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Original Research Article

Correlation between body mass index, waist hip ratio, blood sugar and blood pressure in young adults

Tejashwini Basarigidad^{1,*}, Ganashree C P¹¹Dept. of Physiology,, Basaveshwara Medical College, Chitradurga, Karnataka, India

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ABSTRACT

Background: Obesity is defined as excessive accumulation of fat in various tissues in the body which causes ill health in the body. The basic cause of obesity is imbalance between calories intake and calories expenditure. There is increased intake of calorie rich foods and reduced physical activity due to urbanization all over the world.

Body mass index is simple formula to classify obesity in adults. It is defined as person's weight in kilograms divided by height in meter squares (m^2).

Obesity and elevated BMI are the major causes for development of chronic diseases like stroke, hypertension, Type 2 diabetes and other cardiovascular disorders.

BMI and waist hip ratio are the modifiable risk factors of type 2 diabetes and hypertension. This study was undertaken to assess the relationship between BMI, waist hip ratio, Random blood sugar and blood pressure.

Materials and Methods: This study comprises 45 males and 55 females (100 in total) young adults aged between 18 to 30 years. The design for this study was cross-sectional survey. Ethical approval was taken from ethical committee of BMCH, Chitradurga. BMI, Blood pressure, Waist hip ratio and random blood sugar levels are measured from the subjects.

Result: A total of 100 subjects are examined. Among them 45 males are males and 55 females. The mean age of the subjects was 25 years. Among them, 30 were overweight and 17 were obese while, 4 were underweight. The mean BMI was 26.72 ± 3.45 Kg/ m^2 . The mean WHR was 0.92 ± 0.12 . Among the participants 63 had abnormally high WHR (>0.95 in males and >0.80 in females). Mean RBS was 95.43 ± 19.54 mg/dl.

Both diastolic and systolic blood pressures increased significantly with increased BMI status and abnormally elevated WHR than in participants with normal WHR. RBS was also significantly higher in those with elevated WHR than in those with normal WHR.

Conclusion: Raised BMI and abnormally elevated waist hip ratio are positively correlated with random blood sugar levels and blood pressure in Young adults. Therefore young population all over world are at risk of developing chronic diseases like hypertension, type 2 diabetes, cancer, stroke and other cardiovascular diseases later in their life. Therefore BMI and waist hip ratio should be routinely checked and monitored in young population to prevent future development of chronic diseases; 2: There is need for promotion of a healthy life style, regular exercise, healthy nutrition, stress free life in young population.

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1. Introduction

Obesity is defined as abnormal or excessive fat accumulation in the body that may impairs health.

Body mass index is simple formula to classify obesity in adults. It is defined as person's weight in kilograms divided by height in meter squares.

Obesity is one of the major causes for development of chronic diseases like stroke, hypertension, Type 2 diabetes

* Corresponding author.

E-mail address: teju23091987@gmail.com (T. Basarigidad).

and other cardiovascular disorders.¹

The major cause of obesity is imbalance between calories consumption and calories expenditure. There is increased intake of calorie rich foods and reduced physical activity due to urbanization all over the world.²

Changes in the lifestyle and food habits, lack of nutritious diet, stress, lack of physical activity could increase the BMI as well as the blood pressure.³

Prevention of obesity and hypertension in young age is very important to prevent major problems like cardiovascular diseases later.³

The mechanism by which obesity causes insulin resistance is not well understood. Adipocytes secrete various hormones like leptin, tissue necrosis factor, free fatty acids, resistin.⁴

A positive correlation is thought to exist between random blood glucose and obesity. This study was undertaken to determine the correlation between random blood sugar (RBS), BMI and BP in a healthy young adult Indian population.

2. Materials and Methods

1. This study comprises 45 males and 55 females (100 in total) young adults aged between 18 to 30 years. The design for this study was cross-sectional survey. Ethical approval was taken from ethical committee of BMCH, Chitradurga. BMI, Blood pressure, Waist hip ratio and blood sugar levels are measured from the subjects.
2. Blood pressure was measured in all subjects using sphygmomanometer instrument in the right arm of the subject after resting period of 10 minutes. Then blood pressure classified into normal BP <120/80 mm Hg, pre hypertensive 120-139/80-89 mm Hg and hypertensive > 140/90 mm Hg.
3. The weight of the subject was measured by using weighing machine in kilograms(kg). The height of the subject was measured in centimeter without the shoes. BMI was calculated by dividing weight in kilogram by square of height in meter (kg/m^2).
4. Waist hip ratio is calculated as waist measurement divided by hip measurement (W/H). The Waist circumference was measured as the abdominal girth at the midpoint between the costal margins and the anterior-superior iliac spine. The Hip circumference was measured at the level of the greater trochanters. Patients were classified as normal or abnormal based on the Waist Hip ratio (WHR). $\text{WHR} > 0.95$ for males and > 0.8 for females were considered to be abnormal. Males with $\text{WHR} \leq 0.95$ and females with $\text{WHR} \leq 0.8$ were considered to be normal.
5. Random blood sugar was measured using glucometers.. Random capillary blood sugar level of 130mg/dl (7.7mmol/l) was used as cut off.

