ORIGINAL ARTICLE

DOES BMI AFFECT CHOLESTEROL, SUGAR, AND BLOOD PRESSURE IN GENERAL POPULATION?

Mohammad Faheem, Saqib Qureshi, Jabar Ali, Hameed, Zahoor, Farhat Abbas, Adnan Mahmood Gul, Mohammad Hafizullah

Department of Cardiology, Lady Reading Hospital, Peshawar, Pakistan

Background: Higher BMI in child hood is also associated with an increase risk for coronary heart disease in adulthood. Impaired glucose tolerance is highly prevalent in children and adolescents with severe obesity. Positive correlations between BMI and glucose, lipids and BP have previously been reported. The objective of this study was to find the correlation of BMI with cholesterol and sugar level in general population. **Methods:** This study was a part of 'Peshawar Heart Study', performed at Cardiology Department, Lady Reading Hospital, Peshawar in 2008–2009. Individuals with different ages, gender, professions, socioeconomic class were randomly selected from general population. Random blood sugar and cholesterol was measured with strip method. Height and weight of each individual was recorded and BMI calculated. All individuals were asked about any current medical illness and whether they were performing any exercise or not. Using SPSS-13, descriptive statistics were used for frequencies. Bivariate correlations were used for measuring correlation between BMI, sugar and cholesterol. Partial correlations were used to factor out the effect of other variables. **Results:** A total of 2,270 individuals, 1,798 (79.2%) male and 472 (20.8%) female were examined. Mean age was 38.47±12.66. Mean BMI was 26.38±4.97. Mean RBS was 113.7±47.145. Mean cholesterol was 168.47±28.23. Exercise was performed by 929 (40.90%) individuals. Diabetes was present in 113 (5.0%) and history of high cholesterol in 25 (1.1%) persons. When bivariate correlation analysis were done systolic BP, diastolic BP, RBS and cholesterol had positive correlation with BMI [correlation coefficient of 0.317 (p<0.000), 0.319(p<0.000), 0.125 (p<0.000) and 0.205 (p<0.000) respectively]. These variables also showed a positive correlation among themselves. After factoring out the effects of age, exercise, gender and current medical status on the above correlations, the correlation of RBS and cholesterol with BMI decreased to 0.025 (p=0.232) and 0.135 (p<0.000) respectively and between sugar and cholesterol decreased to 0.018 (p=0.401). **Conclusion:** In general population BMI is positively correlated with RBS and cholesterol. With the effect of age, sex, exercise and current medical status, this correlation is reduced.

Keywords: Body Mass Index (BMI), RBS, Cholesterol, Obese, Obesity

INTRODUCTION

The morbidity and mortality associated with being over weight or obese have been known to the medical profession for more than 2000 years.[1] Excessive body weight has become a major problem in industrialized and developed countries, where it has reached the proportion of an epidemic.[2,3] Individuals from disadvantaged communities are also not exempted and are at a substantial risk of obesity and its complications.[4]

A number of large epidemiologic studies have proved that mortality increases with obesity.[5–7] Obese individuals are prone to many cardiovascular risk factors. T2DM is strongly associated with over weight and obesity.[8,9] Lipid metabolism is also adversely affected in obesity.[3,10] The prevalence of these risk factors substantially increases with increasing BMI.[11]

Overweight and obesity are also known to be independent risk factor for cardiovascular risk disease.[10] Increased body weight is a major risk factor for the metabolic syndrome which itself is a cluster of coronary heart disease risk factors. Many studies have demonstrated that individuals with metabolic syndrome are at high risk for subsequent development of T2 DM.[12–17]

Higher BMI in child hood is also associated with an increase risk for coronary heart disease in adulthood.[18] Impaired glucose tolerance is highly prevalent in children and adolescents with severe obesity.[19] Positive correlation between BMI and glucose, lipids and BP have previously been reported.[20,21]

The aim of the present study was to investigate the relation of BMI with different cardiovascular risk factors (serum cholesterol, glucose level and BP) in local population.

