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ORIGINAL ARTICLE

A STUDY OF RELATIONSHIP BETWEEN ARTERIAL BLOOD PRESSURE AND BODY MASS INDEX IN YOUNG ADULTS

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ABSTRACT: The present study was done to find out the correlation between body mass index (BMI) and blood pressure, systolic blood pressure (SBP), diastolic blood pressure (DBP); pulse pressure (PP) and mean arterial pressure (MAP) values. There is paucity of information on the variation in blood pressure and pulse rate parameters of normal individuals. The aim of the study was to assess the correlation between BMI and BP. The study was conducted in 184 MBBS 1st year students. There were 119 male and 65 female students. In view of gender differences in autonomic regulation, data of male and female subjects were analyzed separately. We used analysis of variance to compare differences between Mean±SD, maximum, minimum values and Pearson correlations of BMI and blood pressure values. **CONCLUSION:** There is Mean±SD of blood pressure was higher in overweight subjects as compared to underweight subjects. A p value *0.05 and * 0.01 was considered statistically significant for both male as well as in female subjects. There was significant Pearson's correlation between BMI and BP in both male as well as in female subjects.

KEYWORDS: Systolic blood pressure, Diastolic blood pressure, Pulse pressure, Mean arterial pressure and Body mass index.

INTRODUCTION: The world is rapidly modernizing so the life is becoming more fast, competitive and stressful. This has a direct impact on the health status of the population. In large cross sectional study of adolescents, BMI has been shown to be a better index of body fatness as compared to waist-hip ratio.[1]Hypertension is a common cardiovascular disease. It is as prevalent in developing countries as in industrialized developed ones, affecting at least 10% of the adult population in most countries. Hypertension is an entity associated with high morbidity and mortality. This disease is a silent threat to the health of people all over the world. It is suggested that hypertension has its origin in childhood or adulthood but goes undetected unless specifically looked for during this period. Blood pressure is one of the most important physiological characters. It is sensitive to socioeconomic conditions, urbanization, activity patterns, diet, body weight and fat, other physical and cultural conditions apart from having a strong genetic as well as physiological components.[2]Blood pressure (BP) is regulated by activity in the autonomic nervous system.[3] Obesity if associated with sympathetic activation, it is the leading risk factor for the development of hypertension.[4] Hypertension is a major problem, affecting both developed and developing countries; and it may lead to irreversible damages in vital organs, including central nervous system, cardiovascular system, and kidney. Besides being a major cause of morbidity and mortality, uncontrolled high blood pressure has a heavy impact on patients and families.[5] The price we are paying for an affluent and developed society is a sedentary life style and faulty dietary habits which result in an imbalance between energy intake and energy expenditure, which, in turn leads to obesity. Overweight and obesity represent a rapidly growing threat to the healthy population in many countries.[6] Obesity is becoming a global epidemic and in the past 10 years in Europe and the United States, dramatic increases in obesity have

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occurred in both children and adults [7]. Body Mass Index (BMI) is a reliable indicator of health and nutritional status of human beings. The aim of the present study has been to assess the correlation between BMI and BP.

AIMS AND OBJECTIVES: To assess the correlation between BMI and BP in young adults.

MATERIAL AND METHOD: This cross sectional study was done in Mahatma Gandhi Memorial Medical College, and Maharaja Yashwantrao Hospital, Indore. The study population was 184 1st year medical students, of which 119 were males and 65 were females of 17 to 26 years age group. After obtaining ethical clearance and satisfying the inclusion and exclusion criteria; written consent was taken from every subject. Blood pressures were determined by standard calculation of 184 subjects.

Inclusion Criteria:

- M.B.B.S. first year students who gave written consent to participate in the study.
- Student free from serious illness.
- Healthy, non-smoker and non-alcoholic subjects select for study.

Exclusion Criteria:

- Student not ready to give consent.
- Systemic disorder including hypertension, diabetes mellitus, any sign and symptoms related to renal or endocrinal diseases and any acute illness during the past 1 month.

Anthropometric Measurements: Anthropometric measurements were also taken. Height (In cm) was measured by a vertical measuring scale was used, body weight (In kg) by portable weighing machine, mid arm circumference (MUAC in cm) were also taken. All anthropometric measurements were taken in light clothing.

