and above among females while the highest mean value (85.74mrnHg ±7.44) of the DBP among males was recorded in the age group 50 and above. The one-way ANOVA test for the blood pressures showed statistically significant difference among the age groups for both males and females(Table 2).

Table 2: One way ANOVA test for Blood pressure among different age groups (females and males)

Variables	Age groups (years)				
Females					
	18-27	28-38	39-49	50 & above	F Value
SBP	111.34 ± 9.54	114.82 ±9.34	118.60±14.8	122.27±12.08	6.26+
DBP	76.96± 6.42	77.05±9.48	81.08±8.10	81.63±8.15	3.21*
Males					
SBP	120.46 ± 7.54	125.60 ± 7.12	127.20 ± 12.88	127.68 ± 16.0	3.88*
DBP	79.71 ± 9.10	84.52 ± 8.11	85.00 ± 6.64	85.74 ± 7.44	52.4*

* $p < 0.05$, +$p < 0.01$, ǂ$p < 0.001$

The post Hoc test showed significant difference of age group 18-27 with 28-38($p<0.05$), 39-49($p<0.05$) and 50 and above ($p<0.05$).The significant difference was also shown between 28-38 with 39-49($p<0.05$) and 50 and above ($p<0.05$)as well as 39-49 with 50& above($p<0.05$),for SBP among females. The post-hoc test was found to be significant for 18-27 versus39-49($p<0.05$), 18-27versus 50&above ($p<0.05$), 28-38 versus39- 49 ($P<0.05$), 28-38 versus50&above ($p<0.05$).

Among males also the post Hoc test showed statistically significant difference of 18-27 with 28- 38yrs ($p<0.05$), 39-49($p<0.05$) and 50 and above age group ($p<0.05$). Statistically significant values were also shown for 28-38 age groups with 50 years and above ($p<0.05$) among males. The post Hoc test for diastolic blood pressure showed statistically significant difference in the age groupl8-27 versus28-38 ($p<0.05$) 18-27versus39-49 ($p<0.05$), 18-27 versus50&above ($p<0.05$) among males.

Sexual dimorphism in height, weight, BMI, Systolic blood pressure and Diastolic blood pressure for the different age groups is presented in Table 3. Statistically significant difference among genders was found for height in age groups 18-27 and 28-38 years. For weight however statistically significant difference between the two genders was found for all the four age groups. BMI showed statistically significant difference in the age groups 39-49years and 50 and above among males and females. Systolic and diastolic blood pressure also showed sexual dimorphism. Statistically significant difference was found for age groups 18-27 and 28-38 years for SBP and the age groups 28-38yrs, 39-49 yrs, 50yrs & above for DBP.

Table 3: 't' test for Height, Weight, BMI, and Blood pressure (SBP & DBP), among genders

Variables	Age groups (years)			
	18-27	28-38	39-49	50 and above
Height	9.16ǂ	7.94ǂ		
Weight	5.3ǂ	2.64+	7.05ǂ	10.6ǂ
BMI	1.12	0.91	1.93*	0.87*
Systolic	5.53ǂ	4.83ǂ	1.33	2.47
Diastolic	1.859	3.18+	4.46ǂ	2.12+

* $p < 0.[05$, +$p < 0.01$, ǂ$p < 0.001$

The classification of BMI into different categories of nutritional status is shown [table 4]. Out of the 140 females, 43.5% were normal, 13.6% underweight, 18.6% obese and 24.3% overweight respectively. Maximum number of underweight females were in age group18-27years, overweight in the age group 50 & above and obese in age group28-38 years. Among 148 males, 47.3% were normal, 13.5% were under weight, 25% were 14.2% were obese. Maximum number of underweight were in 18-27yrs, overweight in age group 28-38 yrs, and obese in age group 39-49 yrs.

Overweight category was more among males but females were more obese. As far as SBP is concerned ,in the age groupl8-27yrs,71.2% were normal,27% prehypertensive and 1.7% belonged to hypertensive category, in the age group 28-38yrs,50% had normal SBP,50% were prehypertensive, in the age group 39-49 yrs, 60% had normal SBP,36% were prehypertensive and 4% hypertensive while in the age group 50 & above36% had normal SBP,59.1% had prehypertension and 4.6% were hypertensive.

Diastolic blood pressure was found to be normal among 55.9%,50%,28% and 13% in the age groups 18- 27yrs,28-38yrs, 39-49yrs and 50& above respectively, 42.4%,35.3%,2% and 27.3 were prehypertensive, whereas 1.7%,14.7%,52% and 59.1% were hypertensive among age groups 18-27,28-38,39-49,50 &above, respectively.

