A Comparative Study of Body Mass Index, Body Weight and Waist to Height Ratio to Depict Serum Cholesterol Level in Healthy Young Individuals

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ABSTRACT

Introduction: Many external and internal factors either directly or indirectly regulate our health. Similarly, many parameters such as high glucose, high cholesterol, and high blood pressure are the indicators of our healthiness. Body Mass Index (BMI) and Waist to Height Ratio (WtHR) are such parameters which indicate the degree of healthiness of an individual. Current study aimed at estimation and comparison of the statistical relationships of BMI, body weight and WtHR with serum cholesterol level in healthy Individuals of age group of 18-30.

Material and methods: This study was done on total 54 healthy persons (27 male and 27 females) of age group 18-30. The data of age, height weight and waist circumference of all participants were collected. In their fasting blood samples, total serum cholesterol was measured by colorimetric kit. In this study statistical correlation was confirmed by three different statistical methods.

Results: Our statistical analysis suggested that BMI, body weight and WtHR are positively correlated with average total serum cholesterol level with a significant p value (<0.05). Statistical correlation coefficient values further suggested that BMI could be a better predictor of cholesterol level associated diseases as compared to body weight and WtHR in healthy individuals of age group 18-30. High BMI and Waist circumference are indicators of overweight and/ obesity.

Conclusion: These findings indicated that BMI could be a better predictor of cholesterol level associated diseases as compared to body weight and WtHR in healthy individuals of age group 18-30.

Keywords: Body Mass Index, Cholesterol, Cardiovascular Diseases, Statistical Analysis Waist to Height Ratio

INTRODUCTION

Health is a state of being well physically, emotionally, mentally and socially. But nowadays, it is a great challenge to keep ourselves healthy and away from the health related problems. There are several factors which are responsible for affecting the health status of an individual. The factors include the environment, genetic factors, lifestyle, background, food habits and socio-economic condition. A healthy state can be determined by using physical and biochemical parameters. Both of these parameters are helpful in analyzing the fitness of an individual.

For the past few decades, the rising focus all over the country is on health and weight which leads to the obesity and chronic diseases occur due to obesity. The physical parameter includes the height and weight of an individual. The fitness of an individual can be estimated with the help of these physical parameters. Every individual must do physical activities for a happy, healthy and effective living. Physical activities are necessary for the development of overall personality of a child. It also helps in controlling body weight, reduces the chances of cancer, cardiovascular diseases, strengthens bones and muscles etc. Physical activity was a part of the daily lives of our ancestors. In most of the industrialized countries, physical activity has been disconnected from activities that our ancestors consider essential for daily survival as well as energy intake was also not linked to energy expenditure. Some studies have reported that the strong risk factor for Type 2 diabetes is physical inactivity.[1] Another study suggest that the main positive risk associated with diabetes and obesity is long term watching television which is a symbol of sedentary lifestyle.[2] The lower risk for Type 2 diabetes is associated with moderate and vigorous physical activity.[3]

Body Mass Index (BMI) is a statistical measurement which is calculated by measuring body weight and height of an individual. BMI includes the body weight in kilograms and height in meter squares. It indicates the health issues like

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underweight, healthy weight, overweight and obese. BMI indicates fitness in a very deep manner. BMI is frequently used for the measurement of individual's fitness related to obesity. It also depicts the future risks of individual if he/she comes under obese category. BMI acts as a connecting link between present and future health of a person. BMI could be a considered as a fine marker for measuring the health status of an individual but there could be some biochemical parameters which may be either positively or negatively correlated with BMI. For example, there may be some direct or indirect relation between glucose, cholesterol and blood pressure with BMI.[4] A study reflects an idea that BMI may be directly related with random blood sugar and cholesterol. But due to effect of age, sex and health status this correlation was reduced.[5] BMI can be used as the standard method for the measurement of individual's body fat.[6]

Usually various parameters are used to estimate whether a person is healthy or not. Since blood is a circulatory connective tissue, so it can be used as a good marker of various health related issues. Blood is used in many clinical trials e.g. Glucose estimation, Creatinine test, Cholesterol estimation etc. Serum which is present in blood is plasma which does not contain clotting protein. Proteins which may be present in blood are albumin and immunoglobulin.

