Pravara Med Rev; September 2022, 14 (03), 13 – 19
DOI: 10.36848/PMR/2022/70100.51015

Original article

A cross-sectional study of obesity related indices and its correlation with blood pressure in Medical students

Mr Chandrashekhar Shinde[1], Dr Motilal Tayade[2], Dr Sunita Nighute[3], Dr Vinod Kathore[4]

[1]Assistant Professor, Department of Physiology, Dr. Vitthalrao Vikhe Patil Medical College, Vilad ghat Ahmednagar
[2]Professor , Department of Physiology, Pravara Institute of Medical Sciences, Loni. Ahmednagar
[3]Professor & Head, Department of Physiology, Dr. Vitthalrao Vikhe Patil Medical College, Vilad ghat Ahmednagar
[4]Professor & Head, Department of Physiology , Pravara Institute of Medical Sciences, Loni. Ahmednagar
Corresponding author: Dr Motilal Tayade

Abstract:

Introduction: Obesity is associated with sympathetic activation and is the leading risk factor for the development of hypertension cardiovascular diseases, and diabetes mellitus

Methodology : The study comprises of 60 males and 60 females, age ranging from 18 to 25yrs.The students who were willing to participate were considered and students who were taking any medication for hypertension or obesity or who were suffering any systemic disease were excluded from study

The participated students were screened through a medical history questionnaire. The questionnaire contained information regarding gender, age food habit, and exercise and drug history.

Results : The prevalence of obesity fat % and hypertension is more in males than females. Mean value of systolic BP (120.00, 127.67, 134.24, 145.71) and diastolic BP (76.33, 78.27, 81.41.72, 89.50) were found to be higher as the BMI increased

Conclusion: This huge increase in prevalence of obesity is well documented as one of the major risk factors for the progress of hypertension. They are constant with the worldwide importance on prevention as well as control of weight and obesity. They also specify that measurement of blood pressure and body weight and timely diagnosis and control are exclusively essential for overweight and obese people.

Keywords: Obesity, Hypertension, Cardiovascular diseases

Introduction:

Hypertension is strongly correlated with an increased risk of cardiovascular events. Recent studies have demonstrated that body fat percentage (BF%) is associated with cardiometabolic risk factors. Obesity is associated with sympathetic activation and is the leading risk factor for the development of hypertension cardiovascular diseases, and diabetes mellitus (1,2). Obesity has been primarily diagnosed by using the BMI for the last 30 years. Based on BMI obesity is divided into different classes; normal weight (18.5-25 kg/m^2), underweight (< 18.5 kg/m^2) and overweight (>25 kg/m^2) (3). Obesity is defined as an unnecessary accumulation of fat in the body resulting in an increase in weight beyond that considered desirable concerning age, height, and weight (4). BMI is a better tool to assess the obesity than other methods with a significant clinical utility (5). Many previous studies have shown that higher BMI is associated with higher blood pressure

The increase in the prevalence of cardiovascular disease (CVD) is a global health concern because CVD has become an important cause of morbidity and mortality worldwide (6). Cardiovascular risk factors can be categorized into independent or non-modifiable risk factors and dependent or modifiable risk factors. Independent risk factors include age, gender and family history.

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

Dependent factors of the 1st grade include smoking, hypertension, lipid disorders and diabetes, while dependent factors of the 2nd grade include overweight, improper dietary habits and stress (7).

In the medical students, fast food consumption is one of the major factors reported as one of the causes of obesity in teenagers. The causes which influence fast food consumption are convenience, cost, menu choices, flavour, and taste (8). but in the real world conditions food decisions are made within the context of time pressure, specific environment, individual presence, and social factors.

Medical students adopt unhealthy lifestyles and habits such as disturbed sleep cycles, irregular meal timings, smoking, and increased nicotine and caffeine use (9). Inappropriate diet and irregularities in diet are independent risk factors for obesity (10). Perceiving medical education is a highly stressful and prevalence of obesity and other cardiovascular risk factors are not studied extensively.

The present study analyzed the correlations between obesity related indices including BMI, %BF and BP indices viz. systolic blood pressure (SBP), diastolic blood pressure (DBP) in first year medical students. In the present study, we need to find out the correlation between BP indices viz. systolic blood pressure (SBP), diastolic blood pressure (DBP), BMI and % fat in first year medical students.

