Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 6, 2024

ABNORMALITIES OF LIPID PROFILE IN CORONARY HEART DISEASE (CHD) AND OBESITY IN INDIAN SUBJECTS: A CLINICAL STUDY

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ABSTRACT

Background: In the past three decades, obesity has reached the level of a global epidemic. Also, coronary heart disease is the most common cause of mortality globally including in India. However, existing literature data is scarce concerning lipid profiles in subjects with CHD and obesity.

Aim: The present study aimed to assess the abnormalities of lipid profiles in coronary heart disease (CHD) and obesity in Indian subjects.

Methods: In 250 subjects with CHD, 125 obese subjects, and 125 healthy controls blood samples were collected to assess VLDL, LDL-C, HDL-C, triglycerides, and total cholesterol with commercially available kits. The results were compared in two groups for dyslipidemia in controls and study subjects. Logistic regression was done to assess the association of lipid parameters with CHD and obesity.

Results: Dyslipidemia was seen in CHD and obese subjects compared to healthy controls with a higher proportion of CHD in first-degree blood relatives from the CHD group with 36%. Similar results were seen in the obese group with a positive family history in 63.9% of subjects. In some cases, 51% of subjects showed combined lipid abnormalities with deranged HDL-C, TG, LDL-C, and TC values. Higher than cut-off values were seen for TC (> 200 mg/dl) and LDL-C (> 100 mg/dl) in 49.5% and 52% subjects respectively. Also, 64% of subjects had HDL < 50 mg/dl (moderate CHD risk) and 84% had TG >150mg/dl (> upper normal range).

Conclusion: The present study concludes that Indian subjects are hyperlipidemic with low HDL and deranged lipid profiles are seen in subjects with comorbidities. The present study also points to deranged lipid profiles in metabolic disorders that can predispose to complications.

Keywords: coronary heart disease, CHD, Dyslipidemia, obesity, lipid profile

INTRODUCTION

The term obesity signifies excess body weight. Following the WHO (World Health Organization), obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. A body mass index (BMI) over 25 is considered overweight, and over 30 obese. It is a chronic disease showing a rapid increase worldwide and replacing traditional health concerns. Obesity is directly linked to cardiovascular concerns and children with a parental history of

cardiovascular diseases have high weight during childhood and are obese when they are adults. CHD (coronary heart disease) is considered to be the leading cause of death in developing nations in coming years. It has been estimated that more than 80% of the subjects with CHD worldwide contribute to the burden from low-income countries. However, the knowledge concerning vital risk factors is attained from the developing nations.[1]

A large geographic variation is being seen concerning the prevalence of CHD risk factors and it is vital to utilize the existing local data during the discussion of the relationship between various risk factors and the diseases. It remains unclear as to what extent, the risk factors for CHD known are applicable in the Indian population. This can be attributed to the higher prevalence of risk factors for CHD as dyslipidemia, obesity, and hypertension in Indian subjects.[2] Considering obesity as a risk factor for CHD, it has been noted that in the South Asian population, a higher prevalence of risk factors for CHD is seen including type 2 diabetes, insulin resistance, and abdominal obesity. As CHD can result from obesity, the involved biochemical pathways in obesity development have also been assessed to have a role in CHD development.[3]

Levels of lipids in the blood are the modifiable risk factors for CHD and atherosclerosis. As lipids are hydrophobic in nature, phospholipids, triglycerides, cholesterol esters, and cholesterols are transported in the form of lipoproteins to each other. HDL (high-density lipoproteins), LDL (low-density lipoproteins), and chylomicrons are the major classes of lipoproteins that are named by their assembly site and the type of apoprotein and lipids they have. Excessive FAs (fatty acids) in the liver are converted to triacylglycerols, which in addition to phospholipids, esterified and free cholesterol are packed into VLDL (very-low-density lipoproteins) in addition to various apoproteins. During their travel to the peripheral tissues, the triacylglycerol content is hydrolyzed with LPL (lipoprotein lipase) into VLDL remains and fatty acids. The remnants of VLDL with further hydrolysis of the triglyceride contents produce IDL (intermediate-density lipoproteins) and LDL. LDL has an apo B100 apoprotein component which is a major carrier of cholesterol in the peripheral circulation. Elevated levels of plasma in these non-HDL lipoproteins are major risk factors for CHD.[4]

