STUDY ON RELATIONSHIP OF SERUM TOTAL CHOLESTEROL LOW DENSITY LIPOPROTEIN AND TRIGLYCERIDES WITH BODY MASS INDEX

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Summary

The present case control study was designed to determined the relationship between serum Total cholesterol, Low Density Lipoprotein (LDL), Triglycerides (TG) and Body Mass Index (BMI) The study was carried out in the Department of Biochemistry Chittagong Medical College during the period of January 2010- December 2010. Samples were collected from population of different area of Chittagong City Corporation of different occupations, age from 35- 60 years. The data were collected by a structured questionaries which includes age, sex, occupation, dietary habits, family history of hyperlipidemia and DM. BMI was calculated by standardized protocol. Population suffering from DM, renal diseases and other endocrine disease were excluded. A total of 105 subjects were included in this study. Among them 70 were considered as case (whose BMI was 25 kg/m^2) and 35 were considered as control (whose BMI was < 25 Kg/ m^2).Serum Total cholesterol, LDL-C, HDL-C and TG were measured in all samples in fasting state. Study showed that female were more obese than male,(31.14 ±2.23kg/m^2 Vs 29.71 ±2.69kg/m^2), p= <0.05.Results showed that Serum TC(45%), LDL-C(65%), TG(70%) were significantly higher in cases than that of controls (p=<0.001).Serum HDL-C(35%) was significantly decreased in cases than that of controls (p=<0.001).Study showed that hypertriglyceridemia (70%) was the common lipid abnormality and then LDL-C (65%). Study revealed that there was no significant difference in lipid profile between male and female. Pearson's Correlation Coefficient showed that there were positive correlation between TC (r=0.234,p=<0.05), LDL-C (r=0.258,p=<0.01), TG (r=0.409,p=<0.001) and BMI, and was negative correlation between HDL-C(r= -0.403, p= <0.001) and BMI. So early detection and prevention of obesity and abnormal lipid profile can largely reduce morbidity and mortality and alleviate undue burden on our limited health budget.

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Key words

Total cholesterol; LDL-C; TG;HDL-C; BMI

Introduction

Obesity is a disorder of body weight regulatory system characterized by an accumulation of excess fat. Obesity has increased globally and is public problem throughout the world [1,2,3]. The prevalence of obesity and overweight is increasing world wide and both have reached in epidemic proportions in the both developed and developing countries. The diseases associated with abdominal obesity includes hypertension, hyperlipidemia, insulin resistance, diabetes mellitus and CVDs [2,4,5].

Various lipid/ Lipoprotein have been observed in obese individuals including elevated total cholesterol, TG and lowered HDL-C. Epidemiologic study shown that increasing body mass index is associated with higher total cholesterol and LDL-cholesterol. Higher BMI is directly associated with TG and inversely associated with HDL-C [5,6,7]. Abnormal serum concentration of lipids such as total cholesterol and LDL-C are strongly correlated with early atherosclerotic lesion [8,9,10].

The most important modifiable risk factors of CVDs are unhealthy diet, physical inactivity and tobacco use and the effects of unhealthy diet and physical inactivity include abnormal blood lipid, obesity etc [7,11]. Low physical activity and excess fat rich diet are two major health concerns in affluent society. A study in Bangladesh revealed 27.93%, 21.08% and 13.41% stroke patient with lipid disorder had high cholesterol, LDL-C and TG level respectively and 42.07% patient had low HDL-C level showed in the same study [11].

With the growing prevalence of obesity the prevalence of T_2DM and CVD in our communities also increased. Prevention and management of this dyslipidemic state is critically important for the prevention of coronary artery and macro vascular diseases [12].

The regional types of fat cells are biochemical different. Abdominal fat cells are much larger and have a higher rate of fat turn over than do lower body fat cells [13,14].

The abdominal adipocytes are also hormonally more responsive than fat cells in the legs and buttock. So men accumulate the readily mobilizable abdominal fat, they generally loss weight more readily then do women, who accumulate lower body fat. Further substances released from abdominal fat cells are absorbed via the portal vein and thus have direct access to the liver. Fatty acids taken up by the liver may lead insulin resistance and increase synthesis of triglycerols, which are released as VLDL [15,16].