MATERIAL AND METHODS

This study is a part of Peshawar heart study, which was launched with an aim to find cardiovascular risk factors in general population. The field work of data gathering was performed during 2008 and 2009, by the team of Cardiology Department, Lady Reading Hospital Peshawar. Data was collected in adult population using

stratified random sampling technique. The population was first divided (stratified) into different professional groups (Strata). These groups belonged to different socio economic status, including poor (e.g., Sweepers) as well as well-off (e.g., Lawyers and Doctors) professions. Individuals of different age and gender were then randomly selected from each group. All of the examinees were first interviewed by one of the trained surveyors, using a questionnaire developed specifically for this research program. The questionnaire was designed for collecting extensive information on personal data (name, gender, marital status, occupation and various life style variables including exercise, smoking etc), current and past medical history and drug intake.

Blood pressure was measured on both arms in sitting position and the average recorded. Height and body weight were measured using a single anthropometer. Body Mass Index (BMI) was determined as weight divided by height squared (Kg/m^2). BMI was divided into three groups as group 1: ≤24.9, group 2: 25–29.9, and group 3: ≥30. Random blood glucose and total cholesterol of each individual were measured using strip method.

All data were analysed using SPSS-l3. Descriptive statistics were used to show the frequency of different variables. Quantitative data was presented as Mean±SD. For comparing means of different variables between males and females, independent sample *t*-test was used. For multiple group comparisons (according to BMI groups) one way ANOVA was used. Bivariate correlations were used for measuring correlation between BMI, BP, cholesterol and sugar. The coefficient used was Pearson's correlation coefficient for continuous data and the test of significance was two-tailed. Correlation was taken as significant at $p<0.01$ levels. To factor out the affect of other variables, two-tailed partial correlations were used.

RESULTS

A total of 2,270 individuals, 1,798 (79.2%) male and 472 (20.8%) female were examined. Mean age of the subjects was 38.47±12.66 years. Among them, 867 (38.19%) were overweight and 536 (23.61%) were obese. Mean BMI was 26.38±4.97 Kg/m^2. Mean RBS was 113.7±47.145 mg/dL. Mean cholesterol was 168.47±28.23 mg/dL.

Comparison of these parameters between males and females, showed that BMI, cholesterol, and systolic BP, were significantly higher in females (Table-1). Individuals who were performing exercise were 929 (40.90%). Diabetes was present in 113 (5.0%) and history of high cholesterol in 25 (1.1%) persons. Both overweight and obese individuals had significantly higher level of RBS, cholesterol, systolic and diastolic BP than individuals of normal weight (Table -2).

When bivariate correlation analysis were done systolic BP, diastolic BP, RBS and cholesterol had positive correlation with BMI [correlation coefficient of 0.317 ($p<0.000$), 0.319 ($p<0.000$), 0.125 ($p<0.000$) and 0.205 ($p<0.000$) respectively] (Table 3). These variables also showed a positive correlation among themselves. After factoring out the effects of age, exercise, gender and current medical status on the above correlations, the correlation of RBS and cholesterol with BMI decreased to 0.025 ($p=0.232$) and 0.135 ($p<0.000$) respectively and between sugar and cholesterol decreased to 0.018 ($p=0.401$).

Table-1: Gender distribution of cardiovascular risk factors (Cholesterol, RBS and Blood Pressure)

Parameters	Male (n=1798)	Female (n=472)	*p*-value
BMI	25.78±4.65	28.72±5.35	0.000
RBS	112.49±44.35	118.29±56.35	0.17
Cholesterol	166.33±28.11	176.58±27.19	0.000
Systolic BP	126.27±18.60	129.07±21.99	0.005
Diastolic BP	83.11±11.90	83.35±12.67	0.706

Independent sample *t*-test used for comparing means

Tbale-2: Cardiovascular risk factors (Cholesterol, RBS and BP) according to BMI groups

