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Correlation of Obesity Indices with Blood Pressure and Blood Glucose Level among Young Medical Students

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Abstract : *Overweight and obesity are affecting both developed and developing countries. WHO has declared obesity as a disease of pandemic significance*
Objectives *To assess the relationship of obesity indices with blood pressure and blood glucose level among young adult medical students.*
Materials and methods: *The present cross sectional study was conducted in Department of B S Medical College, Bankura,West Bengal with a sample size of 90 young adult medical students aged 17 – 23 years. Obesity indices measured were BMI, WC, WHpR and WHtR using standard protocol. Blood pressure and fasting blood glucose levels were measured using standard techniques.Data analysis was done using suitable statistical methods.*
Results: *The results of the present study revealed a significant correlation of BMI with both systolic and diastolic blood pressure. WC and WHtR were significantly associated with systolic and diastolic blood pressure among males while there was statistically significant correlation between WHpR and systolic blood pressure among females.*
Conclusion: *Results of present study reveal the increased risk of development of hypertension in young adult age group at an earlier age. Hence, it's necessary for implementing an effective prevention and health promotion programs targeted towards young adult age group.*
Keywords: *Blood Pressure, BMI, Fasting blood sugar, WC, WHpR, WHtR.*

I. Introduction

Overweight and obesity are affecting most developed and developing countries. The World Health Organization (WHO) has declared obesity as a disease of pandemic significance.The relationship between obesity and diabetes mellitus has been reported to be age-dependent. A recent meta analysis has shown an age dependent relationship between Body Mass Index (BMI) and the incidence of diabetes mellitus throughout the entire Asia Pacific region..BMI (weight in kilograms divided by the square of the height in meters) is stated by the WHO as the most useful epidemiological measure of obesity. It is a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and populations. [3] Waist hip circumference ratio (WHpR), waist height ratio (WHtR) and waist circumference are commonly used to predict the risk of obesity related morbidity and mortality as they account for regional abdominal adiposity. [4]
Medical students are of particular interest because they fall in young adult age group and are also future physicians. Therefore knowledge and awareness regarding the health consequences of lifestyle changes are generally expected to be high among these students. This may influence the prevalence of lifestyle diseases such as hypertension and diabetes among them.
The present study was planned to assess the relationship of obesity indices with blood pressure and blood glucose level and to determine the prevalence of overweight and obesity in young adult medical students.

II. Methodology

The present study was conducted among first year medical students enrolled in the Department of Biochemistry, B.S. Medical College, Bankura.

Inclusion criteria

Medical students within the age group of 17 – 23 years.

Exclusion criteria

1. History of any drug intake which would cause weight gain. (Carbamazepine, Gabapentine, Corticosteroids, Haloperidol, Chlorpromazine Amitriptyline, Oral contraceptive pills and others.)

2. History of diabetes and hypertension.
3. History of smoking.

Apparatus used
1.Digital scale
2.Measuring tape
3.GOD POD kit
4.Spygmomanometer
Stadiometer

Procedure

A pre designed questionnaire was used to record the information about descriptive data of the participant's age, detailed family history and personal history including history of smoking, alcohol consumption and history of long term drug intake which would affect the health and detailed history consisting of family history of hypertension and diabetes by interviewing the participants.
Age was recorded to the nearest completed year as determined from the register of the college.
Sex.

Physical characteristics
Weight

Digital scale (seca) with an accuracy of +100gm for measurement of body weight. Subjects were made to stand on the center of the weight scale platform and weighed without shoes in light clothings.

Height

Standing body height was measured without shoes to the nearest 0.5 cm with the use of a commercial stadiometer, with the shoulders in relaxed position and arms hanging freely. With his or her back to the vertical backboard of the stadiometer. The weight of the participant was evenly distributed on both feet. The heels of the feet were placed together with both heels touching the base of the vertical board. The buttocks, scapulae and head were also positioned in contact with the vertical backboard.

Body mass index (BMI)

Calculated as body weight in kilograms (kg) divided by square of the body height in meter square (m^2). Students were classified according to the BMI classification given by the WHO, the International Association for the Study of Obesity and the International Obesity Task Force Proposed the appropriateness of the classification of obesity in Asia in 2000.

BMI (kg/m^2)	**Classification**
≤18.5	Underweight
18.5 -22.9	Normal range
23 -24.9	Overweight at risk
25 -29.9	Obese I
≥30	Obese II

Waist circumference

The subject was made to stand and asked hold up his/her gown. The hip area was palpated for the right iliac crest and a horizontal line marked at the highest point of the iliac crest. The measuring tape was then placed around the trunk in a horizontal plane at that level marked on the right side of the trunk. The measurement was made at minimal respiration to the nearest 0.1 cm.
The cut off point for central obesity was defined as
90 cm for male participants
80 cm for female participants.