In the literature there is a wide spread opinion that the reduction of BMI among older person will automatically lead to decrease in cholesterol level [17,18]. Weight loss achieved by lowing diet or exercise has shown a reduction of TG level and elevation of HDL-C level [19,20].

So early detection and prevention of obesity and abnormal lipid profile can largely reduce morbidity and mortality and alleviate undue burden on our limited health budget.

Materials and methods

The case control study was conducted in the Department of Biochemistry, Chittagong Medical College from January 2010 to December 2010. The population of different area of Chittagong City Corporation fulfilling the enrollment criteria were included in this study. Total 105 subjects were included in this study. Among them 70 were Case (Group A) and 35 were Control(Group B). BMI 25 kg/ m^2, age 35-60 years were included in cases and BMI < 25 kg/ m^2, age 35-60 years were included in control and persons suffering from diseases which causes rising blood lipids such as Diabetes mellitus, Hypothyroidism, Cushing's syndrome and renal failure were excluded from the study group. Data were collected by interview of the study population by using research instruments.

Total cholesterol (TC) and triglyceride (TG) was estimated directly by enzymatic method. For Total cholesterol CHOD-POD method and for Triglycerides GPO-POD method. High Density lipoprotein cholesterol (HDL-C) was measured by Phosphotungstic-precipitation method. All measurements were analyzed in the semi auto analyzer SPECTROPHOTOMETER-5010. While low-density lipoprotein-cholesterol (LDL-C) was calculated by the Friedewald formula. (LDL= Total Cholesterol - HDL - 1/5 TG mg/dl). (Appendix-3)

Increased serum Total cholesterol (TC) is defined as serum TC level of 200 mg/dl , elevated Triglycerides (TG) level is 150 mg/dl and elevated LDL-C is 100 mg/dl. Low HDL-C is defined as < 40 mg/dl and >40 mg /dl are normal (According to NCEP and ATP –III) [14].

Body mass index (BMI)

Body height and weight was measured according to a standardized protocol with participants standing without shoes and heavy outer garments. Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meter (kg/m^2).

Result and observation

Data was analyzed by computer based software SPSS v 15. Data were expressed as mean ± SD. Confident level was fixed at 95% level and "p" value of 0.05 or less was considered significant. Student`s 't' test for quantitative or continuous variables, Chi-square test for categorical variables were done where applicable. Bar diagram and Pie chart with best fitting line were drawn.

Table I : Distribution of body mass index (BMI) among the case (Group A) and control (Group B)

		N	Mean	± Sd	Median	Range	Sign
BMI (Kg/m^2)	Group A (case)	70	30.29	2.51	30.00	25 – 39	t = 20.814 P = 0.000
	Group B (control)	35	23.01	1.06	23.00	20 – 24	Very Highly
	TOTAL	105	27.86	4.05	29.00	20 – 39	Significant

Table I shows the mean BMI of cases are 30.29 ± 2.51 kg/m^2 and controls are 23 ± 1.06 kg/m^2

Table II : Distribution of serum total cholesterol among the cases (Group A) and control (Group B) (with t test significance)

		N	Mean	±Sd	Median	Range	Sign
Serum Total Cholesterol (mg/dl)	Group A (cases)	70	202.17	37.28	195.00	144–316	t = 3.712 P = 0.000
	Group B (control)	35	183.60	13.46	183.00	156–210	Highly Significant

Table II shows that mean Total cholesterol (TC) are significantly higher in cases than that of control (202.17±37.28 vs 183.60 ±13.60 mg/dl, p=<0.001)

Table III : Distribution of serum triglycerides among cases (Group A) and controls (Group B) (with t test significance)

		N	Mean	± Sd	Median	Range	Sign
Serum Triglycerides (mg/dl)	Group A (case)	70	195.16	65.04	172.00	104–386	t = 5.829 P = 0.000
	Group B (control)	35	148.51	11.21	146.00	130–178	Very Highly
	TOTAL	105	179.61	57.76	153.00	104– 386	Significant

Table III shows that mean serum TG are highly significantly increased in cases than that of controls (195.16 ±65 vs 148.51±11.21 mg/dl, p=<0.001)

