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Short Communication

A study of serum cholesterol level in young adults and its relation to body mass index and waist-circumference

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Abstract

The present study was carried out to determine the serum total cholesterol (TC) level in young adults of Dibrugarh town of Assam and to find the association of serum cholesterol level with body mass index (BMI) and waist-circumference (WC). A cross-sectional study was done among 150 healthy young adults aged 20-30 years. TC was estimated by the enzymatic method. Hypercholesterolemia was defined as TC > 200 mg/dl. Cases were classified into different categories of BMI and WC according to the recommendations of WHO/IASO/IOTF (2000). The range of TC level in the study group was found to be (146–212) mg/dl. Mean cholesterol level in males and females were 169.5±13.6 and 172.3±15.09 mg/dl respectively. 7% of the cases had hypercholesterolemia. TC was significantly correlated with BMI ($r=0.90$, $p<0.001$) and WC ($r=0.73$, $p<0.001$ in males and $r=0.86$, $p<0.001$ in females). We conclude that young adults ≥ 20 years of age and especially who are overweight should be advised routine cholesterol testing so that preventive measures can be adopted to avoid hypercholesterolemia and it's complications in future life.

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 young adults, the serum cholesterol level is a strong predictor of clinically evident cardiovascular diseases occurring 25 or more years later (2). The risk of developing CAD and premature atherosclerosis increases, as the level of serum cholesterol rises. 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. Limited information exists regarding the serum cholesterol level in young adults of Assam. The present study was conducted to determine the serum cholesterol level in young adults of Dibrugarh town of Assam. Another purpose of the study was to determine if there is any association of the serum cholesterol level of the subjects with their body mass index (BMI) and waist-circumference (WC).

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Methods

The present study comprised of a total of 150

apparently healthy subjects (100 males and 50 females) aged 20-30 years and was undertaken in the Department of Physiology, Assam Medical College and Hospital, Dibrugarh. Local youths, comprising mostly of medical and paramedical students were chosen as subjects. The cases were selected randomly during the one year period of August 2009 to July 2010. The study was cross-sectional in nature with adequate statistical analysis. Subjects having major diseases like hypertension, diabetes mellitus, endocrine diseases, coronary artery disease or those taking any lipid altering medication were excluded from the study group. Written informed consent was obtained from all the subjects. Anthropometric measurements, general examination, and systemic examination were done in each case. The procedures followed were in accordance with the ethical standards of the committee on human experimentation of the institution.

Method of measuring serum cholesterol

Serum cholesterol was determined using enzymatic method (CHOD-PAP) (5, 6). 12-14 hours fasting blood sample was taken by venipuncture in all the subjects for serum cholesterol estimation. Using a centrifuge machine serum was separated. Within 4 hrs of sample collection, estimation of serum total cholesterol was done manually in the departmental laboratory with the help of Cholesterol kit from (Crest Biosystems, a division of Coral Clinical Systems, Goa, India) and Digital Photo colorimeter from (Instruments & chemicals Pvt. Ltd., Ambala city, India).

The desirable cholesterol range in adults is < 200 mg/dl. Serum cholesterol ≥ 200 was categorized as hypercholesterolemia (7).

Method of measuring BMI

The height of the subjects, who were bare-footed, was measured in metres with a standard Anthropometer and weight was measured in kilogram using a weighing machine. BMI was calculated using the WHO formula: BMI = weight (in kg)/height^2 (in $m^{2)}$.

Method of measuring WC

WC is measured in centimeters to the nearest 0.1 cm, with a standard flexible tape on bare skin, at the midway point between the lowest rib and the iliac crest, at the end of expiration with the person breathing silently.

The subjects were classified into different categories of BMI and WC as per the WHO/IASO/IOTF (2000) recommendation for Asian adults (8). 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 is a risk factor for cardiovascular diseases in case of Asian population.

