

Relation of serum cholesterol level with body mass index and waist circumference in young adults

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ABSTRACT

Background: Indians have one of the highest rates of coronary artery disease (CAD) in the world and are prone to CAD at a much younger age. The serum cholesterol level is a strong predictor of clinically evident cardiovascular diseases occurring 25 or more years later. The serum cholesterol level depends on many factors such as hereditary factors age, sex, dietary habits, environmental factors, and physical activity. **Objectives:** The objectives of this study were to determine any association of the serum cholesterol level of the subjects with their body mass index (BMI) and waist circumference (WC). **Materials and Methods:** The present study comprised a total of 50 apparently healthy subjects (26 males and 24 females) aged 20–40 years. Subjects having major diseases such as hypertension, diabetes mellitus, endocrine diseases, CAD, or those taking any lipid-altering medication were excluded from the study. Standard methods of measurements for serum cholesterol, BMI, and WC were used. **Results:** The mean cholesterol level in males and females was 144.57 ± 47.52 mg/dl and 144.5 ± 45.65 mg/dl, respectively. Out of 50 cases, 6% of cases had hypercholesterolemia. According to BMI, 22% of cases were overweight and 20% were obese. According to WC cutoffs, 16% of males and 33% of females were obese. **Discussion:** Elevated cholesterol concentration correlates positively with premature CAD. Early detection in these patients allows for earlier introduction of cholesterol-lowering therapy. Hypercholesterolemia and obesity have been proved to be individual risk factors for cardiovascular diseases. Interventions at this age may be particularly effective to decrease the burden of cardiovascular disease later in life. **Conclusion:** Young adults should adopt a healthy lifestyle so as to avoid the risk of obesity and hypercholesterolemia in future life.

KEY WORDS: Cholesterol; Hypercholesterolemia; Waist Circumference; Body Mass Index; Coronary Artery Disease


INTRODUCTION

Indians have one of the highest rates of coronary artery disease (CAD) in the world and are prone to CAD at a much younger age.^[1] In healthy adults, the serum cholesterol level is a strong predictor of clinically evident cardiovascular diseases occurring 25 or more years later.^[2] The serum

cholesterol level varies from population to population and depends on many factors. Hereditary factors play the greatest role; however, dietary habits, environmental factors, age, sex, and physical activity also play a part.^[3,4] These findings have stimulated research all over the world and populations with different dietary habits have been investigated. The risk of developing CAD and premature atherosclerosis increases, as the level of serum cholesterol rises.

Aims and Objectives

The purpose of the study was to determine any association of the serum cholesterol level of the subjects with their body mass index (BMI) and waist circumference (WC).

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MATERIALS AND METHODS

The present study comprised a total of 50 apparently healthy subjects (26 males and 24 females) aged 20–40 years and was undertaken in the Department of Physiology, B. J. Medical College and Civil Hospital, Ahmadabad. Subjects having major diseases of cardiovascular system such as hypertension, CAD, any history of cardiac surgery, those taking medicine for lipid altering, diabetes mellitus, and endocrine diseases were excluded from the study group. Informed written consent was taken from all the subjects. General examination, systemic examination, and anthropometric measurements were done in each case.

Method of Measuring Serum Cholesterol

Serum cholesterol was determined using Trinder's method, fully autoanalyzer. For serum cholesterol estimation 10–12 h, fasting blood sample was taken by venipuncture in all the subjects. Within 4 h of sample collection, serum was separated using a centrifuge machine. Estimation of serum total cholesterol (TC) was done manually with the help of cholesterol kit. The desirable cholesterol range in adults is <200 mg/dl. Serum cholesterol ≥ 200 was categorized as hypercholesterolemia.^[5]

Method of Measuring BMI

The subjects were barefooted, weight was measured in kilogram using a weighting machine, and height was measured in meters with a standard anthropometer. BMI was calculated using the WHO formula: $BMI = \text{Weight (in kg)} / \text{height}^2 \text{ (in m}^2\text{)}$.

Method of Measuring WC

WC is measured at point between the lowest rib and the iliac crest at umbilicus level at the end of expiration with the person breathing silently, with a standard flexible tape on bare skin in centimeters.

The subjects were classified into different categories of BMI and WC as per the WHO/IASO/IOTF (2000) recommendation for Asian adults.^[6] In these recommendations, overweight is defined as a BMI ≥ 23 and obesity as a BMI ≥ 25 . WC ≥ 90 cm for men and ≥ 80 cm for women are a risk factor for cardiovascular diseases in case of Asian population.

RESULTS

A total of 50 (26 males and 24 females) healthy adults aged 20–40 years comprised the study population. Characteristics of the study population are presented in Table 1. The range of serum cholesterol level in the study group was found to be 56–227 mg/dl. The mean cholesterol level in males and females was 144.57 ± 47.52 mg/dl and 144.5 ± 45.65 mg/dl,

respectively. Out of 50 cases, 47 (94%) cases had cholesterol level <200 mg/dl and 3 (6%) cases had cholesterol >200 mg/dl, i.e., hypercholesterolemia.

The Variation of Mean Cholesterol Level with BMI

According to BMI category out of 50 cases 12 (24%) were underweight, 17 (34%) cases had normal weight, 11 (22%) cases were overweight and 10 (20%) were obese of which five were male and five were female. It is seen that mean cholesterol level were lowest in underweight group in BMI category which was 123 ± 45.81 where as highest were in obese group which was 197.8 ± 19.03 . Similarly in females the lowest was in underweight group 96.75 ± 24.47 where as highest was in obese group with 163.6 ± 51.00 . Thus mean cholesterol level in all subjects were lowest in underweight group and highest were in obese group with 181.00 ± 40.60 in BMI category [Table 2].

