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RESEARCH ARTICLE

ASSESSMENT OF CORRELATION BETWEEN BODY MASS INDEX (BMI) AND BLOOD PRESSURE (BP) INDICES IN MEDICAL STUDENTS

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ABSTRACT

Blood pressure has been shown to vary in several health conditions. In adult life, weight gain seems to be an important risk factor for the development of hypertension. The relationship between measures of body mass and blood pressure has been extensively documented, usually with body mass index as the measure of relative weight. Since BMI is the simplest, affordable and noninvasive method of measuring obesity prevalence in a large population, this was adopted to ascertain how it correlates with blood pressure indices. To evaluate relationship between BMI and Blood Pressure indices among 1ST Year M.B.B.S. students of MNR medical college. A total of 235 students, 120 males and 115 females participated in the study conducted between June and July 2015 at MNR Medical College. Their ages ranged between 17 to 20 years were selected as subjects because of easy availability. All students were divided into underweight, normal, over weight according to Western Pacific Regional Organization 2000 (WPRO) BMI classification. Complications of cardiovascular system were determined from the measurement of Blood pressure (BP) indices. Comparison of blood pressure among different groups was made by ANOVA. The First year MBBS students were in the age group of 18 -23 years and male: female was in a ratio of 1:1. The mean height of the male students was 172.6 cms (SD= 5.0) and females155. 24 cms (SD= 7. 1). The mean weight of the Male students was 62.5 kg (SD=7.3); and females 56.9 kg (SD=7.6). Overall, 81% of students were within the normal weight range. Around 10% males and 20% female students were overweight. Obesity was found only in1% of students. The 3% students were underweight and included all the male students. Being overweight is a rising problem of male and female medical students. Both obesity and underweight issues are seen common in students. Carrying excess body fat, puts you at greater risk for health problems such as heart disease, cancer, diabetes and stroke.

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INTRODUCTION

Obesity is one of the leading preventable causes of death worldwide. It is becoming a global epidemic (Ogden *et al.,* 2006). The worldwide prevalence of obesity and associated cardio-metabolic diseases have increased dramatically in the past 2-3decades, rapidly becoming major challenges to the health care systems of most industrialized countries. Current estimates indicate that>1billion people in the world are overweight or obese (Yach *et al.,* 2006). The relationship between BMI and blood pressure was for a long time perceived to be strong and a universal finding from the majority of the initial studies that some authors proposed that obesity was central to a common pathway linking NCD (non communicable disease) risk factors and cardiovascular morbidity (Anderson and Whitaker *et al.,* 2009). Population studies show that excess weight gain predicts future development of hypertension, and the relationship between body mass index and blood pressure appears to be nearly linear in diverse populations throughout the world (Mufunda *et al.,* 2007). Some studies suggestthat excess weight gain may account for 65–75% of human essential hypertension (Kanavi Roopa Shekharappa *et al.,* 2011). Moreover, clinical studies indicate that weight loss is effective in primary prevention of hypertension and in reducing BP in most hypertensive subjects (Garrison *et al.,* 1987).

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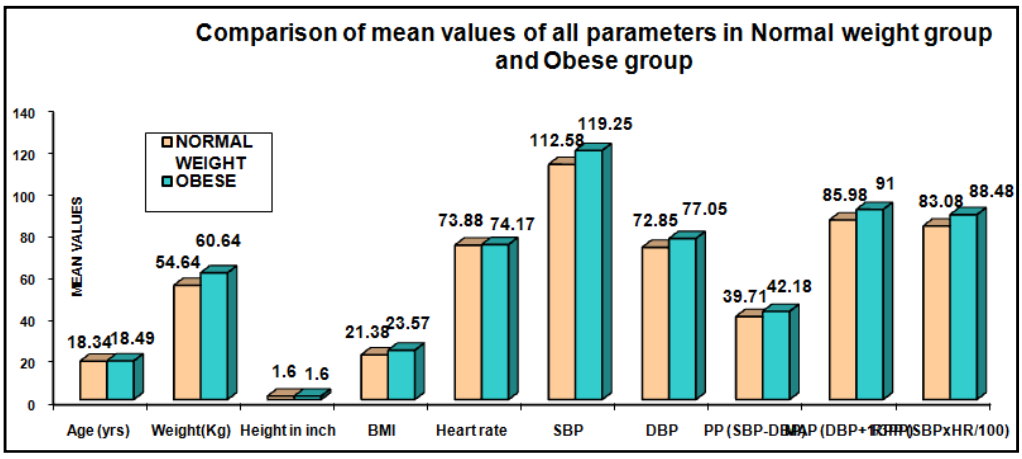

