Original Research Article

Correlation of lipids and lipoprotein concentration with body mass index in obese, overweight and normal weight south Indian adults

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ABSTRACT

Background: Obesity a chronic disorder is gradually becoming a serious public health problem in many countries. The aim of the study was designed to measure serum lipids and lipoproteins as marker for cardiovascular disease among obese and overweight South Indian adults.
Methods: The study was done between June 2016 to December 2016, in SRM medical college hospital and research centre, Kattankulathur which comprised of 270 participants of both gender in the age of 18- 55 years. 90 individuals with body mass index (BMI $\geq 25 kg/m^2$), 90 individuals with BMI in the range of 23.0 to $24.99 kg/m^2$ and 90 age and sex matched controls (BMI = 18 to $22.99 kg/m^2$) were selected for the study. Serum levels of total cholesterol, Triacylglycerol, high density lipoprotein (HDL-C) and low-density lipoprotein (LDL-C) were analyzed by using auto analyzer Beckman Coulter AU480. The cardiac risk ratio 1 (cholesterol/HDL-C ratio) and 2 (LDL-C/HDL-C) ratio were calculated.
Results: The difference between the mean values of total cholesterol, triglycerides and LDL-C, were found to be statistically significant across the three groups. Positive correlation was observed between BMI and cardiac risk ratios one and two in both obese and overweight groups.
Conclusions: Cardiac risk is increased in South Indian overweight and obese individuals which is evident from the elevated levels of total cholesterol, triglycerides, LDL-C and cardiac rick ratio one (cholesterol/HDL-C ratio) and two (LDL-C/HDL-C).

Keywords: Body mass index, Cardiac risk, Obesity

INTRODUCTION

In recent decades the prevalence of obesity and overweight has increased steadily in both developed and developing countries.[1] Alterations in body fat distributions are associated with changes in lipids and lipoproteins.[2] Obesity is a risk factor for adult coronary heart disease and is in increasing order among young people and adults.[3,4] Various lipid/lipoprotein abnormalities have been observed in obese individuals, including elevated cholesterol, triglycerides, and lower high-density lipoprotein (HDL) cholesterol levels. Of these indicators, changes in triglyceride and HDL cholesterol levels are most consistent and pronounced.[5] Serum levels of Leptin have a close correlation with adiposity indices and lipid profile and its level increases significantly with increasing grades of obesity.[6]

Body mass index is widely used as a marker of adiposity, but it may not be a good measurement of adiposity, mainly in extremes of stature and with advancing age.[7]

Cardiovascular diseases (CVD), the most leading cause of morbidity and mortality in the western World is now emerging as public health problem in the developing countries.[8] Association between dyslipidemia, obesity and hypertension is well established. The present study was designed to measure serum lipids and lipoproteins as markers for cardiovascular diseases among obese and overweight South Indian adults.

METHODS

The study was performed in accordance with the approval of the Institutional ethics committee (EC no:957/IEC/2016), and informed written consent was taken from all subjects. The study was done between June 2016 to December 2016, which comprised of 270 South Indians in the age of 18 - 55 years. The subjects were selected from those who were attending master health checkup programme at SRM Medical College Hospital and Research centre, Kattankulathur-South India. These subjects were sub-grouped into 90 overweight (BMI =23 to 24.9 kg/m^2), and 90 obese (BMI $\geq$25), beside 90 ages matched (BMI= 18 to 22.9 kg/m^2) healthy persons as control group.

Individuals with history of smoking, alcohol intake, any drug intake and hypertension were excluded from the study. Venous blood was collected from all the participants after an overnight 10-12 hours fast. 2ml of the blood sample was collected in an oxalate fluoride vacutainer for estimation of fasting plasma glucose. 3ml

of blood collected in a plain vacutainer was allowed to clot and serum was separated after centrifugation at 3,000 RPM for 10 minutes. The lipids and lipoproteins were measured immediately using automated chemical analyzer (Beckman Coulter AU 480). Total cholesterol (cholesterol oxidase method), triglycerides (glycerol phosphate oxidase peroxidase-GPO POD), LDL-C (direct method) and HDL-C (direct method) were measured parallel with control samples from BIORAD Company. Cholesterol/HDL and LDL/HDL ratios were calculated by subdividing total cholesterol and LDL respectively by HDL. Statistical analysis was conducted using IBM SPSS Statistics 20 and one-way ANOVA (p<0.05). Simple descriptive statistics (mean and Standard Deviation; SD), were used to describe the observed variation in lipids and lipoproteins between the groups under the study. Pearson's correlation analysis was done to study the association between BMI and cardiac risk ratio one and two.