- **Hip circumference**

The subject was made to stand erect with feet together and weight evenly distributed on both feet and asked hold up his/her gown. The tape was placed at the maximum extension of the buttocks and hip circumference was measured in cm.

- **Waist to hip ratio**

Calculated with the corresponding values of waist circumference by hip circumference.
The cut off point for central obesity was defined as
≥ 0.9 for male participants
≥ 0.8 for female participants.

Cardiovascular risk factors :

i. Bood pressure measurement:

Measurement was done in the morning at 7.30 am. Blood pressure was measured using mercury sphygmomanometer. Subjects were seated in a chair with their back supported at heart level. Measurements were done after a rest of five minutes. The participant was made to be seated comfortably with the arm supported and positioned at the level of the heart. Ensuring that no tight clothing constricts the arm. Measurements were taken using a mercury sphygmomanometer applied on the right arm of the participants. Appearance of Korotkoff sounds were recorded for systolic and disappearance of Korotkoff sounds were recorded for diastolic blood pressure. Three readings were recorded at interval of 2 mins and average was taken. Blood pressure was defined among the study participants according to the Seventh Report of Joint National committee on Prevention, Detection, Evaluation and Treatment of High blood Pressure (JNC-VII) criteria.

	Systolic	**Diastolic**
Normal	< 120 mmHg	<80 mmHg
Pre- hypertensives	120-139 mmHg	80-89 mmHg
Stage-1 hypertensives	140-159 mmHg	90-99 mmHg
Stage-2 hypertensives	≥160 mmHg	≥100 mmHg

Ii. Blood glucose level measurement:

Early morning 7 tl 8 am, 2ml of venous blood samples were drawn for blood glucose level measurements, following a 12 hour overnight fast. Fasting blood glucose level was measured after a 12 hour overnight fast. It was measured using Glucose oxidase peroxidase (GOD POD) method.

Fasting blood glucose was defined among the study participants according to the criteria adapted from the American Diabetes Association, 2007.

		Hyperglycemia	
	Normal glucose tolerance	**Pre diabetes (impaired fasting glucose or impaired glucose tolerance)**	**Diabetes mellitus**
FBS	< 100 mg/dL(<5.6 mmol/L)	100 – 125 mg/dL(5.6 mmol/L – 6.9 mmol/L)	>126 mg/dL(≥ 7.0 mmol/L)

Data analysis

Data analysis was done using unpaired 't' test to compare the mean of two groups.

Chi-square test was used to compare the rates of different groups.

Differences were considered significant at $p < 0.05$ level.

'F' test (ANOVA) was used to compare means of more than to two groups followed by Bonferroni multiple comparison test.

III. Results

Table 1: Baseline physical characteristics**.**

Characteristics	**Males**	**Females**
Bmi (Kg/M^2)	22.7 ± 3.73	23.4 ± 4.18
Waist Circumference (Cm)	89.2 ± 8.34*	82.5 ± 10.07 *
Whpr	0.90 ± 0.04 *	0.84 ± 0.06 *
Sbp (Mm Of Hg)	120.9 ± 8.69 *	110.7 ± 9.22 *
Dbp (Mm Of Hg)	79.3 ± 8.46 *	75.4 ± 7.54 *
Fasting Blood Glucose Level (Gms)	86.3 ± 5	85.1 ± 6.13

$p < 0.05$ – statistically significant.

Table 2: Correlation of obesity indices and cardiovascular risk factors in male subjects.

Obesity Indices	**Sbp(Mmhg)**	**Dbp(Mmhg)**	**Fbs(Mg/Dl)**
Bmi ≤18.5(N = 03)	110.5 ± 6.30 *	76.1 ± 6.32 *	84.4 ± 4.52
Bmi 18.5 -22.9(N = 36)	116 ± 8.34 *	77.5 ± 7.90 *	85.5 ± 5.56
Bmi 23 -24.9(N = 14)	120.1 ± 5.51 *	79.4 ± 7.50 *	87.0 ± 5.94
Bmi 25 -29.9(N = 07)	125.3 ± 7.66 *	84.4 ± 9.74 *	86.9 ± 7.45
Bmi ≥30(N = 02)	131.6 ± 6.59 *	86.8 ± 7.97 *	89.8 ± 6.56

Wc> 90(N = 22)	121.7 ± 8.74 *	81 ± 8.78 *	85.6 ± 6.44
Wc< 90(N =50)	118.3 ± 8.46 *	78.2 ± 8.03 *	87.1 ± 5.59
Whpr > 0.9 (N =16)	118.9 ± 8.45	80 ± 8.24	83.9 ± 4.98 *
Whpr < 0.9 (N = 46)	121.1 ± 8.99	78.7 ± 8.77	89.6 ± 5.7 *

BMI categorized into five groups have shown a significant correlation with systolic blood pressure.
Diastolic blood pressure also showed a significant association with BMI. Multiple comparison tests showed a significant difference between subjects of group II and group IV and V. In contrast to the blood pressure comparison of fasting blood sugar level with BMI was not significant in male participants.
The cut off point for waist circumference in males is 90 cm which was statistically significant with both systolic and diastolic blood pressure.
Cut off value for WHpR was > 0.9 for male subjects. The correlation between the blood pressure and WHpR was not significant in them.

