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Research Article

The Epidemiological Study on the Association of BMI and Blood Pressure in College Students of Jodhpur City

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Abstract: Obesity and hypertension are both major public health problems of the world. Hypertension remains the most important risk factor identified for the cardiovascular disease of stroke, myocardial infarction, congestive heart failure, coronary artery disease and peripheral vascular disease. It has been observed that body mass index (BMI) is one of the most important risk factor for elevation of blood pressure. This study was carried out in 500 students of Dr. S. N. Medical College, Jodhpur. All these students, according to their gender were divided into two groups of 250 boys and 250 girls. The students were 17 to 23 years old. Students of each group were than subjected to measurement of height, weight and blood pressure. The results revealed that BMI is the main determinant of elevation in both systolic and diastolic blood pressure. The mean systolic (106.77mmHg) and diastolic (73.11mmHg) blood pressure of the underweight male was significantly lower than the normal weight (111.49mmHg and 74.89mmHg respectively). The blood pressure measured of normal weight male (111.49mmHg and 74.89mmHg) was significantly lower than of overweight male (126mmHg and 84mmHg) respectively. The mean systolic (96.94mmHg) and diastolic (65.69mmHg) blood pressure of the underweight female was significantly lower than the normal weight (103.42mmHg and 69.27mmHg respectively). The blood pressure measured of normal weight female (103.42mmHg and 69.27mmHg) was significantly lower than of overweight female (115.68mmHg and 74.05mmHg) respectively while blood pressure of overweight female was not significantly different than obese female. This study clearly establishes positive relation between blood pressure and obesity status of a individual (as evident by BMI values), There is a linear rise in mean SBP and DBP with rise in BMI.
Keywords: Obesity, Systolic, Diastolic, Overweight

INTRODUCTION

The prevalence of obesity and its related medical consequences are increasing in many countries. Obesity refers to an excess of body fat. It is always due to energy intake greater than energy expenditure, always defined in terms of co-morbidities and more mortality [1]. The excess food whether fats, carbohydrates or proteins is stored almost entirely as fat in adipose tissue to be used later for energy [2]. Obese adults are at greater risks of hypertension, stroke, heart disease, diabetes and osteoarthritis [3]. The most widely used clinical parameter for the assessment of obesity is the body mass index (BMI) which is an inexpensive and easy to perform method of screening for weight categories [4].

Changes in life-styles, over eating, fast food-consumption, stressful, hectic time schedule, close work on electronic gazettes and related factors are pushing the college youth on the path of chronic diseases. Increasing hypertension in India and other developing countries has been related to the secondary life style, excess salt intake, increasing generalized and central obesity, stress of migration and urbanization.

The increased blood pressure has been found to be a single largest independent risk factor for cardiovascular disease. In India, the hypertension is a major public health problem among the middle and high socio-economic class [5]. Obesity induced hypertension is associate with increased peripheral resistance and cardiac output, increased sympathetic tone, increased salt sensitivity and insulin mediated salt retention.

Hypertension and pre-hypertension in college youth are on the rise. New findings have implication for the

cardiovascular disease public health burden, particularly the risk of a new cardiovascular disease transition. They reinforce the urgent call for the early prevention of obesity and hypertension in this productive age group. Recent studies suggest that approximately 30-35% of college students are overweight or obese based on BMI, with 65-70% of the undergraduates at a healthy weighty [6].

Life style especially diet and physical activity are associated with elevation of blood pressure. Unhealthy life style components such as lack of physical activity and imbalanced or higher food intake have been recognized as important risk factors for the development of hypertension. Healthy life style modification plays a significant role in the prevention and management of hypertension [7].

MATERIALS AND METHODS

This study was carried out in 500 students of Dr. S. N. Medical College, Jodhpur. All these students, according to their gender were divided into two groups of 250 boys and 250 girls. The students were 17 to 23 years old. Students of each group were than subjected to measurement of height, weight and blood pressure. Then blood pressure of each student were also measured in day time between 8-11 AM using stethoscope and sphygmomanometer after providing peaceful environment.

All these selected students were performing normal physical activity which is essentially required for daily routine work. All the students were going to college on their bikes. Those who were found going for jogging, cycling or any activity were not included in this study.

Body mass index of each student scaled according to height and weight. The BMI was calculated formula: Body mass index (BMI) = weight (Kg)/Height (m^2).