Cholesterol is a waxy, fat like substance which is found in all the body cells. The main sources of cholesterol are liver and food sources. It is synthesized in the liver in the body and is circulated through blood. It is found in food such as meat, poultry and dairy items obtained from animals. It is carried in the form of lipoproteins though blood. There are different types of lipoproteins like high density lipoprotein (HDL), low density lipoprotein (LDL), Intermediate density lipoproteins (IDL) and Very low density lipoproteins (VLDL). HDL cholesterol is also known as good cholesterol because it helps us to keep building cholesterol in the arteries. It prevents the atheroma (blockage in arteries) formation in the body. LDL cholesterol is known as bad cholesterol. It is involved in blocking the arteries and is the main cause for cardiovascular diseases. The more the amount of LDL cholesterol, there will be more chances of risk to health. The main factors responsible for affecting the cholesterol levels are diet, weight, physical activity, smoking, age, gender, family history etc. Sex differences contribute in association of BMI with total cholesterol and LDL cholesterol which leads to the lower risk of developing chronic heart diseases in women as that of men.[7] On the other hand, waist circumference is one of the main factor which is used for differentiating between healthy individuals from overweight and obese individuals other than BMI.[8] The method which is used for the evaluation of adiposity is waist measurement which is associated with the visceral fat mass. It is also considered as a better marker for abdominal obesity. Greater waist circumference is strongly associated with cardiovascular disease and Type 2 diabetes. According to WHO, the normal waist circumference for men is less than 40 inches and for women is 35 inches. More the value of waist circumference, greater will be the chances of getting chronic diseases. A strong positive association was observed between waist circumference and body fat. It could act better for the estimation of central obesity as well as for the identification of overweight and obese individuals.[9] BMI, waist circumference and waist to hip ratio are used to depict the chances of obesity in Indian population because there was a strong positive association found between fasting blood glucose, waist circumference and BMI.[10] Still, there are very less evidences of relationship between BMI, Body Weight and Waist to Height ratio (WtHR) with Serum Cholesterol in young males and females of age group 18-30 years. In this study, we had examined and compared the statistical relationships of BMI, body weight and WtHR with serum cholesterol level in healthy Individuals of age group of 18-30.

MATERIAL AND METHODS

This study had been carried out at Dr. B Lal Institute of Biotechnology, Jaipur Rajasthan. Students of bachelors and masters and staff members (27 male and 27 female) participated in this clinical study. Subjects of either gender between 18-30 years with not suffering from any diseases and not taking any cholesterol lowering drug were included in this study. Persons suffering from any diseases like liver, renal, cardiac, respiratory were excluded. Pregnant women were also excluded for this study.

Blood sample collection and total cholesterol measurement

Blood samples were collected from individuals from antecubital vein of arm. The collected blood was allow to clot for 30 minutes. Serum was separated from blood samples by centrifugation at 3000g for 15 minutes. Total cholesterol was measured by *Infinite* laboratory cholesterol kit by taking OD at 505nm. Body weight was measured without shoe and straight position by weighing machine and height and waist circumference were measured by using a tape meter. Body mass index was calculated by formula weight (kg)/height square (meter). Waist to height ratio was calculated by dividing waist (cm) by height (cm) of the individuals.

Ethics

Blood samples used in this project follows all ethical rules of Institutional Ethical Committee (IEC) at Dr. B Lal Institute of Biotechnology. Proper on paper consent had been taken from volunteers.

STATISTICAL ANALYSIS

The parametric Pearson and the non-parametric Kendall and Spearman methods of univariate analysis were used to test the relationship between two independent variables. Kendall's method provides the coefficient of correlation, denoted by "Tau." Spearman's and Pearson's correlation coefficients are denoted by "rs" and "r," respectively. Both negative and positive correlation may exist, which is denoted by negative and positive coefficients. P-values indicate whether the difference between two comparisons is statistically significant. Significant differences were considered at $p < 0.05$*.

Relationship	Parameters	Kendall's		Pearson's		Spearman's	
		Tau Value	P value	r value	P value	rs value	P value
BMI vs Total Cholesterol	Overall Both Sex	0.516	<0.0001	0.633	<0.0001	0.707	<0.0001
	Male	0.425	0.0019	0.652	0.0002	0.599	0.0010
	Female	0.601	<0.0001	0.698	<0.0001	0.790	<0.0001
Body Weight vs Total Cholesterol	Overall Both Sex	0.422	<0.0001	0.606	<0.0001	0.597	<0.0001
	Male	0.356	0.0101	0.562	0.0023	0.518	0.0056
	Female	0.587	<0.0001	0.688	<0.0001	0.778	<0.0001
WtHR Vs Total Cholesterol	Overall Both Sex	0.284	0.0025	0.368	0.0068	0.409	0.0021
	Male	0.377	0.0059	0.587	0.0013	0.525	0.0049
	Female	0.460	0.0008	0.512	0.0064	0.610	0.0007

Table-1: Statistical correlation between BMI, Body Weight and WtHR with Total Serum Cholesterol in healthy individuals by three different statistical methods. Here, Tau: Kendall's correlation coefficient, r: Pearson's correlation coefficient, rs: Spearman's correlation coefficient.