Materials and method:

This cross-sectional study was conducted on first year MBBS students of Rural Medical College, Loni. PIMS (DU) after being granted approval from the ethical committee PMIS/RMC/IEC-UG-PG/2019/65. The study comprises of 60 males and 60 females, age ranging from 18 to 25yrs.The students who were willing to participate were considered and students who were taking any medication for hypertension or obesity or who were suffering any systemic disease were excluded from study The participated students were screened through a medical history questionnaire. The questionnaire contained information regarding gender, age food habit, exercise and drug history.

Height was determined using a length measuring tape in cm and recorded in the nearest 0.5 cm. Weight was measured using kg weight scale and recorded to the nearest 0.1 kg using electronic scale.

BMI was classified according to the proposed criteria of World Health Organization (WHO) underweight < 18.5, normal = 18.5-24.5, overweight = 25.0-29.9, and obese ≥30.00 (2).

In the present study, all the subjects having BMI ≥30 were taken as obese. BMI was then calculated through standard formula i.e., weight (kg)/height (m^2).

The measurements of blood pressure were taken through pre-checked and reliable apparatus i.e., mercury sphygmomanometer.

The students were seated calm and quiet for at least 5 minutes prior to measurement on comfortable chairs. 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 (JNC8(11).

Body fat % was measured using a commercially available digital weight scale incorporating a bioelectric impedance analyzer (HBF-352, Omron Health care Co., Kyoto, Japan). The instrument is portable and easy to use in epidemiological field surveys. BF % was measured to the nearest 0.1 per cent. The digital weight scale includes a hand grip and foot plate, each of which is equipped with two electrodes. The two electrodes between the left and right grip were short circuited, along with those for the left and right feet. Upon measurement, the study subject stood on the foot plate and gently grasped the two handgrips with arms held straight forward. During the measurement, the instrument records impedance from the hands to the feet, which corresponds to the whole body impedance, by applying an electric alternating current flux of 500 μA at an operating frequency of 50 kHz. Consequently, BF % was calculated from the impedance value and the pre entered personal data. Total body water was predicted from the impedance index

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

(height^2 / impedance) (12,13). From the total body water, the BF % was calculated as 100 x [weight-(total body water)]/ weight (13). The calculation is done by software program based on algorithm developed and patented by Omron Health Care Co., Kyoto, Japan. Impedance measured and predicted total body water, which is not displayed to user, is automatically fed to algorithm along with pre entered data and the software calculates the body fat% (2).

Statistical analysis:

Data was collected and grouped by using Microsoft excel. Descriptive data represented by the percentage. Unpaired students t-test was used to compare the variables. For correlation of BMI with blood pressure, % fat, Pearson correlation test was used. Association of BMI with blood pressure and % fat was analysed by chi square test and pearson correlation to analyze the correlation between BMI, Fat % and blood indices. The probability level of $p< 0.05$ was set for statistical analysis.

Results:

Table.1 Sex and BMI cross tabulation

BMI classification	Boys.no. (%)	Girls no. (%)	Total (n)
Underweight (BMI* <18.5)	7 (12 %)	2 (3 %)	9
Normal weight (18.5 -24.9)	27 (45 %)	33 (55 %)	60
Overweight (25 -29.9)	18 (30 %)	19 (32 %)	37
Obese (>30 -39.9)	8 (13 %)	6 (10 %)	14
Total	60 (100%)	60 (100%)	120

Table.2 Sex and blood pressure cross tabulation

Systolic BP	Boys (n)	Girls (n)	Total (n)
<120	23 (38) %	18 (30) %	41
120-139	18 (30) %	31 (52) %	49
140-159	19 (32) %	11 (18) %	30
>160	0	0	0
Diastolic BP			
<120	18 (30) %	18 (30) %	36
120-139	30 (50) %	31 (52) %	61
140-159	12 (20) %	11 (18) %	23
>160	0	0	0

Table.3 Mean % fat and BP in each BMI Category

Body Mass Index	Mean % Fat	Mean Systolic BP	Mean Diastolic BP
<18.5)	22.26± 10.41	120.00± 00	76.33±6.20
(18.5 -24.9)	22.50± 10.81	127.67±8.60	78.27±80.00
(25 -29.9)	20.74± 10.77	134.24±7.94	86.41±7.58
(>30 -39.9)	43.36± 16.32	145.71±3.85	89.50±3.63

Mean % Fat: SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Table.4 Pearson correlation of BMI BP and % Fat

	% Fat		SBP		DBP		
	p-value	r-value	p-value	r-value	p-value	r-value	
BMI	< .001	0.32***	< .001	0.70***	< .001	0.42***	

Correlation significant at: * p < .05, ** p < .01, *** p < .001 *Significant difference between BMI and % Fat: SBP and DBP.