RESULTS

The study included 270 participants totally. 90 subjects were obese, 90 subjects were overweight and 90 were age and gender matched healthy controls.

The mean values of measured parameters of the study groups are shown in table 1. Descriptive study of mean Serum cholesterol, triglycerides, HDL-C, LDL-C, fasting plasma glucose, BMI and Cholesterol/HDL, LDL/HDL ratios in obese, overweight and their controls (Table 1).

Table 1: Mean ± standard deviation of measured parameters of the study groups.

Parameter	Healthy (n = 90) Mean ± SD	Overweight (n = 90) Mean ± SD	Obese (n = 90) Mean ± SD
BMI (kg/m^2)	20.69 ± 1.98	23.79 ± 0.55	29.69 ± 4.55
FBS (mg/dl)	116.57 ± 42.55	109.48 ± 33.09	125.52 ± 48.24
T. choles (mg/dl)	153.93 ± 37.90	164.13 ± 31.80	184.44 ± 36.67
TGL (mg/dl)	97 ± 36.35	145.15 ± 99.48	159.60 ±120.60
HDL-C (mg/dl)	39.54 ± 11.34	44.51 ± 7.35	40.94 ± 7.76
LDL-C (mg/dl)	112.62 ± 31.65	149.13 ± 31.97	153.33 ± 38.60

Comparison of Biochemical Parameters between the three groups using One-Way ANOVA are shown in Table 2.

Mean values of T.C, TGL and LDL-C of the Study Groups Obese, Overweight and Healthy (Figure 1) were significantly different among the three groups.

Correlation between BMI and CHO/LDL ratio in Obese subjects (Figure 2).

Correlation between BMI and LDL/HDL ratio in Obese subjects (Figure 3).

The Pearson's correlation coefficient was determined. A significantly positive correlation was found between BMI and cardiac risk ratios.

Cardiovascular risk ratio 1 and 2 in obese individuals was found to correlate positively with BMI.

Table 2: Comparison of biochemical parameters between the three groups using one-way ANOVA.

Parameters		Sum of squares	DF	Mean square	F-value	P-value
FBS	Between groups	11619.6963	2	5809.8481	3.330	0.034
	Within groups	465822.9	267	1744.655		
	Total	477442.596	269			
T. Choles	Between groups	43425.27	2	21712.637	17.174	<0.00001
	Within groups	337560.22	267	1264.2705		
	Total	380985.4963	269			
TGL	Between groups	193390.7852	2	96695.393	11.259	0.00002
	Within groups	2293005.422	267	8588.0353		
	Total	2486396.207	269			
HDL-C	Between groups	1180.4667	2	590.2333	7.2867	0.0008
	Within groups	21627.5333	267	81.002		
	Total	22808	269			
LDL-C	Between groups	90242.8741	2	45121.437	38.5	<0.00001
	Within groups	312859.555	267	1171.7586		
	Total	403102.4296	269			

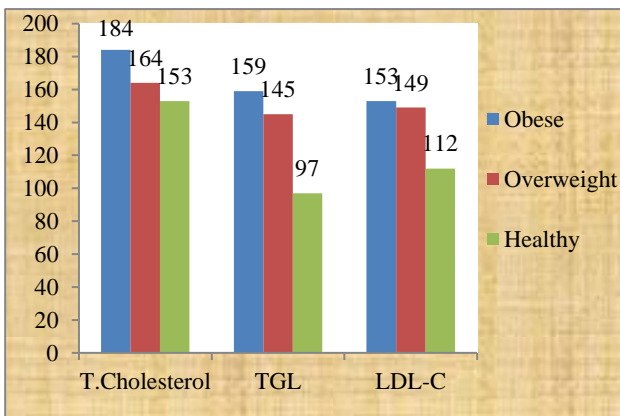$P < 0.05$ Considered statistically significant