It has been noted that many lipoprotein/lipid abnormalities have a high prevalence in subjects with cardiovascular diseases and obesity which collectively is known as dyslipidemia. Majorly, these dyslipidemias are hyperlipidemias where the majority of the lipids are shifted to the upper limit range or more than the range. Transportation availability and recent lifestyle modernization have resulted in a high prevalence of metabolic disorders in Indian subjects as seen on the global level. This not only interferes with social interactions, work performance, and daily activities but also lays a high burden on healthcare.[5] Considering the vital role of lipid traits in developing nutritional disorders, the present study aimed to assess the patterns of lipid profiles in CHD and obese subjects in the Indian context.

MATERIALS AND METHODS

The present case-control clinical study aimed to assess the patterns of lipid profiles in CHD and obese subjects in the Indian context. The study was done at Shri Balaji Metro hospital Raigarh

,from May 2023 to April 2024, after the clearance was given by the concerned Ethical committee of the Institute. The study subjects were from the Department of Cardiology of the Institute. The study included 250 subjects with CHD, 125 obese subjects, and 125 healthy controls that were gender and age-matched. Verbal and written informed consent were taken from all the subjects before study participation.

The study included subjects with CHD with non-fatal MI (myocardial infarction) as diagnosed by a consultant cardiologist depending on clinical history, Troponine T/I, angiography, cardiac echo, and ECG. Only the cases with coronary artery disease were recruited in the study who had recent diagnoses and were not on the antihypertensive drugs or lipid-lowering drugs.

The inclusion criteria for the study were subjects that were obese following BMI cut-off values for Asian populations where >30kg/m2 was taken as obese.[6,7] Indirect indicator of lower and upper body fat was taken as waist to hip ratio.[8] The control subjects were healthy subjects with BMI in the range of 18 to 24 and with no history of CHD. The exclusion criteria for the study were subjects with obesity and CHD, infections, malignancies, pregnant females, and underweight subjects.

The presence of various comorbidities as hypertension or diabetes was also identified. Diabetes was considered with FBG (fasting blood glucose) levels of 6.7 mmol/L or higher or a 2-hour PP (postprandial) blood glucose levels of 11.1 mmol/L or higher. For hypertensive and normotensive subject classification, it was followed by reports from the seventh Joint National Committee for Hypertension (JNC-V).[9] Blood pressure of each participant was done by a healthcare personnel expert in the field after 5 minutes of sitting.

For each participant, 5ml of intravenous blood was collected after overnight fasting under strict aseptic and sterile conditions in a test tube having a gel clot activator. The blood was collected from the median cubital vein with a tourniquet placed on the arm and with the fist squeezed. The collected blood was subjected to centrifugation at 10,000 rpm for 10 minutes to settle all the elements formed and for separation of the serum. The separated serum was then transferred to the autoclaved Eppendorf and was refrigerated till further assessment.

Plasma lipoproteins and lipid variables such as triglycerides (TG) and total cholesterol (TC) were assessed with the commercially available kits. Optical density assessments were done at 546 nm for triglycerides and total cholesterol. HDL-C (high-density lipoprotein) and LDL-C (low-density lipoprotein C) were assessed following Mohsen Ibrahim et al[10] in 2012. Assessment of HDL needed precipitation of LDL and VLDL from the serum leaving HDL-C in the serum which is further assessed following the principle similar to total cholesterol. Determination of LDL-C utilizes modified PVS (polyvinyl sulfonic acid) and PEGME (polyethylene-glycol methyl ether) coupled classic method of precipitation. PEGME and PVS react with chylomicron, VLDL, and LDL making inaccessibility of these substances by CHER (cholesterol esterase) and CHOD (cholesterol oxidase), whereas, HDL reacts with enzymes. Adding a second detergent having a reagent releases LDL from the PEGME/PVS complex. The LDL released then reacts with enzymes to produce H2O2 which is quantified using Tinder reaction.

The data gathered were analyzed statistically using the SPSS software version 21.0 (IBM Corp., Armonk, NY, USA) and the one-way ANOVA (analysis of variance) along with logistic regression analysis. The data were expressed as mean and standard deviation for normally distributed and non-normally distributed continuous variables and frequency and percentage for categorical variables. Statistical significance was kept at a p-value of <0.05.