The BMI < 18.5 kg/m^2 was considered as the normal while 23-25 kg/m^2 was overweight whereas > 25 kg/m^2 considered as obese.

Statistical analysis

One way analysis of variance unstacked (ANOVA) was applied using MINITAB software.

RESULTS

To study the effect of obesity on blood pressure, all the students (boys and girls) were categorized into 4 groups according to the recommendations of WHO for the Asian population. All these selected students were performing normal physical activity which is essentially required for daily routine work. All the students were going to college on their bikes. Those who were found going for jogging, cycling or any activity were not included in this study.

Table no. 1 shows that the overall prevalence of obesity in 500 college students of both the sexes. They were classified on the basis of their BMI (body mass index) and were arranged as: 139 students (27.8%) were with BMI (<18.5kg/m^2) under weight, 262 students (52.4%) were with BMI (18.5-23kg/m^2) normal weight, 62 students (12.4%) were with BMI (>23-25kg/m^2) over weight, 37 students (7.4%) were with BMI (>25kg/m^2), more than half (52.4%) students were of control group BMI (18.5-23kg/m^2).

Table no. 2 shows the prevalence of obesity in 250 boys and 250 girls. They are classified on the basis of their BMI status. Out of 250 boys and 250 girls observed; underweight girls (BMI<18.5) were found to be much less (20.4%) than boys (35.2%). The obesity was found to be more prevalent in girls.

Table no. 3 shows that BMI has considerably significant effect on systolic and diastolic blood pressure. In boys, both SBP and DBP values were higher in control group BMI (18.5-23kg/m^2) than the underweight category with p-values <0.0001 and p<0.0001 respectively. These results conclude that body mass index (BMI) has a positive influence on both systolic and diastolic blood pressure of college boys.

In girls, with low BMI had low SBP and DBP, and higher values of SBP and DBP with higher BMI. This changes in means SBP and DBP was found to be highly significant with p-value of <0.0001 and <0.0001 respectively.

The results revealed that BMI is the main determinant of elevation in both systolic and diastolic blood pressure. The mean systolic (106.77mmHg) and diastolic (73.11mmHg) blood pressure of the underweight male was significantly lower than the normal weight (111.49mmHg and 74.89mmHg respectively). The blood pressure measured of normal weight male (111.49mmHg and 74.89mmHg) was significantly lower than of overweight male (126mmHg and 84mmHg) respectively. The mean systolic (96.94mmHg) and diastolic (65.69mmHg) blood pressure of the underweight female was significantly lower than the normal weight (103.42mmHg and 69.27mmHg respectively). The blood pressure measured of normal weight female (103.42mmHg and 69.27mmHg) was significantly lower than of overweight female (115.68mmHg and 74.05mmHg) respectively while blood pressure of overweight female was not significantly different than obese female.

Table no. 4 & 5 shows the similar result indicating that moderate exercise of two months period caused an appreciable fall in within same gender and BMI group. This study shows a negative effect of prolonged exercise on blood pressure in both sexes and in all BMI groups.

Table 1: Overall prevalence of obesity (as per BMI status) in 500 students (both boys and girls)

Sl. No.	BMI (kg/m^2) Category	Frequency	Prevalence (%)
1	Under weight BMI < 18.5	139	27.8
2	Normal weight BMI 18.5-23	262	52.4
3	Over weight BMI > 23 to 25	62	12.4
4	Obese BMI > 25	37	7.4
	Total	500	100

Table 2: Overall prevalence of obesity (as per BMI status) in 250 boys and 250 girls)

Sl. No.	BMI (kg/m^2) Category	In boys (250)		In girls (250)	
		Frequency	Prevalence (%)	Frequency	Prevalence (%)
1	Under weight BMI < 18.5	88	35.2	51	20.4
2	Normal weight BMI 18.5-23	125	50	137	54.8
3	Over weight BMI > 23 to 25	25	20	37	14.8
4	Obese BMI > 25	12	4.8	25	20

Table 3: Correlation of Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) with Body Mass Index (BMI) in boys and girls

