UDC 577.125+612.146 doi: https://doi.org/10.15407/ubj94.04.054

LIPID PARAMETERS IN THE BLOOD OF CORONARY ARTERY DISEASES PATIENTS DEPENDING ON AGE AND DIETARY COMPONENTS: A CASE STUDY

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Received: 19 March 2022; **Revised:** 13 September 2022; **Accepted:** 04 November 2022

Coronary artery disease (CAD) is the major cause of mortality worldwide and is defined as an elevated level of atherogenic cholesterol and low levels of HDL cholesterol. However, very few studies have been conducted in India on the association of blood lipid profile with age and diet. The study aims to estimate lipid parameters in the blood of CAD patients aged 40-70 years on different diets. Lipid parameters were analyzed by enzymatic method on EM-200 fully automated Biochemistry analyzer. The data obtained showed that the majority of patients who suffered from CAD were between the age group of 51-60 years. Patients with CAD had altered lipid profiles, with higher levels of serum TGs, total cholesterol and low levels of HDL. Vegetarians have been found to have reduced lipid risk factors for coronary heart disease compared to patients on a mixed diet.

K e y w o r d s: coronary artery disease, age, cholesterol, triglycerides, HDL, dietary components.

Hyperlipidemia particularly increased LDL concentration (hypercholesterolemia), is one of the major prevalent risk factors for coronary artery diseases. This plays an important role in the evolution of atherosclerosis and consequent vascular disease [1].

Over the period of time, Coronary artery disease (CAD) has become the largest cause of death worldwide. By 2030, World Health Organization predicts that worldwide 14.9% of death in men and 13.1% of deaths in women will be caused by CAD [2].

The World health organization reports that the major proportion of death among old age people especially females are due to CAD. Aging is one of the major non-modifiable risk factors in males at the age of 50-65 years and in females about 10 later following menopaus. [3]. A number of other predisposing factors have been identified for the development of hyperlipidemia which includes increased consumption of dietary animal fat, lack of physical exercise, genetic factors, severe stress, increased age, sex, alcohol, and tobacco consumption, and metabolic consumption like diabetes mellitus and hypothyroidism [4].

Nutritional status is the balance between the intake of nutrients by an organism and the expenditure of energy in the processes of growth, reproduction, and health maintenance [5].

Diet plays an important role both in physiology and pathology. The role of diet in many noncommunicable diseases is well studied and proven, pieces of evidence that show a significant relationship between food patterns and chronic disease. Diet is considered to be another more efficient and effective way the management of CVD [3]. Many western research studies have shown that a vegetarian diet is associated with a lower risk of CHD. A vegetarian diet includes more amounts of nuts, legumes, seafood, whole grains, fruits, and vegetables. Indians consume a vegetarian diet as part of belief or culture rather than considering its beneficial effect on health [6].

Accumulated lipids on the epithelial wall of the site of necrosis are engulfed by macrophages and form foam cells. This cholesterol build-up within the “foam cells” causes subsequent mitochondrial dysfunction, apoptosis, and, ultimately, leading to myocardial tissue necrosis [1]. An abnormal lipid pattern is also one of the predominant causes and

modifiable risk factors. Globally, 56% of coronary heart diseases are due to abnormal cholesterol. Many clinical trials have revealed that the maintenance of healthy cholesterol reduces the risk of CHD [6].

A plethora of studies have identified a major role for the type and amount of dietary fat in determining serum cholesterol, and established a strong correlation between total serum cholesterol, in particular high LDL cholesterol, and coronary heart disease. While high LDL cholesterol, which makes up approximately 70% of total cholesterol, is associated with disease, HDL cholesterol levels are inversely correlated with disease [7]. Dyslipidemia is defined as the elevated level of total cholesterol, LDL, triglycerides, Apo B or Lipoprotein (Lp), and low levels of HDL-cholesterol and apo A. Low levels of HDL-C and elevated triglyceride, both of which are independent predictors of coronary artery disease [8]. Various research work has shown an association between serum total cholesterol and CAD risk but due to a small and non-representative sample with less evidence, its findings cannot be generalized [9]. Further focusing attention on the relation between diet, Aging, and diseases, the present study has planned to identify the dietary pattern and its relation to lipid parameters by using the age factor.

Materials and Methods

A type of interdepartmental case-control study was conducted in the Department of Biochemistry, SBKSMI & RC, and Sumandeep Vidyapeeth, Vadodara, Gujarat. A total of 200 outdoor samples were collected from the Department of Medicine and Cardiology at Dhirja Hospital, SBKSMI & RC, Sumandeep Vidyapeeth, Vadodara, Gujarat, India after getting ethical approval from the Sumandeep Vidyapeeth institutional ethics committee (SVIEC/ON/Medi/BNPG19/D20066) with the duration of 12 months.

Study design. The purposive sampling method was followed by the calculation of the total sample size by using the population mean at a 95% confidence interval with 10 absolute errors. A total of 200 subjects of either sex having an age group of 40-70 years were enrolled for this study and were categorized into the following two groups. After calculation of the sample size, they were divided into 40-50, 51-60, and 61-70 years of age groups.

A total of 100 coronary artery disease (CAD) patients were enrolled in case group after the confirmed diagnosis by the cardiologist and 100 healthy individuals in and around the hospital comprised a control group. Written and verbal consent were taken from all the participants. Participant general information was collected. Each participant's response to dietary assessment and pattern regarding consumption of various food items and beverages were recorded by using an interview session of dietary recall with the help of a pre-constructed questionnaire.