Figure 1: Mean values of T.C, TGL and LDL-C of the study groups obese, overweight and healthy.
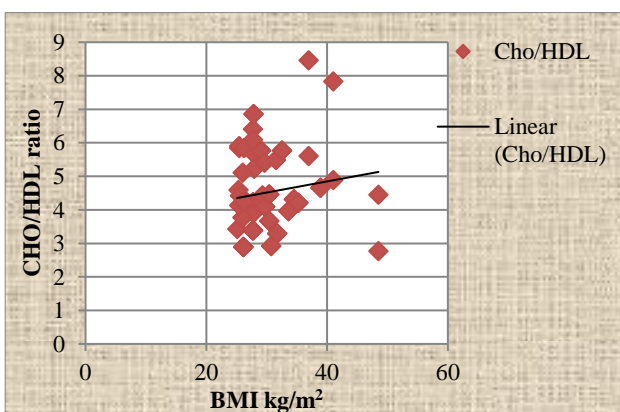

Figure 2: Correlation between BMI and CHO/LDL ratio in obese subjects.

DISCUSSION

Recent studies have shown changing trends with almost doubled incidence of obesity among children, adolescents and young adults.[9-11] Our study showed a statistically significant higher value of various lipid parameters like Total Cholesterol (TC), Triglycerides (TG) and LDL-C in overweight, obese individuals.
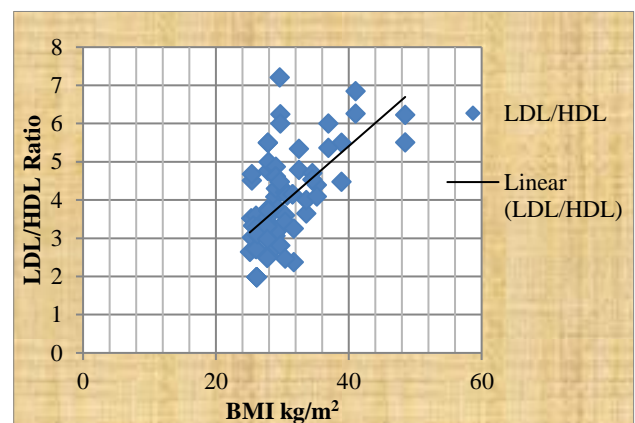

Figure 3: Correlation between BMI and LDL/HDL ratio in obese subjects.

These results are in accordance with a cross sectional study done during 2009-10 by Michael Khoury, Cedric Manlhiot et al which showed statistically significant association between lipid profile and measures of adiposity.[12]

Another case control study of adolescents done by Gilles Plourde on Caucasian adolescents also revealed that overall abnormal glucose and lipid profile were significantly associated with obesity.[13]

The Framingham study and other large epidemiologic studies have reported a correlation between obesity and increased coronary heart disease-related events.[14-16] The proposed mechanisms for cardiac events in obese patients

include increased atherosclerosis related to dyslipidemia, insulin resistance, hypertension, and diabetes.[17-19]

The effects of dyslipidemia on cardiac events is generally considered to be largely due to increased TC20 and LDL cholesterol.[21-27]

Mechanism contributing to complications of altered lipid profile in obesity is due to excessive fat in visceral adipocytes which release an excess amount of free fatty Acids. This further increases the synthesis of triglycerides and secretion of VLDL rich in triglycerides into circulation increasing fasting TG blood levels. Through cholesteryl ester transfer protein (CETP), TGs from VLDL are exchanged for cholesterol in HDL. TG-rich LDL and VLDL subsequently undergoes hydrolysis by hepatic lipase or lipoprotein lipase leading to formation small, dense LDL particles which are more toxic and atherogenic.[28] This atherogenicity is the root cause for all obesity related complications.

CONCLUSION

South Indian overweight and obese subjects, show a significant increase in the serum levels, of total cholesterol, triglycerides and LDL with high atherogenic index. Early and immediate interventional measures like increase in physical activity, healthy dietary habits and regular surveillance are required to prevent development of irreversible dangerous complications.

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