Parameters	BMI Groups			*p*-value
	Normal Weight (n=867)	Overweight (n=867)	Obese (n=536)	
RBS	107.82±41.65	115.44±47.22	120.37±53.87	0.000
Cholesterol	161.61±24.51	171.38±30.46	174.85±27.82	0.000
Systolic BP	120.36±16.06	128.52±19.27	134.66±20.99	0.000
Diastolic BP	78.33±10.49	84.75±11.96	87.75±12.31	0.000

Differences between BMI groups compared using one way ANOVA

Table-3: Correlation between BMI, RBS, Cholesterol and BP [Correlation coefficient (*p*)]

	BMI	Systolic BP	Diastolic BP	RBS	Cholesterol
BMI	1				
Systolic BP	0.317 (0.000)	1			
Diastolic BP	0.319 (0.000)	0.773 (0.000)	1		
RBS	0.125 (0.000)	0.191 (0.000)	0.124 (0.000)	1	
Cholesterol	0.205 (0.000)	0.164 (0.000)	0.177 (0.000)	0.105 (0.000)	1

DISCUSSION

Overweight and obesity lead to many complications, including diabetes, dyslipidemia and hypertension. Most of the landmark studies on these cardiovascular risk factors have been done on western population.[3,5–7,10]

It is expected that as the BMI increase, the frequency of these complications will also increase.. In our study differences between BMI groups (normal, over weight, Obese); were found for all

parameters tested. These results are in accordance with the results of other studies, which showed that over weight and obesity are consistent parameters associated with cardiovascular risk in most population.[22–25]

In our study mean BP, cholesterol, and random blood glucose level showed a positive correlation with BMI. These findings are in accordance with the results from other western studies.[20,21,26,27] Several studies on Asian population also showed the same findings.[28,29] Mixed results have been shown by some studies.[30,31] Bakari *et al*[32] showed positive correlation of BMI with RBS in females but no correlation in males.

In our study correlation of mean cholesterol and random blood glucose with BMI is weak. One reason for this may be that instead of using other anthropometric measures for measuring obesity and body fat, we used BMI. CT and MRI are the gold standard methods used to evaluate body fat distribution,[33] but waist and waist hip ratio are the indicators most commonly used to predict visceral fat accumulation in epidemiological studies.[34,35]

Chehrai *et al*[36] showed that the correlation of waist height ratio and waist hip ratio with lipid profile was far greater than the correlation of BMI with lipid profile. They suggested that these parameters can best predict dyslipidemia and be used in clinical and epidemiological studies.

Mean age in our study was 38±12 years, which is best representative of adult population. Mean BMI in our study was in the overweight range, 26±4. Other studies done on this subject in our country also show above normal BMI. Hussain *et al*[37] reported a mean BMI of more than 28 in diabetics as well as in non-diabetics. Other studies done in our neighbouring countries also showed high BMI and significant prevalence of obesity.[28,31,38] In a region where majority of the population has poor access to good nutritious food, finding BMI in the over weight range is alarming. It shows that in addition to food obesity is associated with other factors like genetics and lack of exercise. Our study also showed that majority (60%) of the individuals were not performing any exercise. The association of BMI and cholesterol and RBS in our study is weakened after adjustment for age, gender and exercise. Turcato *et al*[21] have also shown that in both men and women, BMI was correlated with cardiovascular risk factors but the association was no longer significant after age adjustment.

Like western nations our population is also at risk of obesity. BMI should be routinely checked in clinical practice and epidemiological surveys. Our people need formal guidance about healthy life style especially about diet and exercise.

CONCLUSION

In general population BMI is positively correlated with RBS, cholesterol and blood pressure. With the effect of age, sex, exercise and current medical status, this correlation is reduced.

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Address for Correspondence:

Dr. Muhammad Faheem, House No. 32, Street 19, Near Bilal Masjid, Shami Road, Peshawar Cantt. Pakistan.
Cell: +92-333-9202002
Email: drfaheem@live.com