Body Mass Index (Quetlets's Index): Is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2). Body mass index (BMI) is measure of body fat based on height and weight that applies to both adult men and women. Subjects were classified into four groups based on BMI as follows: Subjects were classified into four groups based on BMI as follows: <18.5 Underweight (22males and 21 females), 18.5-24.9 Normal weight (91males and 39 females), 25-29.9 Overweight (6males and 4females) and ≥ 30 Obesity (1 female).

Measurement of Blood Pressure: Standardization of instrument. Blood pressure Measurements were taken on right arm with a mercury sphygmomanometer and a standard stethoscope placed at the heart level of the subject who has been rested at least 5 minutes in relaxed and supine position on a couch. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded to the nearest mmHg as the appearance (phase I) and disappearance (phase V) of Korotkoff's sound, respectively, since the main target of the study was to examine the relationship between BMI and blood pressure. Blood pressure was recorded Morning at 8 to 9 Am.

Pulse pressure (PP) and mean arterial pressure (MAP) have been calculated from systolic and diastolic blood pressures values, as follows. PP is SBP-DBP and MAP = DBP+1/3 PP.

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STATISTICAL ANALYSIS: A detailed database was prepared using Microsoft Excel Software.

The statistical analysis included calculation of mean, standard deviation; maximum, minimum value, Pearson's correlation and p value were performed using the statistical package for social sciences (SPSS - 22) software.

RESULTS: In view of the possibility that there could be gender differences in regulation of cardiovascular autonomic function, we have analyzed data in males and females separately.[8,9]

Sl. No.	Variables	Under weight (22)		Normal wt (91)		Overweight (6)	
		Mini	Maxi	Mini	Maxi	Mini	Maxi
1	AGE	18.0	23.0	17.0	26.0	19.0	24.0
2	WT. (kg)	04.0	64.0	48.0	85.0	60.0	85.0
3	HT.(cm)	160.02	189.00	155.86	185.96	152.40	179.00
4	BMI	14.7	17.9	18.20	24.90	25.0	26.5
5	PULSE	66.0	80.0	66.0	94.0	72.0	80.0
6	SBP	110.0	134.0	100.0	140.0	110.0	140.0
7	DBP	60.0	84.0	60.0	90.0	70.0	90.0
8	PP	30.0	58.0	28.0	70.0	34.0	56.0
9	MAP	76.0	100.0	73.0	106.0	83.0	106.0

Table 1: Anthropometric characteristics, BP (Pulse, SBP, DBP, PP and MAP) of male subjects. Data are expressed as Minimum (Mini), Maximum (Maxi) value. Sample size (n) is indicated within brackets

Sl. No.	Variables	Under weight (21)		Normal wt (39)		Overweight (4)	
		Mini	Maxi	Mini	Maxi	Mini	Maxi
1	AGE	17.0	23.0	18.0	24.0	18.0	19.0
2	WT. (kg)	36.0	53.0	42.0	65.0	65.0	68.0
3	HT.(cm)	142.00	181.00	143.86	167.64	160.0	162.4
4	BMI	12.9	17.9	18.1	24.5	25.0	25.8
5	PULSE	70.0	78.0	70.0	90.0	74.0	78.0
6	SBP	90.0	122.0	90.0	128.0	112.0	128.0
7	DBP	65.0	80.0	60.0	88.0	70.0	82.0
8	PP	20.0	50.0	20.0	50.0	40.0	46.0
9	MAP	75.0	95.0	73.0	101.0	84.0	97.0

Table 2: Anthropometric characteristics, BP (Pulse, SBP, DBP, PP and MAP) of female subjects. Data are expressed as Minimum (Mini), Maximum (Maxi) values.Sample size (n) is indicated within brackets