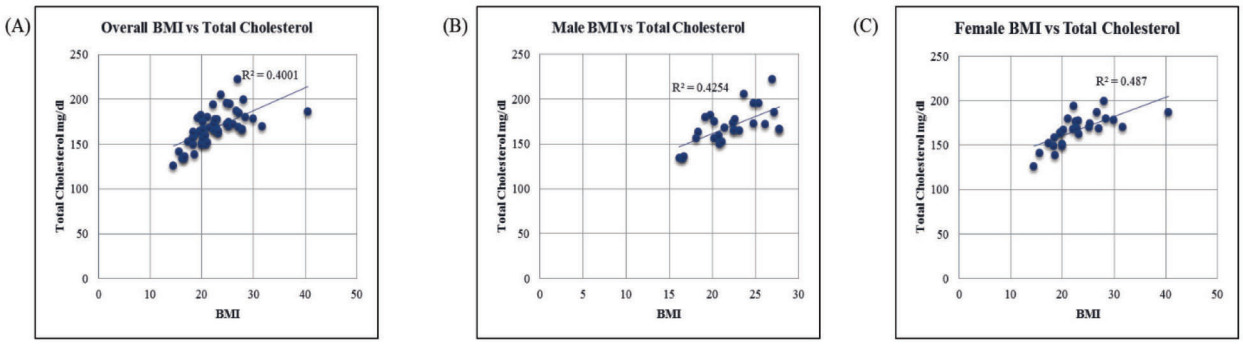

Figure-1: Regression line graph of relationships between BMI and Total Cholesterol for (A) Overall (Both Sex) (B) Male and (C) Female

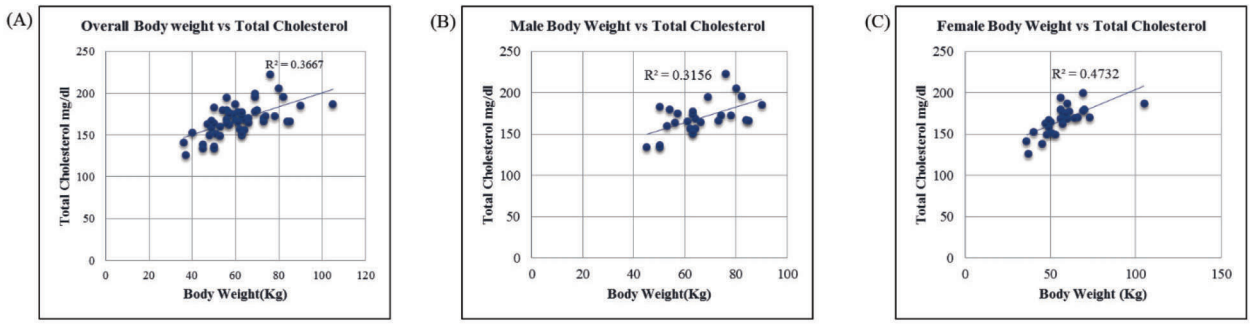

Figure-2: Regression line graph of relationships between Body Weight and Total Cholesterol for (A) Overall (Both Sex) (B) Male and (C) Female