WHO classification of BMI

BMI <18.5	Underweight
BMI 18.5-24.9	Normal
BMI 25-29.9	Overweight
BMI >30	Obese

Statistical analysis was done using the SPSS 16.0 and WHO Anthro. Continuous variables were reported as Means \pm Standard deviation. Associations were tested using student t-test, one way ANOVA and chi-square test.

3. Results

A total of 100 subjects are examined. Among them 45 males are males and 55 females. The mean age of the subjects was 25 years. Among them, 30 were overweight and 17 were obese while, 4 were underweight. The mean BMI was $26.72 \pm 3.45 \text{ Kg}/\text{m}^2$. The mean WHR was 0.92 ± 0.12 . Among the participants 63 had abnormally high WHR (> 0.95 in males and > 0.80 in females). Mean RBS was $95.43 \pm 19.54 \text{ mg}/\text{dl}$ (Table 1).

Comparison of these parameters between males and females showed that BMI was significantly higher in females, whereas men had significantly higher WHR as expected. However, while men tended to have WHR within what is normally expected for their sex, women were shown to have abnormally high WHR than expected for their sex (Table 1).

Both diastolic and systolic blood pressures increased significantly with increased BMI status and abnormally elevated WHR than in participants with normal WHR. RBS was also significantly higher in those with elevated WHR than in those with normal WHR. (Tables 2 and 3).

Bivariate correlation analysis showed that SBP, DBP, RBS and WHR had positive correlation with BMI. They also had a positive correlation with WHR. The variables also showed a positive correlation among themselves except that the blood pressure (systolic and diastolic) was not correlated with RBS (Table 3).

4. Discussion

Obesity is defined as excessive accumulation of fat in various tissues in the body which causes ill health in the body.

Obesity and raised BMI are the major causes for the development of chronic diseases like stroke, hypertension, type 2 diabetes, cancer, musculoskeletal disorders and other cardiovascular diseases later in life.⁴

Our study demonstrated that there is significant correlation between BMI and waist hip ratio for the parameters like random blood sugar and blood pressure. As BMI and Waist hip ratio increases, there is linear increase in blood sugar levels and blood pressure in person. This increase in BMI and waist hip ratio could be due to

Table 1: Sex distribution of mean values of risk factors

Parameters	Male (N=45)	Females (N=55)	P Value
Body mass index(BMI)	25.99±4.45	27.42±1.23	0.000
Waist- Hip Ratio	0.93±8.7	0.91±0.07	0.000
Random blood sugar	96.7±5.45	94.7±7.95	0.256
Systolic Blood pressure	128±12	126±10	0.178
Diastolic blood pressure	86±18	84±8	0.882

Independent sample t-test used for comparing means

Table 2: Distribution of mean values risk factors according to BMI groups

Parameters	BMI Groups				P value
	Underweight	Normal weight	Overweight	Obese	
RBS	87.98±14.45	92.98±10.45	99.98±14.45	105.98±04.45	0.000
Systolic BP	107±14.45	114.23±12.09	124.15±15.87	136.98±16.45	0.000
Diastolic BP	70.89±12.98	74.67±8.90	78.78±5.67	80.89±21.87	0.004

Differences between BMI groups compared using one way ANOVA

Table 3: Distribution of mean values risk factors according to WHR groups

Parameters	Waist-Hip Ratio groups		P value
	Abnormal/Elevated	Normal	
Random blood sugar	110.02±20.74	101.02±19.46	0.000
Systolic Blood pressure	136.02±25.46	118.22±19.22	0.000
Diastolic Blood pressure	86.45±35.87	74.42±26.46	0.000

Differences between WHR groups compared using one way ANOVA

Table 4: Correlation between BMI, RBS and BP {correlation coefficient (p-value)}

	Body mass index(BMI)	Waist Hip ratio	Random blood sugar	Systolic Blood pressure	Diastolic Blood pressure
Body mass index(BMI)	1				
Waist hip ratio	0.250(0.000)	1			
Random blood sugar	0.065(0.03)	0.076(0.008)			
Systolic blood pressure	0.309(0.000)	0.345(0.000)	0.312(0.005)	1	
Diastolic blood pressure	0.165(0.000)	0.231(0.000)	0.067(0.45)	0.450(0.000)	1

genetic factors, sedentary life style, lack of physical activity, urbanization, intake of junk foods, increased stress levels.¹

The mechanism behind relation between BMI and blood pressure is due to increased sympathetic nervous system activity, activation of rennin-angiotensin –aldosterone pathway, elevation of leptin hormone, hyper insulinemia.²

In our study, we demonstrated that mean systolic blood pressure, diastolic pressure, random blood sugar level showed positive correlation with raised BMI and elevated waist hip ratio in both genders.

5. Conclusion

1. Raised BMI and abnormally elevated waist hip ratio are positively correlated with random blood sugar levels and blood pressure in Young adults. Therefore young population all over world are at risk of developing chronic diseases like hypertension, type

2 diabetes, cancer, stroke and other cardiovascular diseases later in their life. Therefore BMI and waist hip ratio should be routinely checked and monitored in young population to prevent future development of chronic diseases.

2. There is need for promotion of a healthy life style, regular exercise, healthy nutrition, stress free life in young population.

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7. Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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Author biography

Tejashwini Basarigidad, Associate Professor

Ganashree C P, Professor

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