Table IV : Association of serum total cholesterol status with BMI grading (with X^2 test significance)

		BMI GRADING Normal (Control) (n = 35)	Overweight (Case) (n = 22)	Obese (Case) (n = 48)	Total (N=105)	Sig
Serum Total Cholesterol Status	Normal	29 (82.9%)	11 (50.0%)	27 (56.2%)	67 (63.8%)	x^2= 8.503 P = 0.014 Significant
	High	06 (17.1%)	11 (50.0%)	21 (43.8%)	38 (36.2%)	

Table IV shows that high serum total cholesterol was observed in overweight and obese group in percentage of 50% & 43.8% than that of control group 17.1% and statistically significant, p= < 0.05.

Table V : Association of serum triglycerides status with BMI grading (with X^2 test significance)

		BMI GRADING Normal (Control) (n = 35)	Overweight (Case) (n = 22)	Obese (Case) (n = 48)	Total (n=105)	Sig
Serum Triglycerides Status	Normal	27 (77.1%)	06 (27.3%)	15 (31.2%)	48 (45.7%)	x^2=20.993 P = 0.000 Very Highly Significant
	High	08 (22.9%)	16 (72.7%)	33 (68.8%)	57 (54.3%)	

It was observed that high serum TG was observed in overweight and obese group in percentage of 72.7% and 68.8% respectively than that of control group 22.9% and was statistically significant, p=<0.001 (Table-V).

Table VI : Correlations between serum total LDL, HDL cholesterol, triglycerides and BMI

Correlations Between	Pearson's Correlation Coefficient (R)	P	Significance	
Serum Total Cholesterol and BMI	0.234	0.016	< 0.05	S
Serum LDL Cholesterol and BMI	0.258	0.008	< 0.01	HS
Serum HDL Cholesterol and BMI	- 0.403	0.000	< 0.001	VHS
Serum Triglycerides and BMI	0.409	0.000	< 0.001	VHS

VHS = Very Highly Significant, HS = Highly Significant, S = Significant.

Table VI demonstrated that there was positive correlation between BMI and Total Cholesterol (r=0.234, p=<0.05) LDL-C (r =0.258, p=< 0.01) TG (r = 0.409, p = < 0.001) but negative correlation between HDL-C (r = - 0.403, p = < 0.001)

Discussion

In this study average age of the cases were 43± 6 years and male- female ratio is 3:2. The average BMI of cases were 30.29 ±2 kg/m^2 and controls were 23±1 kg/m^2 . In cases 31.4% were overweight and 68.6% were obese. But in a study found 40.5% were overweight and 4.7% were obese [11].

In the obtained results of this study the mean BMI of female was significantly (p <0.05) higher than that of male. In this study 89% female were obese (BMI 31.14kg/m^2) and 55% male was found to be obese (BMI 29.7 kg/m^2). The findings is more or less similar to that of another study [19].

There was a significant difference in serum total cholesterol between case and control (p < 0.05) as given in table. The serum total cholesterol of cases were 202±37 mg/dl and controls were 183±13 mg/dl respectively. This is of finding is also observed in other studies [21,22]. But the observation showed that serum total cholesterol was very near to the desired level of lipid profile given by NCEP ATP-III [16]. This may be due to the lack of abnormalities in cholesterol homeostasis or difference in study population. Again, it may be noted that the desired level of serum total cholesterol in this region was not calculated with reference studies. But it is to be noted that 45% of cases had increased serum total cholesterol .

Regarding serum triglycerides there was a significant difference between values of serum triglycerides of cases and controls iè, the mean serum triglycerides in cases was 195±65 mg/dl and that of control was148±11 mg/dl respectively with a p value of <0.05. So in cases there was significant high serum triglycerides level than that of control. This study was consistent with that of other studies [21,22,23].

With respect of serum LDL values the mean value of serum LDL in cases was a significantly higher than that of controls. It showed the mean serum LDL in cases was 120±34 mg/dl and that of control was 98±8 mg/dl with a p value of < 0.05. A similar kind of observations are also read in others studies [21,23].