Statistical methods

Statistical analyses were done using SPSS software. Student's t-test was done to analyze the quantitative data and to determine the p value. A level of $p<0.05$ was used to indicate statistical significance in all analyses. Pearson's correlation coefficient was employed to determine the correlation between BMI and TC level and WC and TC level.

Results

150 (100 males and 50 females) healthy young adults aged 20-30 years comprised the study population. Characteristics of the study population are presented in Table I.

The range of serum cholesterol level in the study group was found to be (146-212) mg/dl. The mean cholesterol level in males and females were 169.5±13.63 mg/dl and 172.3±15.09 mg/dl

TABLE I: The physical characteristics of the study group.

Parameter	*Male (n=100)*	*Female (n=50)*
Mean Age (in years)	24±4.24	25.12±4.52
Mean Height (in meters)	1.70±0.07	1.64±0.05
Mean Weight (in kg)	67.0±10.7	62.05±9.0
Mean BMI (kg/m2)	22.96±10.73	22.8±2.91
Mean WC (in cm)	84.28±4.22	80.42±5.51

Values are means±standard deviation. BMI: body mass index; WC: Waist-circumference; n: number of cases.

respectively. Out of 150 cases, 93% cases had cholesterol level < 200 mg/dl and 7% cases had hypercholesterolemia, i.e. > 200 mg/dl. Out of 150 cases, 59% cases had normal weight, 20% cases were overweight, 19% were obese and 2% underweight.

The variation of mean cholesterol level with BMI

From Table II, it is seen that mean TC levels increased from 147 mg/dL in males at the lowest BMI category to 191 mg/dL at the highest category of BMI. Among females, mean TC level increased from 149 mg/dL at the lowest BMI category to 195 mg/dL at the highest BMI level.

Variation of mean cholesterol with WC

From Table III, it is seen that the mean TC level in males having WC ≥ 90 cm is more than males having WC < 90 cm and from table 4, it is seen that the mean TC level in females having WC ≥ 80 cm is more than females having WC < 80 cm.

Statistical analysis

The mean cholesterol levels in different BMI categories are presented in Table II.

The mean cholesterol values of normal weight cases were compared with that of overweight. Unpaired two-tailed t-test was performed to find the p-value. Significant differences was noted between the two categories (p<0.001). Similarly, the mean cholesterol values of normal weight cases were compared with that of obese. Here again, significant differences was noted between the two categories (p<0.001). Pearson's correlation coefficient (r) was calculated to find the correlation between TC and BMI. The correlation coefficient was found to be 0.90, (p< 0.001).

TABLE III: Variation of mean cholesterol with WC in males.

WC	*No. of cases*	*Mean cholesterol ±S.D.(mg/dl)*
<90 cm	83	165.2±7.7
≥90 cm	17	198.1±9.2

WC: Waist-circumference; S.D: standard deviation.

TABLE IV: Variation of mean cholesterol with WC in females.

WC	*No. of cases*	*Mean cholesterol ±S.D.(mg/dl)*
<80 cm	30	163.6±7.7
≥80 cm	20	185.2±14.2

WC: Waist-circumference; S.D: standard deviation.

Variation of mean cholesterol with WC in males is presented in Table III. Here, also unpaired two-tailed t-test showed significant differences between the mean cholesterol level of males with WC <90 cm and males with WC ≥ 90 cm (p<0.01). The correlation coefficient between WC and TC in males was 0.73, p<0.001.

Variation of mean cholesterol with WC in females is presented in Table IV. Unpaired two-tailed t-test showed significant differences between the mean cholesterol level of females with WC <80 cm and females with WC ≥ 80 cm (p<0.01). The correlation coefficient between WC and TC in females was 0.86, p<0.001.

Thus, in the present study we found a strong positive correlation between TC and BMI as well as between TC and WC.

TABLE II: Variation of mean cholesterol level (in mg/dl) with different groups of BMI.