Figure 1. Comparison of mean values of all parameters in Normal weight group and obese group

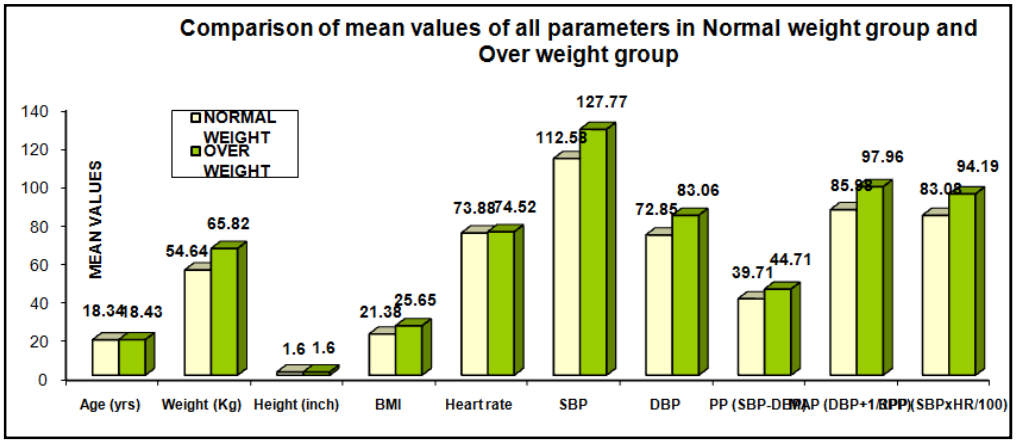

Figure 2. Comparison of mean values of all parameters in Normal weight group and Overweight group

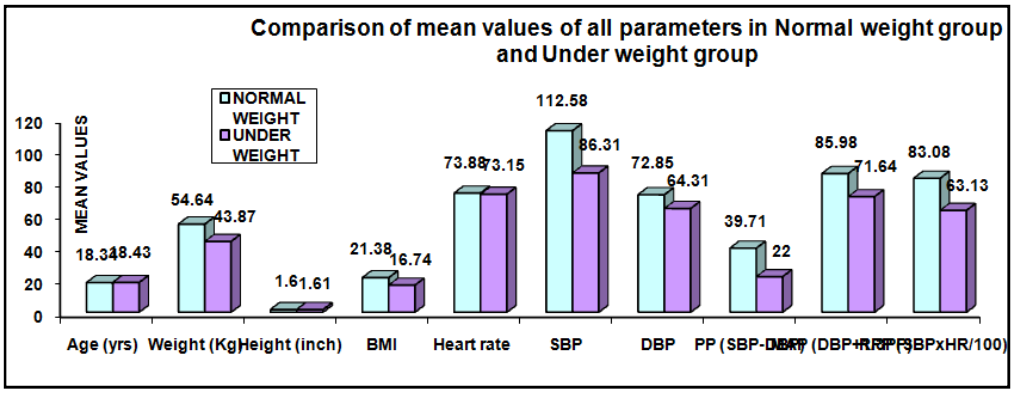

Figure 3. Comparison of mean values of all parameters in Normal weight group and Underweight group