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Sl. No.	Variables	Under weight (22)	Normal weight (91)	Overweight (6)
1	Age	20.409±1.4027	21.191±1.7840	20.833±1.9408
2	Weight	51.591±6.26114	61.313±7.8644	72.000±9.2304
3	Height	174.2255±7.47079	170.6325±6.78541	176.6300±9.7747
4	BMI	16.936±0.9358	20.9518±1.78362	25.733±.5125
5	Pulse	77.364±3.7231	77.231±3.9863	77.000±3.5214
6	SBP	117.909±7.4700	118.747±8.7668	124.667±12.4365
7	DBP	74.273±5.8324	74.791±6.0654	81.333±6.6533
8	PP	43.636±8.0151	43.846±7.3589	43.333±8.0664
9	MAP	88.500±5.1709	89.000±6.2592	95.333±8.0166

Table 3: Anthropometric characteristics, BP and Pulse of male subjects. Data are expressed as Mean±SD. Sample size (n) is indicated within brackets

Sl. No.	Variables	Under weight (21)	Normal weight (39)	Overweight (4)
1	Age	19.619±1.4310	19.692±1.3794	18.750±.5000
2	Weight	42.905±4.3001	51.538±5.6457	66.000±1.4142
3	Height	160.4771±9.05576	157.0703±5.28328	160.900±1.1489
4	BMI	16.657±1.2081	20.941±1.8427	25.5000±.3830
5	Pulse	74.47623.1822	75.795±3.1721	75.500±1.9149
6	SBP	105.429±8.4651	109.744±7.5558	118.500±7.1880
7	DBP	69.714±3.0519	70.872±4.6065	75.500±6.4031
8	PP	35.714±7.2190	38.872±6.0662	43.000±2.5820
9	MAP	82.333±4.9733	83.513±5.0098	89.500±6.5574

Table 4: Anthropometric characteristics, BP and Pulse of female subjects. Data are expressed as Mean±SD. Sample size (n) is indicated within brackets

Sl. No.	Variables	Male (119)	Females (65)
1	Pulse	r =-.019 NS (p=.840)	r = -.051 NS (p=.685)
2	SBP	r =.241** HS (p=.008)	r =.316* S (p=.010)
3	DBP	r =.258** HS (p=.005)	r =.256* S (p=.040)
4	PP	r =.082 NS (p=.373)	r =.233 NS (p=.062)
5	MAP	r =.276** HS (p=.002)	r =.254* S (p=.041)

Table 5: Pearson Correlation (r) of body mass index with BP (Pulse, SBP, DBP, PP and MAP) of both male as well female subjects

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

HS – Highly Significant, S – Significant and NS – Not Significant.

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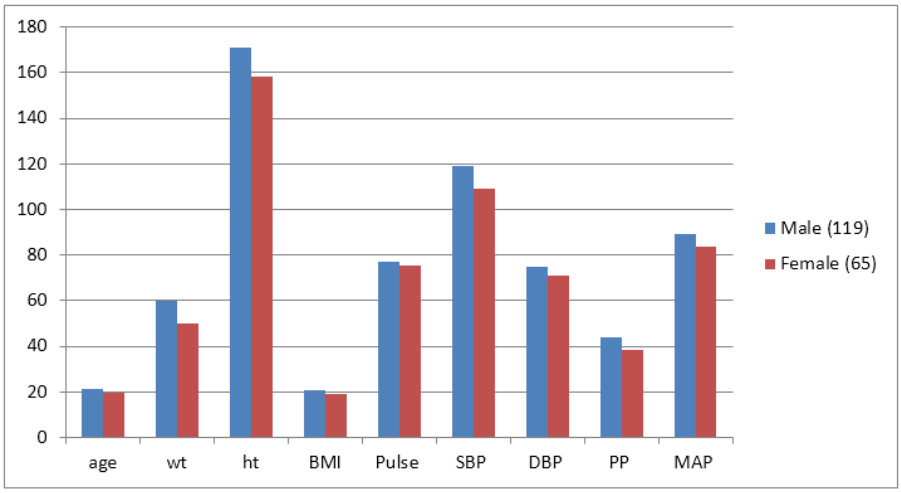

Fig. 1: Comparisons of various variables of male and female subjects

Wt = weight, ht = height.

This figure shows that all parameters are higher in male subjects as compared to female subjects.