RESULTS

The present case-control clinical study was aimed to assess the abnormalities of lipid profile in coronary heart disease (CHD) and obesity in Indian subjects. The study assessed 250 subjects with CHD, 125 obese subjects, and 125 healthy controls blood samples were collected to assess VLDL, LDL-C, HDL-C, triglycerides, and total cholesterol with commercially available kits. The mean age of the study subjects was significantly higher in controls and CHD subjects with p=0.002. The gender between controls, obese, and CHD subjects was statistically comparable with p=0.47. The family history was significantly higher in obese and CHD subjects compared to controls with p<0.0001. Similar results were seen for smoking, hypertension, and diabetes which was significantly lower in controls compared to obese and CHD subjects with p<0.0001. The waist-hip ratio was higher in obese subjects compared to CHD and controls with p<0.0001. BMI was significantly higher in obese subjects compared to CHD and controls with p<0.0001 as shown in Table 1.

On assessing the blood lipid levels in different groups of study subjects, HDL-C and TC levels were significantly higher in subjects with CHD and obese subjects with p<0.001. LDL-C levels were significantly higher in obese subjects followed by subjects with CHD and were least in controls with p<0.001. HDL-C levels were highest in controls followed by CHD and obese subjects which was statistically significant with p<0.001. Total triglycerides were highest in obese subjects followed by CHD and controls with p<0.001. Similar results were seen for total cholesterol levels that were highest in obese subjects followed by CHD and controls depicting statistical significance with p<0.001 as depicted in Table 2.

It was seen that on gender-wise assessment of subjects in obese and CHD groups with deranged lipid profiles, LDL-C values of >99 were seen in 55.2% (n=69) males and 47.2% (n=59) females from the obese group and in 24.4% (n=61) males and 19.2% (n=48) females from CHD group respectively. HDL-C <40 was seen in 52% (n=65) males and 45.6% (n=57) females from the obese group and 31.6% (n=79) males and 22% (n=55) females from the CHD group. HDL-C <49 was seen in 48.8% (n=61) males and 44.8% (n=56) females from the obese group and 22% (n=55) males and 8.4% (n=42) females from the CHD group respectively. TG>149 was seen in 88.8% (n=111) males and 74.4% (n=93) females from the obese group and in 38% (n=950 males and 28.4% (n=71) females from the CHD group. TC>199 was seen in 45.6% (n=57) males and 39.2% (n=49) females from the obese and 24.8% (n=62) males and 17.2% (n=43) females from the CHD group (Table 3).

The study results showed that on gender-wise assessment of lipid profile in the obese and CHD group, LDL-C was 103.5±29.4 and 98.5±27.6 mg/dl in males and females from the obese group

which was statistically non-significant with p=0.06 and was 104.6±39.7 and 104.4±35.3 mg/dl in CHD group showing statistical non-significance with p=0.85. HDL-C levels were 55.3±17.1 and 54.9±17.8m/dl in males and females from the obese group and 44.4±11.4 and 46.5±12.3mg/dl in the CHD group which was statistically non-significant in both groups with p=0.81 and 0.08 respectively. Similar results were seen for TG levels in obese and CHD groups with p=0.06 and 0.67 respectively. TC also showed statistical non-significance in males and females from obese and CHD groups with p=0.08 and 0.86 respectively as shown in Table 4.

On logistic regression analysis for obese and CHD subjects, a significant correlation was seen in LDL-C levels to obesity and CHD with respective p-values of <0.001 and <0.001. For HDL-C levels, a significant association was seen in obesity and CHD both with p<0.001. A similar significant correlation was seen in triglyceride and obesity and triglyceride and CHD with p<0.001 and <0.001. A significant correlation was also seen in total cholesterol to obesity and CHD with respective p-values of <0.001 and <0.001 as summarized in Table 5.

DISCUSSION

The present study assessed 250 subjects with CHD, 125 obese subjects, and 125 healthy controls blood samples were collected to assess VLDL, LDL-C, HDL-C, triglycerides, and total cholesterol with commercially available kits. The mean age of the study subjects was significantly higher in controls and CHD subjects with p=0.002. The gender between controls, obese, and CHD subjects was statistically comparable with p=0.47. The family history was significantly higher in obese and CHD subjects compared to controls with p<0.0001. Similar results were seen for smoking, hypertension, and diabetes which was significantly lower in controls compared to obese and CHD subjects with p<0.0001. The waist-hip ratio was higher in obese subjects compared to CHD and controls with p<0.0001. BMI was significantly higher in obese subjects compared to CHD and controls with p<0.0001. These data were similar to Lawler PR et al[11] in 2015 and Sutter I et al[12] in 2014 where authors assessed subjects with demographic data comparable to the present study in their respective studies.