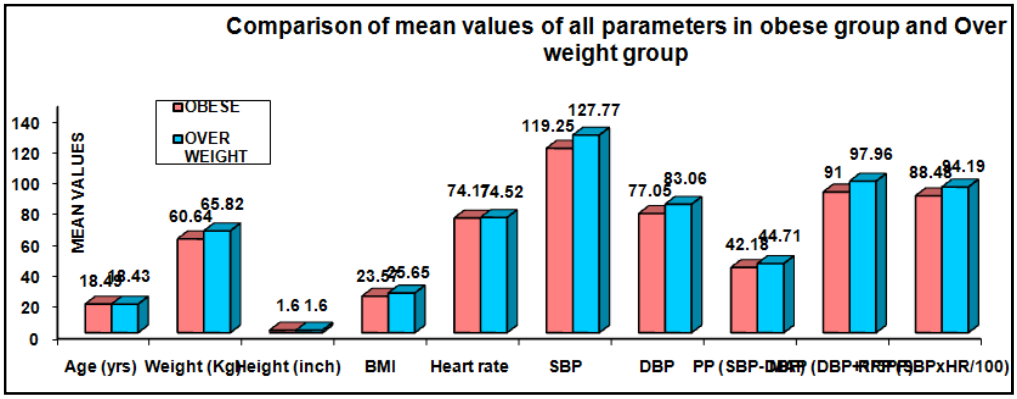

Figure 4. Comparison of mean values of all parameters in Normal weight group and Underweight group

The World Health Organization attributes hypertension, or high blood pressure, as the leading cause of cardiovascular mortality. The World Hypertension League (WHL), an umbrella organization of 85 national hypertension societies and leagues, recognized that more than 50% of the hypertensive populations worldwide are unaware of their condition (Stevens *et al.,* 2001).On average, obesity reduces life expectancy by six to seven years: a BMI of 30–35 reduces life expectancy by two to four years, while severe obesity (BMI > 40) reduces life expectancy by 10 years (Whitlock *et al.,* 2009). Body Mass Index provides the most useful, population-level measure of obesity. It can be used to estimate the prevalence of obesity within a population and the risks associated with it. Obesity produces an increment in total blood volume and cardiac output that is caused in part by the increased metabolic demand induced by excess body weight (Chockalingam, Mokdad *et al.,* 2007). Although the importance of obesity as a major cause of essential hypertension is well established, the physiological and molecular mechanisms that mediate the BP effects of excess weight gain are only beginning to be elucidated.

MATERIALS AND METHODS

After informed consent 235 asymptomatic, healthy students of M.B.B.S of MNR Medical College and Hospital, Sangareddy were recruited for the study. Their ages ranged between 17 to 20 years were selected as subjects because of easy availability.

Inclusion criteria

Asymptomatic, healthy subjects**,** Age group between 17-20 years**,** First year medical students and include both male and female

Exclusion criteria

Hypertensive, Diabetic and Ill health subjects

Instruments

Mercury Sphygmomanometer (Diamond), Stethoscope (Littman), Weighing machine, measuring steel tape.

Parameters

General characteristics were observed in subjects. All subjects were assigned to learn the whole procedure and protocol for measuring the parameters and were explained in detail by the investigator. On the first day of study, subjects came to the training room for the various anthropometric and cardio autonomic parameters, which were assessed using standard test. Parameters used in the study are: Height, Weight, Body Mass Index (BMI), Heart rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Pulse Pressure (PP), Mean Arterial Pressure (MAP) and Rate Pressure Product (RPP).

Statistical tools used for analysis of data are

- Mean, Standard Deviation.
- One-way Analysis of Variance (ANOVA).
- Tukey-Kramer's multiple comparison test.
- Karl – Pearson's Correlation Coefficient.

RESULTS

By applying Student's 't' test the correlation between BMI and SBI, BMI and DBP, BMI and PP, BMI and MAP, BMI and RDP in normal weight group, obese group, over weight group and underweight group is significant (i.e. $p<0.05$). (Table no.2) It is also concluded that the correlation in BMI and blood pressure indices is positive, it means if BMI increases (decreases) blood pressure indices are also increases (decreases)

Table 1. Distribution of the mean and SD values of all parameters in all groups under study

Parameters	Normal weight (n=110)	Obese (n=31)	Overweight (n=62)	Underweight (n=32)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age in years	18.34±0.47	18.49±0.52	18.43±0.49	18.43±0.5
Weight in Kg	54.64±5.42	60.64±8.97	65.82±5.0	43.87±2.04
Height in inch	1.60±0.05	1.60±0.05	1.60±0.05	1.61±0.03
BMI	21.38±1.22	23.57±3.63	25.65±1.16	16.74±0.70
Heart rate	73.88±3.38	74.17±3.41	74.52±3.67	73.15±3.51
Systolic Blood Pressure	112.58±3.34	119.25±10.89	127.77±3.22	86.31±3.87
Diastolic Blood Pressure	72.85±2.66	77.05±7.17	83.06±2.55	64.31±2.39
PP (SBP-DBP)	39.71±1.89	42.18±4.21	44.71±2.14	22.0±3.44
MAP (DBP+1/3PP)	85.98±2.92	91.00±8.46	97.96±2.60	71.64±2.48
RPP (SBPxHR/100)	83.08±4.34	88.48±10.37	94.19±7.91	63.13±4.32