Sl. No.	BMI (kg/m^2) Category	In boys (250)		In girls (250)	
		SBP (mmHg)	DBP (mmHg)	SBP (mmHg)	DBP (mmHg)
1	Under weight BMI < 18.5	106.77±4.83	73.11±3.33	96.94±3.84	65.69±3.38
2	Normal weight BMI 18.5-23	111.49±6.38	74.89±4.38	103.42±7.78	69.27±3.95
3	Over weight BMI > 23 to 25	126.0±3.27	84.0±3.27	115.68±6.52	74.0±6.06
4	Obese BMI > 25	135.66±8.17	94.5±9.23	126.08±3.29	84.08±3.29

Table 4: Comparative trend of SBP and DBP in boys (of all BMI Groups) with average & moderate exercise

Sl. No.	BMI (kg/m^2) Category	In boys (250)			
		SBP (mmHg)		DBP (mmHg)	
		Average exercise	Moderate exercise	Average exercise	Moderate exercise
1	Under weight BMI < 18.5	106.77	103.07	73.11	69.20
2	Normal weight BMI 18.5-23	111.49	106.77	74.89	73.12
3	Over weight BMI > 23 to 25	126.0	111.84	84.0	74.24
4	Obese BMI > 25	135.66	126.00	94.5	84.00

Table 5: Comparative trend of SBP and DBP in girls (of all BMI Groups) with average & moderate exercise

Sl. No.	BMI (kg/m^2) Category	In girls (250)			
		SBP (mmHg)		DBP (mmHg)	
		Average exercise	Moderate exercise	Average exercise	Moderate exercise
1	Under weight BMI < 18.5	96.94	96.55	65.69	66.63
2	Normal weight BMI 18.5-23	103.42	96.98	69.27	65.77
3	Over weight BMI > 23 to 25	115.68	102.59	74.0	69.08
4	Obese BMI > 25	126.08	116.00	84.08	74.32

DISCUSSION

Hypertension is a common problem in elder population. It remains the most important risk factor identified for the cardiovascular disease of stroke, myocardial infarction, congestive heart failure, coronary artery disease and peripheral vascular disease [8]. Physical inactivity, poor dietary choices, increased caloric intake, increased stress and disturbed sleep patterns, in addition to many other factors, contribute to the increased weight gain and obesity in college-aged young adults [9-10]. In many cases, increased body weight contributes to the development of the metabolic syndrome in adolescents and young adults, including impaired glucose tolerance, insulin resistance, hyperlipidemias, elevated blood pressure and increased abdominal fat [11].

Most investigators report higher rates of inactivity in women compared to men, with 10-37% of the college-aged men and 22-48% of the college-aged women reporting no physical activity in the past month. A few studies have examined changes in physical activity during the first two years of college. Racette *et al*. observed reduced participation in aerobic exercise and increased participation in stretching exercise during first two years of college in boys and girls at a medium sized independent university in an urban setting. The changes in physical activity in this study contributed to a significant weight gain (4.1±3.6 kg, $p<0.001$) during first two years of college [12].

In contrast, Pinto and colleagues found that exercise participation did not change from the first to second year of college in boys and girls in university. Of these investigators observed 42% of the students were sedentary or exercising below the recommended guidelines at least 30 minutes of moderate physical exercise on most days of week. This information indicates the increased participation of college students in low intensity activity, and exercise at a lower intensity or duration than current recommendation [13].

Study performed by Jonhston *et al*. on college students in Ireland had shown that blood pressure increases linearly with rise in BMI, especially after the control group BMI status. They studied 458 students including 190 boys and 268 girls, of age 18 to 29 years. 45% of boys and 49% of girls were with normal BMI (control group 18.5-23.0 kg/m^2). The overweight percentage was 16% and 23% in boys and girls, respectively. The mean systolic blood pressure of boys with BMI (<18.5), (18.5-23), (>23-25) and (>25 kg/m^2), was 96.8, 107.2, 123.7 and 139 mmHg respectively. Their mean diastolic blood pressures were 65.3, 69.0, 105.3, 125.2 and 135 mmHg respectively and their DBP values were found to be 60.5, 66.7, 78.8 and 85.0 mmHg respectively [14].

The present study showed that increase in body mass index is the most important predictor of elevated blood pressure in this population. The reason for high blood pressure may be high lipid dietary intake, less physical activity and changed life style. Normalization of blood pressure cannot occur without reaching ideal body weight. The change in life style including increase of physical activity and reduction in fat intake is the best method to prevent elevation in blood pressure, which is a risk factor for further hypertension and cardiovascular ailments.

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