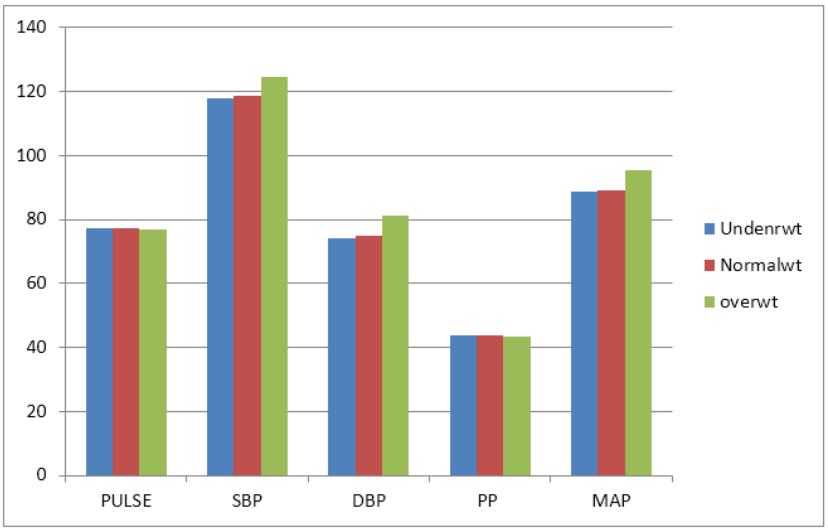

Fig. 2: Comparison of mean±SD (Pulse, SBP, DBP, PP and MAP) in underweight, normal weight and overweight subjects

In present study mean of SBP, DBP and MAP was more in overweight subjects.

In Male Subjects: There was a significant difference in the three groups in terms of BMI. Whereas Mean±SD of SBP, DBP and MAP were lowest in underweight and highest in overweight subjects. Pulse and PP were no differences in the three groups.

Female Subjects: There were significant differences in SBP amongst the three groups. It was highest in overweight subjects and least in underweight subjects; however, differences in the DBP and MAP did similar it was least in underweight subjects and highest in overweight subjects.

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Correlations: In male subjects Pearson correlation BMI with various parameters was; for pulse r=-.019 (p=.840), for SBP r=.241** (p=.008), for DBP r=.258** (p=.005), for PP r=.082 (p=.373), and for MAP. In female subjects, Pearson correlation was for pulse r=-.051 (p=.685), for SBP r=.316* (p=.010), for DBP r=.256* (p=.040), for PP r=.233 (p=.062), and for MAP r=.254* (p=.041).

There were statistically significant correlation between BMI and all BP indices in all male as well as in female subjects.

DISCUSSION: In both males and in females we found that SBP, DBP and MAP were highest in overweight subjects and least in underweight subjects. This is possibly due to sympathetic tone between underweight and overweight subjects. However, PP similar, assuming that arterial compliance was not different among the groups, this suggests that stoke volume is similar. Pulse rate also similar. It is because of cardiac output was not significant different in the various groups. Differences in BP could be largely due to peripheral resistance which in turn is greatly influenced by tonic sympathetic control of resistance vessels, our results indirectly suggest that the higher BP in overweight subjects is due to heightened sympathetic vascular tone.[10] According to CL Ghai, overweight individuals tend to have higher blood pressure. Since resistance to blood flow through a blood vessel depends on its length, increased length of blood vessels is bound to increase the resistance and hence blood pressure. (Each extra kg of adipose tissue is associated with the development of an additional 400 km of blood vessels).[11]

Similar finding were reported by various investigators (Sandin et al., 1990 [12]; Roche and Siervogel, 1991;[13] Chen et al., 1995;[14] Roberto J. Rona et al., 1996;[15] Kaufman et al., 1997;[16] Venkataramana et al., 2001;[17] Mufunda et al., 2006[18] Singal, P., et al 2008[19] and Zuhul 2008[20] in all studies they found as association between height, weight, body mass index and blood pressure).

CONCLUSION: In both males and females; Mean±SD of blood pressure were higher in overweight subjects as compared to underweight subjects. There was significant Pearson correlation between BMI and BP (SBP, DBP and MAP) in both male and female subjects. Our results indicate that SBP, DBP and MAP were linearly related to BMI in male as well as in female subjects.

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