Table 4: Categorization of subjects according to BMI, (females and males)

Category	Age groups (years)				Total
Females					
	18-27	28-38	39-49	50 & above	140
Underweight	17 (28%)	2 (5.9%)	0 (0%)	0 (0%)	19 (13.6%)
Overweight	2 (3.38%)	9 (26.47%)	11 (44%)	12 (54%)	34 (24.3%)
Obese	1 (1.69)	11 (32.35%)	8 (32%)	6 (28%)	26 (18.6%)
Normal	39 (66.8)	12(35.29%)	6 (24%)	4 (18%)	61 (43.5%)
Males					
	18-27	28-38	39-49	50 & above	148
Underweight	14 (29.9%)	0 (0%)	0 (0%)	6 (19.35%)	20 (13.51%)
Overweight	4 (8.0%)	12 (48%)	16 (40%)	5 (16.13%)	37 (25%)
Obese	2 (3.85%)	4 (16%)	11 (27.5%)	4 (12.9%)	21 (14.2%)
Normal	32 (61.53%)	9 (36%)	13 (32.5%)	16 (51.61%)	70 (47.3%)

Among males,26.9%,16.6%,2.4%and 16.13 % had normal systolic blood pressure ,73%,84%,90% and 70.9% were prehypertensive, in the age groups ,18-27,28-38,39-49 and 50&above respectively. Hypertension (SBP) was only seen in age groups 39-49 and 50 & above to be 7.5% and 12.9% respectively. Normal diastolic blood pressure was 34%,2%,7.5% and 9.68%,while 44%,11%,23% and 70.96% had prehypertension and 21%,36%,35% and 48.38% were Hypertensive(DBP),in the age groups 18-27, 28-38, 39-49 and 50 & above respectively, (Table 5).

Table 5 : Prevalence of hypertension (SBP & DBP) in the different age groups (females and males)

Category	Age groups (years)					Total
Females						
		18-27	28-38	39-49	50 & above	140
Normal	SBP	42 (59)71.2%	17 (34)50%	15 (60%)	8 (36%)	82 (58.57%)
	DBP	33 (55.9%)	17 (50%)	7 (28)%	3 (13%)	60 (42.86%)
Prehypertension	SBP	16 (27%)	17 (50%)	9 (36%)	13 (59.1%)	55 (30.13%)
	DBP	25 (42.4%)	12 (35.3%)	5 (2%)	6 (27.3%)	48 (34.29%)
Hypertension	SBP	1 (1.7%)	0	1 (4%)	1 (4.60%)	3 (2.14%)
	DBP	1 (1.7%)	5 (14.7%)	13 (52%)	13 (59.1%)	32 (22.86%)
Males						
Normal	SBP	14 (26.9%)	04 (16.6%)	01 (2.4%)	5 (16.13%)	24 (16.21%)
	DBP	18 (34%)	05 (2%)	03 (7.5%)	03 (16.13%)	29 (19.59%)
Prehypertension	SBP	38 (73%)	21 (84%)	36 (90%)	22 (70.96%)	117 (79.05%)
	DBP	23 (44%)	11(44%)	23 (57.5%)	13 (4.93)	70 (47.30%)
Hypertension	SBP	0 (-)	0 (-)	3 (7.5%)	4 (12.90%)	7 (4.73%)
	DBP	11 (21%)	9 (36%)	14 (35%)	15 (48.38%)	49 (33.1%)

Age was found to have positive and statistically significant correlation with both SBP (r = 0.21, P < 0.01) and DBP (r = 0.18, P<0.01) among females and males, the correlation between age and blood pressure (SBP and DBP) was r = 0.44, P < 0.01 and r = 0.27, P < 0.01, (Table 6) among female and males respectively. There was statistically significant positive correlation between blood pressure (both SBP and DBP) and BMI among males (0.32, 0.32) and females (0.32, 0.35), respectively.

Table 6: Regression of Blood Pressure on Age

Age Group (years)	Regression Equation	'r'	S.E.E.
20 +	Females Ysbp = 101.79 ± 0.39 (Age) Ydbp = 72.50 ± 0.17 (Age)	 0.44^{+} 0.27^{+}	 10.79 8.17
20 +	Males Ysbp = 118.76 ± 0.16 (Age) Ydbp = 79.84 ± 0.09 (Age)	 0.21^{+} 0.18^{+}	 10.94 7.90

* p < 0.05, +p < 0.01, ǂp < 0.001, sbp – Systolic blood Pressure, dbp – Diastolic blood Pressure

DISCUSSION

The study was done to find out the real community burden of excess weight among the Punjabis of urban city, Delhi .The study demonstrated a high magnitude of overweight (24.3% among females & 25% among males) and obesity (18.6% among females and 14.2% among males) among these apparently Healthy participants and these urban residents may be unaware of their health risk burden. This goes along the recently observed global trend of increasing prevalence of obesity especially among urban dwellers. As reported by other workers the magnitude of obesity was found to increase with advancing age with peak among those in their late thirties to forties. [9, 10,11]. There was a trend of gradual increase in the mean height from the youngest age group(18-27yrs) till the age of 28-38 years [Table 1]. The height declined towards advanced age. This initial increase in the mean height could be as a result of natural growth phenomenon which associates with age.