Increased serum total cholesterol was observed in 45% of cases and increased serum LDL was observed in 65% of cases but increased serum triglycerides was observed in a higher score, ie, 70% cases. Similar observation was also found in others study [20,24,25].

Another important observation of my study is that, mean serum total cholesterol, triglycerides and LDL cholesterol was more in overweight group than that of obese group. This may be due to inclusion of such cases in the research group that lead to variation of sample sizes or otherwise the habits or life style of obese patient may differ with that of overweight group.

A better sample size with more inclusion or exclusion may alter such. The endocrine and metabolic profile would have altered the lipid profile in overweight group towards dyslipidemia. This pattern of dyslipidemia was also observed in other study [24,25].

In present study Pearson´s correlation coefficient (r) showed that there was a positive correlation between BMI and total cholesterol (r=0.234, p= <0.05), BMI and LDL-C (r=0.258, p= <0.01) and BMI and TG (r=0.409, p= <0.001). This is consistent with other study [2,5,6].

In the present study revealed that hypertriglyceridemia is the most common lipid abnormality and then LDL –C. So, in this study the cases showed hypertriglyceridemia was 70% and increased LDL cholesterol was 65% of cases. It was consistent with other study [11].

In present study there were no significant difference was found in serum total cholesterol (male-202mg/dl, female- 198mg/dl) and LDL-C (male-122mg/dl, female-116mg/dl) in overweight and obese group regarding sex. But regarding serum TG (male-204 mg/dl, female-180mg/dl) and HDL-C there was significance difference in male and female with p= <0.05.

Regarding serum HDL-C there was a significant difference between values of serum HDL-C of cases and controls, iè, the mean serum HDL in cases was 38±8 mg/dl and that of control was 52±6 mg/dl respectively with a p value of < 0.001. So in cases there was significant low serum HDL-C level than that of control. Observation also showed that in cases 32% cases decreased serum HDL cholesterol. This study was consistent with that of other studies [5,25].

In present study Pearson´s correlation coefficient (r) showed that there was a negative correlation between BMI and HDL-C (r= -0.403, p=<0.001). This was consistent with the study [2,5,6].

In this study the cases have fallen in to the group of metabolic syndrome as their mean BMI was 30.29kg/m^2, mean serum TG was 195 mg/dl, mean serum HDL-C was 38 mg/dl and mean age was 43 years. According to WHO metabolic syndrome are a group of criteria in which BMI $\geq$ 30 kg/m^2 , serum TG >150 mg/dl, serum HDL-C <40 mg /dl, IGT or IFG and BP$\geq$ 140/90 mmHg. A person fulfilling the three criteria from above are grouped into metabolic syndrome [26].

The causes of raised serum TG in obese person are due to insulin resistant. The hepatic overproduction of VLDL appears to be the primary and crucial defect of the insulin resistant state accompanying obesity.

In addition to increased synthesis , insulin resistant of obesity is characterized by decreased clearance of triglycerides rich lipoprotein (VLDL). Insulin resistant of obesity suppress the activity of lipoprotein lipase (LPL) and LDL receptor (LDLR) activity [17].

In the insulin resistant state, the composition and distribution of LDL particles are altered, resulting in an increased concentration of small, dense LDL.

So as per this discussion relating to the alteration of lipid metabolism in obesity or overweight, all these factors might have contributed in alteration of lipid levels of blood in the cases included for the study. But a further extension of such studies may reconfirm such state by better inclusion or exclusion criteria and methods.

Conclusion

The magnitude of the burden of CVDs and coronary heart disease is large enough to demand urgent attention and action. In the primary care setting there is a strong need for increased public awareness about early identification and prevention of obesity ,which will help in reducing the proportion of people with high lipid level that consequently increases the risk of acquiring cardiovascular diseases. Therefore, patient education is the cornerstone of disease prevention. Since obesity and overweight are accompanied by unfavorable blood lipid patterns that increases the risk of acquiring coronary heart disease, excess body weight is to be considered a major public health issue. Government should take measures to improve public awareness about healthy life style and food habit. Early detection and prevention of obesity and of course abnormal lipid profile can help to reduce morbidity and mortality to a greater extend in this regard.

Disclosure

All the authors declared no competing interest.

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