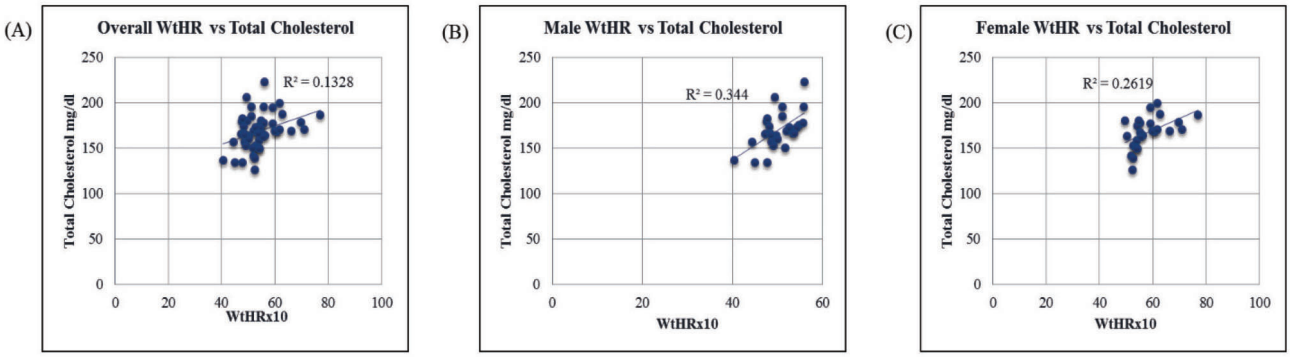

Figure-3: Regression line graphs of relationship between Waist to Height Ratio (WtHR) and Total Cholesterol for (A) Overall (Both Sex) (B) Male and (C) Female

RESULTS

Based on the statistical analysis by three different statistical methods the relationships of BMI, Body Weight and WtHR with serum cholesterol had shown in Table 1. Data indicated that BMI showed stronger correlation coefficient values in relationship with serum cholesterol in overall, male and female groups of age group 18-30 years.

Association between BMI and Serum Cholesterol

All three statistical analysis (Kendall, Pearson and Spearman) shown in Table 1 indicated a positive correlation with a significant p-value between BMI and serum cholesterol level in Overall, Male and Female groups. Regression line graphs (Figure 1) also confirm the positive association between the BMI and serum cholesterol.

Association between Body weight and Serum Cholesterol

The correlation coefficient values obtained from three different statistical analysis indicated (Table 1) the positive correlation between body weight and serum cholesterol level in overall, male and female participants. Simultaneously, regression pattern (Figure 2) for the relationship between body weight and serum cholesterol also confirmed the positive correlation between these two variables.

Association between Waist to Height Ratio (WtHR) and Serum Cholesterol

The correlation coefficient values obtained from three different statistical analysis indicated (Table 1) the positive correlation between WtHR and serum cholesterol level in overall, male and female participants. Individual correlation values had shown in Table 1. Simultaneously, regression pattern (Figure 3) for the relationship between body weight and serum cholesterol also confirmed the positive association between these two variables.

DISCUSSION

This study is mainly emphasized on the comparison of relationships of BMI, body weight and WtHR with total serum cholesterol level. Earlier studies showed the positive association of BMI with blood glucose level in wide range of age groups in male and female.[11-15] Earlier cross sectional study in healthy US women of mean age 54.7 year showed that BMI is positively associated with physical inactivity and cholesterol level.[16] Elevated LDL cholesterol is considered as a risk factor for coronary heart disease. Total stroke rates and coronary events are reduced by statins in patients with a wide range of ages and blood pressure.[17] A study was done to find out the relationship between BMI, serum cholesterol, physical activity and dietary intake. A strong positive correlation was observed between hypercholesterolemia and BMI in females.[18] Literature suggested that other than BMI, body weight and WtHR have been also documented as a measure of obesity with several health parameters like blood glucose, cholesterol etc. in different age groups.[9,19-22] This is matter of debate which one parameter (i.e. BMI, body weight and WtHR) among these is more promising to depict the cholesterol level as a cardiovascular risk factor in young age persons. So in this study we had compared the statistical relationships of BMI, body weight and WtHR with total serum cholesterol in healthy young volunteers.

In this study, statistical analysis showed (Table 1) that all three parameters BMI, body weight and WtHR are positively associated with total serum cholesterol in overall, male and female groups of age 18-30. These statistical relationships were verified by three different statistical methods (i.e. Kendall, Pearson and Spearman. However, the value of correlation coefficient (tau, r and rs) for these relationships was found stronger for the relationship of BMI and total serum cholesterol as compare to body weight and WtHR with total serum cholesterol. Moreover, graphical data suggested a greater R^2 value for the correlation of BMI with total serum cholesterol (Figure 1) as compare to body weight (Figure 2) and WtHR (Figure 3) with total serum cholesterol.

CONCLUSION

Our data indicated that BMI is more promising parameter that body weight and WtHR in young persons of age group 18-30. Still, this study should be done on a large number of healthy volunteers.

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