BMI groups	*Male cases*		*Female cases*		*Total cases*	
	No. of cases (n=100)	*Cholesterol (mg/dl)*	*No. of cases (n=50)*	*Cholesterol (mg/dl)*	*No. of cases (n=150)*	*Cholesterol (mg/dl)*
Underweight (<18.5)	2	147.0±1.4	2	149.0±1.4	4	148.0±1.6
Normal (18.5-22.9)	59	163.0±6.2	27	163.5±5.5	86	163.1±6.0
Overweight (23.0-24.9)	20	170.0±4.6	11	177.4±5.7	31	172.9±5.9
Obese (≥25)	19	191.0±13.7	10	195.0±12.5	29	192.4±13.2

Values of cholesterol are means± standard deviation. BMI: body mass index; S.D: standard deviation.

Discussion

This study was based on the estimation of serum cholesterol in 150 healthy young adults and its correlation with BMI and WC. In our study, the range of serum TC found is (146-212) mg/dl. In a study conducted on Assamese population by M. Das and M. Saikia, the range of TC in males was (98-206) mg/dl and females (93-236) mg/dl in the age group of 21-30 years (9). Thus, the range in our study is little higher than the above mentioned study. This may probably be because most of our subjects were medical students (under graduate and post-graduate) who lead a sedentary but stressful lifestyle. In another study on dietary fat, 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 (10). In the present study, the mean TC in males was 169.5±13.6 mg/dl and in females, it was 172.3±15.0 mg/dl.

Different studies show high prevalence of hypercholesterolemia in Indian subjects. In the present study, prevalence of hypercholesterolemia was 7% which is significant because of the young age of the subjects. Elevated cholesterol concentration correlates positively with premature CAD, as shown by Stamler et al (11). In some young adults, genetic forms of hypercholesterolemia lead to premature CAD (12). Early detection in these patients allows for earlier introduction of cholesterol lowering therapy. Prospective studies strongly suggest that even moderate reductions of cholesterol levels by diet will substantially reduce long-term risk for CAD (13).

Another serious health issue related to young adults is obesity. There are various anthropometric measurements for assessment of obesity. BMI and WC are the two most widely used methods. 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 purposes. In the present study, 19% of the study population is obese when classified according to BMI and when classified according to WC cut offs, 17% males and 20% females were obese.

In the present study, a positive correlation was found between the BMI and serum cholesterol. This is in accordance with the study in young Swiss men undertaken by Christoph H Saely et al where they found that serum cholesterol increased with increasing categories of BMI (14). Some other studies also found that the total cholesterol level rises as the body mass index rises (15, 16). Also, a strong positive correlation between serum cholesterol and WC was found. This is in accordance with the study done by the Canadian Heart Health Survey, where it was concluded that WC may be the best single indicator of cardiovascular risk factors including dyslipidemia (17).

In the present study, a strong correlation was found between serum cholesterol and BMI and WC. Thus, 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 20 years are a particularly important group with respect to the study of cardiovascular risk factors. This is the age of the transition from adolescence to young adulthood where, in parallel to changes in working and social status, alterations in lifestyle typically occur. Interventions at this age may be particularly effective to decrease the burden of cardiovascular disease later in life.

The present study has got several limitations. The number of cases under study should have been more and from different socio-economic strata. Moreover estimation of the complete lipid profile would have been more helpful in assessing the cardiovascular health of the population under study. But serum cholesterol estimation is a relatively cheap and simple test which can be routinely advised as a screening test to assess the cardiovascular health of young adults.

Conclusion

The range of serum cholesterol in the present study was (146-212) mg/dl. The mean cholesterol in males and females was 169.5±13.63 and 172.3±15.09 mg/dl respectively. The serum cholesterol of 93%

of the total cases was in the desirable range and 7% had hypercholesterolemia. A positive correlation was found between BMI and serum cholesterol as well as between WC and serum cholesterol. 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 5 years so that preventive measures can be adopted to avoid hypercholesterolemia and it's complications in future life. Young adults should adopt a healthy lifestyle so as to avoid the risk of obesity and hypercholesterolemia.

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