Concerning the blood lipid levels in different groups of study subjects, HDL-C and TC levels were significantly higher in subjects with CHD and obese subjects with p<0.001. LDL-C levels were significantly higher in obese subjects followed by subjects with CHD and were least in controls with p<0.001. HDL-C levels were highest in controls followed by CHD and obese subjects which was statistically significant with p<0.001. Total triglycerides were highest in obese subjects followed by CHD and controls with p<0.001. Similar results were seen for total cholesterol levels that were highest in obese subjects followed by CHD and controls depicting statistical significance with p<0.001. these results were consistent with the studies of Genest J et al[13] in 2003 and Gordon L et al[14] in 2010 where blood lipid levels in CHD and obesity subjects reported by the authors were similar to the present study.

The study results showed that on gender-wise assessment of subjects in obese and CHD groups with deranged lipid profiles, LDL-C values of >99 were seen in 55.2% (n=69) males and 47.2% (n=59) females from the obese group and in 24.4% (n=61) males and 19.2% (n=48) females

from CHD group respectively. HDL-C <40 was seen in 52% (n=65) males and 45.6% (n=57) females from the obese group and 31.6% (n=79) males and 22% (n=55) females from the CHD group. HDL-C <49 was seen in 48.8% (n=61) males and 44.8% (n=56) females from the obese group and 22% (n=55) males and 8.4% (n=42) females from the CHD group respectively. TG>149 was seen in 88.8% (n=111) males and 74.4% (n=93) females from the obese group and in 38% (n=950 males and 28.4% (n=71) females from the CHD group. TC>199 was seen in 45.6% (n=57) males and 39.2% (n=49) females from the obese and 24.8% (n=62) males and 17.2% (n=43) females from the CHD group. These results were in agreement with the findings of Gupta M et al[15] in 2006 and Aziz KU et al[16] in 2012 where a lipid profile similar to the present study was reported by the authors in their respective studies.

It was seen that on gender-wise assessment of lipid profile in the obese and CHD group, LDL-C was 103.5±29.4 and 98.5±27.6 mg/dl in males and females from the obese group which was statistically non-significant with p=0.06 and was 104.6±39.7 and 104.4±35.3 mg/dl in CHD group showing statistical non-significance with p=0.85. HDL-C levels were 55.3±17.1 and 54.9±17.8m/dl in males and females from the obese group and 44.4±11.4 and 46.5±12.3mg/dl in the CHD group which was statistically non-significant in both groups with p=0.81 and 0.08 respectively. Similar results were seen for TG levels in obese and CHD groups with p=0.06 and 0.67 respectively. TC also showed statistical non-significance in males and females from obese and CHD groups with p=0.08 and 0.86 respectively. These findings were in line with de Lemos J et al[17] in 2010 and Sacks FM et al[18] in 2003 where authors reported the results similar to the present study.

On conducting the logistic regression analysis for obese and CHD subjects, a significant correlation was seen in LDL-C levels to obesity and CHD with respective p-values of <0.001 and <0.001. For HDL-C levels, a significant association was seen in obesity and CHD both with p<0.001. A similar significant correlation was seen in triglyceride and obesity and triglyceride and CHD with p<0.001 and <0.001. A significant correlation was also seen in total cholesterol to obesity and CHD with respective p-values of <0.001 and <0.001. These results were comparable to Ballantyne CM et al[19] in 2001 and Bansal S et al[20] in 2007 where a similar association was seen in deranged lipid profile to obesity and CHD as seen in the present study.

CONCLUSIONS

Considering its limitations, the present study showed that Indian subjects are hyperlipidemic with low HDL, and deranged lipid profiles are seen in subjects with comorbidities. The present study also points to deranged lipid profiles in metabolic disorders that can predispose to complications. Further longitudinal studies with larger sample sizes and longer monitoring periods are needed.