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

Table.1 The study included 120 first year medical students of first year MBBS with a mean age Boys with a mean age of 21.11± 1.45 where 60 were male and 60 were females. The height was measured in centimetre with mean height 162.95± 6.59 cm and the weight was measure in kilogram with mean weight of 65.79± 11.00 kg. About 7 (12 %) male and 2 (3 %) fell under below normal weight and about 27 (45 %) Male and 33 (55 %) females have normal weight 18 (30 %) Male and 19 (32 %) females found over weight 8 (13 %) Male and 6 (10 %) females were obese. The mean fat % was observed 22.26±10.41 participants with BMI below the cutoffs range 22.50±10.81 with normal BMI 20.74± 10.77 with overweight and 43.36±16.32 with obesity. About 30% males and 38% females have normal systolic blood pressure and 30% males and 30% females have normal diastolic blood pressure. While 50%males and 52% females have high systolic blood pressure and 20% males and 18% females have high diastolic blood pressure (Table.3) The prevalence of obesity fat % and hypertension is more in males than females. Mean value of systolic BP (120.00, 127.67, 134.24, 145.71) and diastolic BP (76.33, 78.27, 81.41.72, 89.50) were found to be higher as the BMI increased (Table 4).

Discussion:

The present study provides an idea about the association between BMI, Fat % and blood pressure in students which has important implications for the risk of cardiovascular disorder in future. The result of present study showed that there is strong association between BMI, Fat % and SBP or DBP among medical students as BMI, Fat % increases the blood pressure also increases significantly. Our finding is similar to Esha Shrestha et.al who found BMI is as a strong predictor of blood pressure. Underweight subjects were less likely to have subsequently elevated blood pressure than those who were in normal BMI group. Overweight or obese subjects were more likely to have significantly higher blood pressure than those with normal BMI (14). body mass index to be even more strongly associate with the blood pressure than race (15).Hypertension is strongly associated to BMI than age (16). Schall reported high blood pressure is associate with age due to process of transformation (17). P. Bovet study indicate significant increase in blood pressure among urban old age men than that of rural ageing population of north India (18). Higgins M et.al reported that increase in blood pressure is highly associated with increased overweight in men and women (19). The systolic blood pressure increased 4 mmHg for every 4.5 kg of increased weight.(19). In our study higher body mass index had about 14mmHg higher systolic blood pressure and 6mmHg higher diastolic blood pressure than students in lower body mass index. In the younger adults, males and females with a body mass index of greater than 30 kg/m^2 had a 5 folds higher frequency of high blood pressure than individuals with a BMI less than 20 kg/m^2 (20). In the countrywide Community Hypertension Assessments showing of more than 1 million men and women, the incidence of hypertension in overweight persons aged 20 t0 39 years was twofold that of persons with normal weight and 3 times higher than that of underweight persons (21).long term change in body fat is associated with change in both systolic and diastolic blood pressure. Becoming normal weight condensed the risk of developing hypertension to a level comparable to persons who were never obese (22) High blood pressure is directly associated to BMI; it shows that increase in BMI leads to increase in the trend of hypertension in both male and female students. Our study revealed that obesity prevalence for males is more than that of females (males: 13% and females: 6%). Similar results have been reported from China and Taiwan (23,24) The BP in our study is also higher in male than female. Krzyzaniak, et.al reported that boys have higher blood pressure than girls significantly after the age of 16 (25). The evidence has shown that testosterone plays an important role in higher BP in male and estrogen in female plays an protective role. That is why female have higher blood pressure after menopause (26).