Variation of Mean Cholesterol with WC

In male, of 26 subjects, 22 subjects had <90 cm WC with mean cholesterol level 135.27 ± 45.07 while four subjects had ≥ 90 cm WC with mean cholesterol level 195.75 ± 21.74 [Table 3]. In female, of 24 subjects, 16 subjects had <80 cm WC with mean cholesterol level 125.5 ± 28.60 while eight subjects had ≥ 80 cm WC with mean cholesterol level 182.5 ± 41.46 [Table 4].

DISCUSSION

This study was done in 50 healthy young adults based on the estimation of serum cholesterol and its correlation with BMI and WC. The range of serum TC was found to be 56–227 mg/dl in our study. In the present study, the mean TC in males was 144.57 ± 47.52 mg/dl and in females, it was 144.5 ± 45.65 mg/dl. In the present study, the prevalence of hypercholesterolemia was 6% which is significant due to the young age of the subjects. In the present study, according to BMI classification, 20% of the study population is obese and according to WC cutoffs, 16% of males and 33% of females were obese.

High prevalence of hypercholesterolemia is seen in Indian subjects in different studies. In another study on dietary fat,

Table 1: The physical characteristics of the study group

Parameter	Male (n=26)	Female (n=24)
Mean age (in years)	28.62±5.58	28.96±7.32
Mean TC (mg/dl)	144.57±47.52	144.5±45.65
Mean height (in meters)	1.68±0.041	1.64±0.038
Mean weight (in kg)	62.19±13.49	60.92±10.07
Mean BMI (kg/m ²)	22.15±4.82	22.77±4.02
Mean WC (in cm)	84.73±5.34	79.58±5.85

BMI: Body mass index, WC: Waist circumference, TC: Total cholesterol

Table 2: Variation of mean cholesterol level (in mg/dl) with different groups of BMI

BMI group	Male cases		Female cases		Total cases	
	<i>n</i>	Cholesterol (mg/dl)	<i>n</i>	Cholesterol	<i>n</i>	Cholesterol
Underweight	8	123.0±45.81	4	96.75±24.47	12	114.25±40.81
Normal	7	134.86±45.82	10	130.3±33.80	17	132.17±37.88
Overweight	6	140.33±42.44	5	137.4±24.58	11	140.45±33.84
Obese	5	197.8±19.03	5	163.6±51.00	10	181.00±40.60

BMI: Body mass index

serum cholesterol levels, and incidence of atherosclerosis in Delhi, the mean TC level in medical students was found to be 174.1 ± 35.3 mg/dl.^[7] Elevated cholesterol concentration correlates positively with premature CAD, as shown by Stamler *et al.*^[8] In some young adults, genetic forms of hypercholesterolemia lead to premature CAD.^[9] Early detection causes earlier introduction of the medical management of hypercholesterolemia in such subjects. Prospective studies strongly suggest that even moderate reductions of cholesterol levels by diet will substantially reduce long-term risk for CAD.^[10] The TC level changes variation due to different lifestyle, different socioeconomic status, etc. A positive correlation was found between the serum cholesterol and BMI in the present study. This is in accordance with the study in young Swiss men undertaken by Saely *et al.* where they found that serum cholesterol increased with increasing categories of BMI.^[11] Some other studies also found that the TC level rises as the BMI rises.^[12,13] A strong positive correlation between serum cholesterol and WC was found in the study. The study done by the Canadian heart health survey concluded that WC may be the best single indicator of cardiovascular risk factors including dyslipidemia.^[14]

Obesity is another serious health issue in young adults. BMI and WC are the two most widely used anthropometric measurements for the assessment of obesity even though there are various measurements available. While direct assessment of fat mass may be a better index of obesity-related health risk, it is difficult to measure this accurately in the field setting. Thus, anthropometry still remains the most widely used method for clinical and epidemiological purpose. A strong correlation was found between serum cholesterol and BMI and WC in the present study. Hence, we can say that increasing BMI and WC may increase the risk of hypercholesterolemia. Hypercholesterolemia and obesity have been proved to be individual risk factors for cardiovascular diseases. Young individuals aged around 25 years have the age of the transition from adolescence to young adulthood with changes in working and social status, alterations in lifestyle. Interventions at this age may be particularly effective to decrease the burden of cardiovascular disease later in life.

Estimation of the complete lipid profile would have been more helpful in assessing the cardiovascular health of the population under study. However, serum cholesterol estimation is a relatively simple, easy, and cheap test which

Table 3: Variation of mean cholesterol with WC in males

WC	<i>n</i>	Mean cholesterol
<90	22	135.27±45.07
≥90	04	195.75±21.74

WC: Waist circumference

Table 4: Variation of mean cholesterol with WC in females

WC	<i>n</i>	Mean cholesterol
<80	16	125.5±28.60
≥80	08	182.5±41.46

WC: Waist circumference

can be done routinely as a screening test to assess the cardiovascular health of young adults.

CONCLUSION

The range of serum cholesterol level in the study group was found to be 56–227 mg/dl. The mean cholesterol level in males and females was 144.57 ± 47.52 mg/dl and 144.5 ± 45.65 mg/dl, respectively. The serum cholesterol of 94% of cases had cholesterol level <200 mg/dl in desirable level and 6% of cases had cholesterol >200 mg/dl, i.e., hypercholesterolemia. A positive correlation was found between serum cholesterol and BMI as well as between serum cholesterol and WC. Thus, increasing BMI and WC may increase the risk of hypercholesterolemia. All young adults ≥20 years of age and especially who are overweight and obese should be advised routine cholesterol testing once every 3 years so that preventive measures can be adopted. Young adults should adopt a healthy lifestyle and diet intake to avoid the risk of obesity and hypercholesterolemia and its complications in future life.

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