Table 3: Correlation of obesity indices and cardiovascular risk factors in female subjects

Obesity Indices	**Sbp(Mmhg)**	**Dbp(Mmhg)**	**Fbs(Mg/Dl)**
Bmi ≤18.5(N = 04)	107.5 ± 9.52 *	71.5± 7.56 *	86 ± 6.50 *
Bmi 18.5 -22.9(N =12)	107.5 ± 8.85 *	73.8 ± 6.85 *	84.3 ± 5.96 *
Bmi 23 -24.9(N = 08)	113 ± 8.48 *	75.9 ± 7.39*	84 ± 6.2 *
Bmi 25 -29.9(N = 02)	114.3 ± 8.68 *	78.3 ± 7.67 *	85.6 ± 5.57 *
Bmi ≥30(N = 02)	121.5 ± 6.34 *	81.7 ± 5.42 *	89.7 ± 12.74*
Wc> 80(N = 11)	112.6 ± 9.30	76.1 ± 7.84	85.4 ± 7.11
Wc< 80(N = 17)	110.6 ± 9.14	74.6 ± 7.07	85 ± 6.19
Whpr > 0.8 (N = 11)	111.2 ± 9.23 *	75.1 ± 7.65	85.1 ± 6.85
Whpr < 0.8 (N = 17)	115.1 ± 8.87 *	77.8 ± 6.71	85.4 ± 6.19

Systolic blood pressure correlated significantly in all the BMI groups among female participants. The same significant difference was observed with diastolic blood pressure. Female subjects had a significant association between their BMI and FBS. Female participants had no significance between their waist circumference and blood pressure levels. The results were not significant in female subjects for correlation between waist circumference and their fasting blood sugar levels.

The WHpR cutoff point was >0.8 for females. There was statistically significant association between the WHpR and systolic blood pressure levels while the correlation was not significant for diastolic blood pressure.
14 (22.5%) males and 08 (28.5%) females were overweight at risk. Prevalence of obese I was seen among 07 (11.2%) male subjects and 02 (7.1%) of female subjects and prevalence of obese II was significantly present in 2 (3.2%) male subjects and 2 (7.1%) of female subjects.

IV. Discussion

BMI and systolic and diastolic blood pressure correlated statistically significant within each categories of BMI.

Studies done among medical students in P US and South Africa also reported the similar association between BMI and blood pressure. [5 – 7]

But there was no significant association between BMI and FBS in male subjects, while there was statistically significant association found between the two in female participants.

The difference in this result between males and females could be because of high prevalence of obesity in females (28.1%) when compared to male subjects (19.9%).

Comparing the association between WC and blood pressure, there was statistically significant correlation between both in male participants while the correlation was not statistically significant in female participants.

The results of the present study shows variation in association between WC and cardiovascular risk factors.

WC is an important component of the diagnostic criteria for the metabolic syndrome. However, measuring WC doesn't reliably distinguish between a large waist due to increases in subcutaneous adipose tissue versus visceral fat; this distinction requires CT or MRI. [8]

This type of varied results is also found in other studies. [5-7] Our results are similar with those of the Bogalusa Heart Study, where WC measurements didn't predict the blood pressure levels of young adults in. [9]

Considering the correlation between WHpR and blood pressure, statistical significance was achieved only for systolic blood pressure and WHpR in female participants, while there was no statistical significance between WHpR and diastolic blood pressure both males and females. The reason for such variation could be that regional fat distribution has an impairment effect on metabolic and haemodynamic measures, only when the overall body fat is larger than a certain quantity. [5]

Other surveys done among medical students show a significant association between WHpR and blood pressure. [5,6] A study conducted in France showed that there was a positive and independent correlation of WHpR with systolic arterial pressure both in males and females. [10]

V. Conclusion

Overweight and obesity are a major health hazard all over the world and are becoming a major health threat among both the sexes and all age groups. The findings of the present study done among young adult medical students reveals

Significant proportions of young adult medical students are overweight and obese, the rate being higher for female participants.

Study participants who were overweight or obese had blood pressure levels above normal: being either prehypertensives or Stage I or II hypertensives.

There was significant relationship between the BMI and BP levels. As the BMI increased, the risk of increased blood pressure also raised.

The obesity index which correlates very well with both systolic and diastolic blood pressure is BMI.

Thus, our results highlight the necessity to institute effective prevention and health promotion programs among younger age groups

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