Table 2. Correlation between BMI and blood pressure indices in all the groups under study: (Karl Pearson's correlation coefficient)

Correlation between	Karl Pearson's correlation coefficient (r)			
	Normal weight	Obese	Over weight	Under weight
BMI and SBI	0.3800	0.4746	0.6523	0.6766
BMI and DBP	0.4610	0.4721	0.7088	0.2862
BMI and PP	0,0390	0.1280	0.1357	0.5620
BMI and MAP	0.4490	0.5115	0.7323	0.5352
BMI and RDP	0.0980	0.0004	0.3427	0.5530

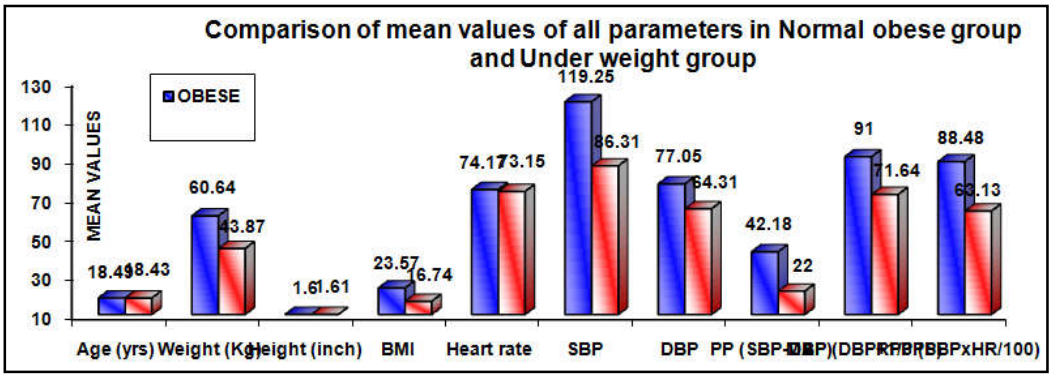

Figure 5. Comparison of mean values of all parameters in obese group and underweight group

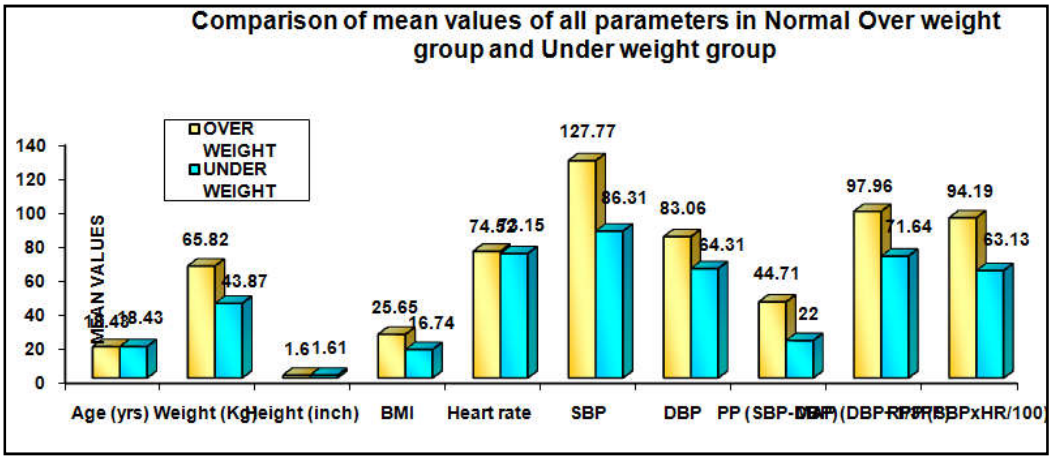

Figure 6. Comparison of mean values of all parameters in over weight group and Underweight group