The result was similar with the findings of Mungreiphy et al. [12] which stated that the initial increase in the height could be due to improvement of socioeconomic condition and better nutrition among the younger subjects. However the decrease in height observed might result due to decrease in bone growth which also associates with demineralization in advanced ages. Similar result was obtained by Aiken [13] who reported that loss of collagen between spinal vertebrae causes the spine to bow and the height to shrink, There was also proportionate increase in the mean body weights with the ages till the age of39- 49 among females and 28-38 years among males, thereafter the weights showed an inconsistence decline in the advanced age groups. It was also evident that the heights of 18-27and 28-38 years groups were statistically significant, this was not surprising as height increases during these periods .

The initial increase in the body weight might not be unconnected with increased physical activity which usually is associated with that age groups and which leads to rapid muscular and bone growth, there by resulting into higher body mass. These results are in concordance with our study Verma et al. [14] which stated that increase in the body weight till middle age might be as a result of fat accumulation from the younger age following the larger appetite which might lead to high energy intake and relatively less energy expenditure due to lesser involvement in physical activities and partly due to bones gradual demineralization. The statistically significant difference in the mean weights of the age groups 18- 27 and 39-49 years are similar to our report Verma et al. [14] however the statistically significant difference showed by 50yrs&above could be due to sedentary lifestyle usually observed in these age range as a result of old age.

The mean BMI of the age groups in the present study showed increase with advancing age groups till 39-49 yrs, and there by a decline in mean values. There was also statistically significant difference in the mean BMI. The highest BMI value was recorded among the 39-49yrs age group while the lowest among the age group 18-27 years. The higher value of BMI among the youngest age could be attributed to the higher body mass to height ratio which usually is common with the younger ages or as explained by Verma et al.[14] while the lower values obtained in the subsequent age groups could also be due to increase in height relative to body mass ratio.

Blood pressure showed increase with age. The present study is in concordance to the earlier studies by Percy et al., which indicated that BP is associated with age. [15,16,17,18] Age was positively correlated with blood pressure (both SBP and DBP). The relationship between blood pressure and age was found to be significant and was stronger in women than men in the present study. In general, blood pressure rises as people become older. Age is known risk factor for high blood pressure. Studies in various populations also showed strong relationship between different anthropometric indicators and blood pressure levels. The significant association of BMI with SBP and DBP is also evident from the values of Pearson's correlation coefficient among males and females of the present study [Tables 2 and 3].

These findings are in agreement with other studies [19, 20], which support a strong relationship between BMI and blood pressure across developed and developing countries. In the present study, we found statistically significant positive correlation between height, weight and SBP and DBP. BMI showed positive and statistically significant correlation with both SBP and DBP These findings are in agreement with other studies [19, 20]. Linear regression showed BMI and waist circumference (WC) as important predictors of hypertension [21]. Present study showed statistically significant difference in both mean systolic and diastolic blood pressure among males and females. The results were similar with the studies of Kusuma et al [21] which found that men possess higher BP levels than females, sample size used for this study was small as compared to some other studies where large data were used.

Studies have shown a strong relationship between BMI and blood pressure across developed and developing countries [22]. A significant correlation between SBP and DBP with age was also reported [23, 24] Similarly a strong association of overall and abdominal obesity with blood pressure was also noticed [25]. In the present sample age and overweight/obesity were identified as significant determinants of hypertension. Obesity indicators (BMI,WHR)were positively associated with blood pressure in adult Indian population,[26].

It is probably presumed that economic transition towards affluence might have increased the risk of hypertension. It is thus demonstrated that BMI is closely associated with BP in populations who are at different stages of socioeconomic transition. Both SBP and DBP were found to be significantly higher among men as compared with women in the present study. Gender differences in blood pressure are detectable during adolescence and persist through adulthood. In all ethnic groups, men tend to have higher mean SBP and DBP than women, and through middle age, the prevalence of hypertension is higher among men than women. [27].

Several studies have been done in different parts of India on factors affecting cardiovascular functions. Obesity or excess relative weight is found to be associated with increased risk of disease morbidity and mortality. Body composition variables such as weight, skinfold thicknesses, etc. have been shown to be significantly correlated with blood pressure in adults. BMI is widely accepted as one of the best indicator of nutritional status in adults.[28, 29, 30] The importance of BMI and skinfolds has been recognized for estimating cardiovascular disease (CVD) risk factors, particulars due to their positive association with hypertension. [31].

CONCLUSION

The study showed a high magnitude of overweight and obesity, 42.9% among Punjabi females and 39.2% among Punjabi males of present study, who are unaware of their health risk burden. Body mass index was closely associated with both systolic and diastolic blood pressure . Though the magnitude of correlation differed, there was positive and significant correlation among BMI, age, systolic and diastolic blood pressures. Mean systolic and diastolic BP levels were higher among age groups with elevated BMI, in the present study.

A high percentage of prehypertension was also observed in the present study. The high percentage of overweight and obesity and high BP in this study may possibly be confounded by cultural factors which are to be explored in light of the present findings, and such studies may provide ways to adopt remedial measures to maintain these insults at low profile.

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