The high prevalence of overweight/obesity among the students might be due to less physical activity and higher consumption of more unhealthy, high fat food, sweetened beverages and salty snacks and less

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

milk, fruits and vegetables than recommended and exposure to persistent stress. Through our observation , We can say that the students are more addicted to junk foods specially burgers, pizza and cold drinks which are common cause of obesity and blood pressure (27,28). Various studies have shown that dietary intake, physical activity and self-discipline are major factors influencing obesity and hypertension(27,28). These findings suggest that obese children are at higher risk of having high blood pressure than normal children. Therefore, obese children should be routinely screened for blood pressure and other coexisting cardiovascular risk factors including lipid profile (29). In addition, healthy lifestyle should be encouraged by college and at home since prevention in them can help to avoid undesirable health consequences in the future. The expenses we are paying for comfortable and urbanized society causing inactive life style and unhealthy dietary habits which result in difference between energy consumption and expenditure which ultimately leads to obesity (30). Previous studies found high prevalence rates of cardiovascular risk factors, including components of metabolic syndrome, in undergraduate university students, with frequencies reaching 60% (31).The prevalence of both hypertension and obesity is a significant public health challenge and its trend is increasing throughout the world.

Conclusion:

This huge increase in prevalence of obesity is well documented as one of the major risk factors for the progress of hypertension. They are constant with the worldwide importance on prevention as well as control of weight and obesity. They also specify that measurement of blood pressure and body weight and timely diagnosis and control are exclusively essential for overweight and obese people.

References: -

1. Barrett KE, Barman SM, Boitano S, Brooks HL. Cardiovascular Regulatory Mechanisms. In: Ganong's Review of Medical Physiology, 25e [Internet]. New York, NY: McGraw-Hill Education; 2018. Available from: accessmedicine.mhmedical.com/content.aspx?aid=1115831937
2. Rahmouni K, Correia MLG, Haynes WG, Mark AL. Obesity-associated hypertension: New insights into mechanisms. Hypertension. 2005;45(1):9–14.
3. Ravisankar P, Madanmohan, Udupa K, Prakash ES. Correlation between body mass index and blood pressure indices, handgrip strength and handgrip endurance in underweight, normal weight and overweight adolescents. Indian J Physiol Pharmacol. 2005;49(4):455–61.
4. Afzal M, Rizvi F, Rajput AM. Original Article Categories of Overweight and Underweight Students According to Body Mass Index in a Private Medical College. 2015;4(1):27–30.
5. Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, Berenson GS. Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. Pediatrics. 2004 Aug;114(2):e198-205.
6. Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, et al. Heart disease and stroke statistics--2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2008 Jan;117(4):e25-146.
7. Poreba R, Gać P, Zawadzki M, Poreba M, Derkacz A, Pawlas K, et al. Life style and cardiovascular risk factors among students of Wroclaw postgraduate schools. Pol Arch Med Wewn. 2008 Mar;118(3):102–10.
8. Purohit G, Shah T, Harsoda JM. Prevalence of obesity in medical students and its correlation with cardiovascular risk factors: Emergency alarm for today? Kathmandu Univ Med J. 2016;13(52):341–5.
9. Aziz Y, Khan AY, Shahid I, Khan MA, Aisha. Quality of life of students of a private medical college. Pakistan J Med Sci. 2020;36(2):255–9.
10. Kumar CA, Revannasiddaiah N, Gopi A, Halevoor V. A cross-sectional study on the dietary factors and their association with body mass index among undergraduate medical students in a medical college. Int J Health Sci (Qassim). 2014;2(2):591–8.
11. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014

evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014 Feb;311(5):507–20.