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TABLES

Variables	**Controls**	**Obese**	**CHD**	**p-value obese vs controls**	**p-value CHD vs controls**
Number (n)	125	125	250	-	-
Mean age (years)	55.85±10.35	39.4±15.17	59.02±12.5	-	**0.002**
Gender % (n)					
Males	55.2 (69)	53.6 (67)	58 (145)	0.129	0.47
Females	41.6 (52)	45.6 (57)	44.4 (111)		
Family history	1.6 (2)	64 (80)	36 (90)	**<0.0001**	**<0.0001**
Smoking	10.4 (13)	12 (15)	29.2 (73)	**<0.0001**	**<0.0001**
Hypertension	16 (20)	25.6 (32)	60 (150)	**<0.0001**	**<0.0001**
Diabetes	13.6 (17)	32 (40)	64.4 (161)	**<0.0001**	**<0.0001**
Waist hip ratio	0.85±0.08	1.00±0.07	0.85±0.04	**<0.0001**	1
BMI (kg/m2)	21.2±8.9	36.7±6.2	22.2±6.5	**<0.0001**	**<0.0001**

Table 1: Baseline demographic and disease data of study participants

Variables	**Controls**	**Obese**	**CHD**	**p-value CHD vs controls**	**p-value obese vs controls**	**p-value (ANOVA)**
HDL-C/TC	2.5±1.13	5.2±0.95	4.4±0.89	$1.4x10^{-32}$	$3.6x10^{-98}$	**<0.001**
LDL-C (mg/dl)	78.3±15.40	115.9±21.97	104.8±37.92	$1.4x10^{-32}$	$1.1x10^{-22}$	**<0.001**
HDL-C (mg/dl)	80.4±12.73	43.3±4.21	45.3±11.61	$1.04x10^{-69}$	$1.4x10^{-177}$	**<0.001**
TG (mg/dl)	187.5±41.79	265.3±50.36	214.3±74.62	$2.07x10^{-32}$	$1.6x10^{-5}$	**<0.001**

TC (mg/dl)	158.8±33.12	214.6±35.04	208.4±54.09	$2.7x10^{21}$	$2.2x10^{-34}$	**<0.001**

Table 2: Blood lipid levels in control and study subjects

Variables	**Obese (n=125)**		**CHD (n=250)**	
	Males n (%)	**Females n (%)**	**Males n (%)**	**Females n (%)**
LDL-C >99	69 (55.2)	59 (47.2)	61 (24.4)	48 (19.2)
HDL-C <40	65 (52)	57 (45.6)	79 (31.6)	55 (22)
HDL-C <49	61 (48.8)	56 (44.8)	55 (22)	42 (8.4)
TG >149	111 (88.8)	93 (74.4)	95 (38)	71 (28.4)
TC >199	57 (45.6)	49 (39.2)	62 (24.8)	43 (17.2)

Table 3: Gender-wise assessment of subjects in obese and CHD groups with deranged lipid profiles

Variables	**Obese**		**p-value**	**CHD**		**p-value**
	Males	**Females**		**Males**	**Females**	
LDL-C (mg/dl)	103.5±29.4	98.5±27.6	0.06	104.6±39.7	104.4±35.3	0.85
HDL-C (mg/dl)	55.3±17.1	54.9±17.8	0.81	44.4±11.4	46.5±12.3	0.08
TG (mg/dl)	237.4±67.3	226.4±62.7	0.06	213.4±74.4	216.4±73.0	0.67
TC (mg/dl)	199.3±45.3	192.0±43.6	0.08	208.3±54.8	207.5±53.7	0.86

Table 4: Gender-wise assessment of lipid profile in obese and CHD group

Variables	**Obese OR (95% CI)**	**p-value**	**CHD OR (95% CI)**	**p-value**
LDL-C (mg/dl)	1.035 (1.04-1.03)	**<0.001**	2.77 (2.24-3.48)	**<0.001**
HDL-C (mg/dl)	0.812 (0.776-0.855)	**<0.001**	7.05 (5.12-9.73)	**<0.001**
TG (mg/dl)	1.111 (1.07-1.138)	**<0.001**	1.44 (1.17-16.7)	**<0.001**
TC (mg/dl)	1.04 (1.03-1.01)	**<0.001**	2.16 (1.74-2.73)	**<0.001**

Table 5: Logistic regression analysis for obese and CHD subjects