DISCUSSION

There was a statistically significant increase in heart rate in obese subjects when compared to non-obese when each age subgroup was compared. There was a positive correlation with increasing body mass index causing increasing heart rate (Allison *et al.,* 1999). Studies also showed that heart rate increases with increase in percentage of body fat. A 10% increase in body weight is associated with a decline in parasympathetic tone accompanied by a rise in mean heart rate and conversely, heart rate declines during weight reduction (Berrington de Gonzalez *et al.,* 2010). Factors linking obesity to increase in BP includes the increment in total blood volume and cardiac output that is caused in part by the increased metabolic demand induced by excess body weight and also mechanisms linking obesity and an increase in peripheral vascular resistance: Endothelial dysfunction, insulin resistance, increased sympathetic nervous system activity, substances released from adipocytes (IL-6, TNF- and so forth) and sleep apnea (Calle *et al.,* 1999). Characteristically, obese subjects have increased sympathetic nerve activity, increased insulin levels and increased activity of the renin–angiotensin-aldosterone system (Manson *et al.,* 1995). BMI was consistently associated with increase in SBP and DBP in all age-gender groups (Haslam DW, James WP *et al.,* 2005). Obesity is commonly associated with hypertension, increased blood volume and cardiac output. There is also activation of the adrenergic system (Peeters, Kaltman *et al.,* 2003). In the present study we compared mean values of all parameters and values are as follows: There is a highly significant increase / difference between the parameters weight, BMI, SBP, DBP, PP, MAP, and RAP in normal weight and obese group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$). Also it is seen that the mean values of age, weight, height, BMI, heart rate, SBP, DBP, PP,MAP, and RAP are more in Obese group as compared with normal weight group (Graph No.1). There is a highly significant increase/ difference between the parameters weight, BMI, SBP, DBP, PP,MAP, and RAP in normal weight and overweight group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$). Also it is seen that the mean values of age, weight, height, BMI, heart rate, SBP, DBP, PP, MAP, and RAP are more in overweight group as compared with normal weight group (Graph No.2). By applying Student's Unpaired 't' test there is a highly significant decrease/ difference between the parameters weight, BMI, SBP, DBP, PP,MAP, and RAP in normal weight and overweight group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$)Also it is seen that the mean values of age, weight, height, BMI, heart rate, SBP, DBP, PP, MAP, and RAP are less in underweight group as compared with normal weight group (Graph No.3). By applying Student's Unpaired 't' test there is a highly significant increase/ difference between the parameters weight, BMI, SBP, DBP, PP,MAP, and RAP in obese and overweight group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$) Also it is seen that the mean values of age,

weight, height, BMI, heart rate, SBP, DBP, PP, MAP, and RAP are less in underweight group as compared with normal weight group (Graph No.4). By applying Student's Unpaired 't' test there is a highly significant decrease/ difference between the parameters weight, BMI, SBP, DBP, PP,MAP, and RAP in obese and underweight group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$. Also it is seen that the mean values of age, weight, height, BMI, heart rate, SBP, DBP, PP, MAP, and RAP are less in obese group as compared with underweight group (Graph No.5). By applying Student's Unpaired 't' test there is a highly significant decrease/ difference between the parameters weight, BMI, SBP, DBP, PP,MAP, and RAP in over weight and underweight group (i.e. $p<0.01$) and there is no significant difference between age, height and heart rate (i.e. $p.>0.05$). Also it is seen that the mean values of age, weight, height, BMI, heart rate, SBP, DBP, PP, MAP, and RAP are less in over weight and underweight group as compared with underweight group (Graph No.6)

Conclusion

The BMI, the Systolic Blood Pressure and Diastolic Blood Pressure are normal in the normal weight subjects, whereas low in underweight and high in over weight and obese subjects in both males and females. Thus the problem of underweight, overweight, obese and hypertension was observed amongst students joining the MNR Medical College, Sangareddy. These need to be addressed to prevent its sequelae.Advised exercise, modification of life style and dietary habits in overweight obese students. Underweight students are advised to improve nutritional status by encouraging to take balanced food. Also advised regular health checkups to exclude iron deficiency and some of the chronic diseases like parasitic infestations etc.The results of the present study provide some insights to support to encourage physical activity during adolescence and also for attempts aimed at modifying the food habits. The role of physical activity, participation in games and sports are to be emphasized in adolescence. Promotion of better food, life style practices and regulated TV viewing could go a long way in preventing development of obesity and overweight.

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