12. Kushner RF, Kunigk A, Alspaugh M, Andronis PT, Leitch CA, Schoeller DA. Validation of bioelectrical-impedance analysis as a measurement of change in body composition in obesity. Am J Clin Nutr. 1990 Aug;52(2):219–23.
13. Stall SH, Ginsberg NS, DeVita M V, Zabetakis PM, Lynn RI, Gleim GW, et al. Comparison of five body-composition methods in peritoneal dialysis patients. Am J Clin Nutr. 1996 Aug;64(2):125–30.
14. Shrestha E, Shrestha S, Shrestha P, Madhikarmi NL. Association Between Body Mass Index and Blood Pressure Among Medical Students of Tertiary Care Teaching Hospital in Birgunj. Birat J Heal Sci. 2021;6(2):1535–9.
15. Kumanyika SK, Landis JR, Matthews YL, Weaver SL, Harlan LC, Harlan WR. Secular trends in blood pressure among adult blacks and whites aged 18-34 years in two body mass index strata, United States, 1960-1980. Am J Epidemiol. 1994 Jan;139(2):141–54.
16. Humayun A, Shah AS, Sultana R. Relation of hypertension with body mass index and age in male and female population of Peshawar, Pakistan. J Ayub Med Coll Abbottabad. 2009;21 3:63–5.
17. Schall JI. Sex differences in the response of blood pressure to modernization. Am J Hum Biol [Internet]. 1995;7(2):159–72.
18. Bovet P, Ross AG, Gervasoni J-P, Mkamba M, Mtasiwa DM, Lengeler C, et al. Distribution of blood pressure, body mass index and smoking habits in the urban population of Dar es Salaam, Tanzania, and associations with socioeconomic status. Int J Epidemiol. 2002 Feb;31(1):240–7.
19. Higgins M, Kannel W, Garrison R, Pinsky J, Stokes J 3rd. Hazards of obesity--the Framingham experience. Acta Med Scand Suppl. 1988;723:23–36.
20. Rabkin SW, Chen Y, Leiter L, Liu L, Reeder BA. Risk factor correlates of body mass index. Canadian Heart Health Surveys Research Group. C Can Med Assoc J = J l'Association medicale Can. 1997 Jul;157 Suppl:S26-31.
21. Stamler R, Stamler J, Riedlinger WF, Algera G, Roberts RH. Weight and blood pressure. Findings in hypertension screening of 1 million Americans. JAMA. 1978 Oct;240(15):1607–10.
22. Juonala M, Magnussen CG, Berenson GS, Venn A, Burns TL, Sabin MA, et al. Childhood adiposity, adult adiposity, and cardiovascular risk factors. N Engl J Med. 2011 Nov;365(20):1876–85.
23. Pan H, Jiang Y, Jing X, Fu S, Jiang Y, Lin Z, et al. Child body mass index in four cities of East China compared to Western references. Ann Hum Biol. 2009;36(1):98–109.
24. Chen LJ, Fox KR, Haase A, Wang JM. Obesity, fitness and health in Taiwanese children and adolescents. Eur J Clin Nutr. 2006 Dec;60(12):1367–75.
25. Krzyzaniak A, Krzywińska-Wiewiorowska M, Stawińska-Witoszyńska B, Kaczmarek M, Krzych L, Kowalska M, et al. Blood pressure references for Polish children and adolescents. Eur J Pediatr. 2009;168(11):1335–42.
26. Reckelhoff JF. Gender differences in the regulation of blood pressure. Hypertens (Dallas, Tex 1979). 2001 May;37(5):1199–208.
27. Sirikulchayanonta C, Ratanopas W, Temcharoen P, Srisorrachatr S. Self discipline and obesity in Bangkok school children. BMC Public Health. 2011;11.
28. Dehghan M, Akhtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. Nutr J. 2005;4(Table 1):1–8.
29. Pearson TA, Palaniappan LP, Artinian NT, Carnethon MR, Criqui MH, Daniels SR, et al. American Heart Association Guide for Improving Cardiovascular Health at the Community Level, 2013 update: a scientific statement for public health practitioners, healthcare providers, and health policy makers. Circulation. 2013 Apr;127(16):1730–53.
30. SAEED S, ALI AUN, KHAWAJA R, SHAIKH IALI, SHAH I, MUSTAFA MW, et al.

RELATIONSHIP BETWEEN BMI AND BLOOD PRESSURE AMONG STUDENTS OF 3 RD YEAR AT INSTITUTE OF MEDICAL TECHNOLOGY (DUHS). Med Channel. 2013;19(4).

31. Zea-Robles AC, LeÃ\textthreesuperiorn-Ariza HH, Botero-Rosas DA, Afanador-CastaÃ\pmeda HD, PinzÃ\textthreesuperiorn-Bravo LA. Factores de riesgo cardiovascular y su relaciÃ\textthreesuperiorn con la composiciÃ\textthreesuperiorn corporal en estudiantes universitarios. Rev Salud PÃ\textordmasculineblica [Internet]. 2014;16:505–15.

PMR P ISSN: 0975-0533, E ISSN: 0976-0164