Participant selection. The 100 CAD patients and 100 healthy controls of either sex were willing to participate were enrolled in this study and Subjects with a known case of diabetes mellitus, liver diseases, renal insufficiency, sexually transmitted diseases, pregnant women, and any other known cases of nutritional disorder were excluded from the present study.

Sample collection and processing. A total of 3 ml Blood sample was collected in a plain vial from each and every individual with all the aseptic precautions. Blood samples were centrifuged at 3000 RPM for 15 min to separate serum samples for the analysis of lipid parameters (Total cholesterol, triglyceride, HDL cholesterol).

All the lipid parameters were analyzed by enzymatic method on EM-200 fully automated Biochemistry analyzer at the Central Clinical Laboratory, Dhiraj General Hospital, and Vadodara Gujarat. Low-density lipoprotein (LDL-c) and very-low-density lipoprotein (VLDL) were calculated by using Friedewald's formula (FF), LDL-C = (TC) - (HDL-C) - (TG/5). Lipid parameters were categorized on the basis of age factors, dietary patterns, and dyslipidemic orientations.

We have calculated lipid ratio (Total cholesterol/HDL-C and LDL-C/HDL-C) from lipid parameters. Non HDL cholesterol was also calculated by the subtraction HDL-C from Total cholesterol.

Statistical analysis. All the collected data were prepared in an excel sheet. All the categorical variables were represented in the form of frequency and numerical variables were represented in the form of mean ± SD. All the data were statistically analyzed by using SPSS Version 16. For the categorical data chi-square test was calculated for the test of significance and for numerical data unpaired Student *t*-test was calculated to see the comparison and to find out the test of significance. $P \leq 0.05$ was considered statistically significant.

Results and Discussion

In addition to accidental deaths which occur globally, CVD is the major contributing factor that is responsible for the deaths that occur in the global population among non-communicable diseases. Various diseases come under the category of CVD including CAD. This is one of the major health issues in resource-limited countries like India. A plethora of studies have reported the association of risk factors with cardiovascular diseases. Age is one of the major unmodified risk factors [10]. It is clinically manifested in a male between the age group of 50-65 and females after the onset of menopause. Age is likely to be a risk factor after 10 years. CAD is the main cause of death among people above the age group [11]. All over the world the general trend is an increase in the life span across various populations of the globe due to improvement in health facilities. When there is an increase in the percentage of the geriatric population, CAD will become naturally one of the major causes of death worldwide [12]. A Malaysian study has reported that the prevalence of CAD among males was two times higher than that of females and were much more prone to the development of atherosclerosis [13].

In this study, there was no such significant difference in serum total cholesterol levels between males and females and it was 251.0 ± 5.8 and 250.0 ± 66.8 mg/dl respectively in the age group 40-50. In the 51-60 and 61-70 age groups, higher levels of cholesterol were observed in females compared to males. These levels in the 51-60 age group of females and males were 268.0 ± 43.8 mg/dl and 236.9 ± 54.7 mg/dl respectively and corresponding levels in the 61-70 age group in females and males were 293.0 ± 29.9 and 252.0 ± 52.4 mg/dl. In controls, no such difference was observed.

Based on the results of the present study, it is difficult to draw any conclusions. The sample size of females in different age groups in our study was very small compared to the sample size of males. Contradictory to the results obtained to other parameters, triglycerides, HDL-C. We did not find much significant difference between males and females of different age groups (Table 1). Haque et al. reported the prevalence of atherosclerosis in men and women [13]. According to this study two categories i.e., 30-39 and 60-69 respectively, women in the 60-69 age group showed 8 times higher and men 16 times higher than that of 30-39 age groups.

Dyslipidemia is one of the major risk factors in the development of CAD. Haque et al. reported that 50% of the samples had high total cholesterol levels [14]. In our study, 62% of subjects had higher cholesterol levels almost 12% more than that.

In the 40-50 age group, there was a total of 36 subjects and out of these 20 (55.5%) had high cholesterol levels of more than 240 mg/dl and 7 (19.4%) were on the borderline criteria and only 9 (16.6%) cases had normal cholesterol and likewise in 51-60 age group, there are a total of 35 subjects and out of these 22 (62.8%) had high cholesterol levels and 7 (20%) were on the borderline criteria and only 6 (17.1%) cases have normal cholesterol levels. Whereas, in the age group of 61-70 age had 24 (82.7%) had high cholesterol levels and the age group of 51-60 and 61-70 had more subjects with high levels of cholesterol compared to the 40-50 age group and 3 (10.3%) were on the borderline criteria and only 2 (20.6%) cases had normal cholesterol levels (Table 2). There is a definitive finding to establish that increase in the plasma cholesterol concentration causes an increased risk of CHD and decreasing the plasma cholesterol decreases the risk of CHD. The framing heart study demonstrated the association of elevated plasma cholesterol with CHD. A cholesterol level of 160 mg/dl is known to be beneficial in decreasing the CHD risk even if other risk factors are present [15].

We have observed higher levels of TAG in different age groups. In the 40-50 age group, there was a total of 36 subjects and out of these 22 (61.6%) had high triglycerides levels of more than 200-499 mg/dl, and 10 (30.5%) were on the borderline criteria and the serum cholesterol was 150- 199 mg/dl and only 4 (11.1%) cases had normal triglycerides levels and likewise in 51-60 age group, there are a total of 35 subjects and out of these 25 (71.4%) had high triglycerides levels and 8 (22.8%) were on the borderline criteria and only 2 (5.71%) cases have normal TAG levels. The age group 51-60 has more subjects with high levels of triglycerides compared to the 40-50 age group. Whereas, the age group 61-70 age had only a total of 29 cases in which 18 (62%) had more subjects with high levels of triglycerides and 8 (27.5%) were on the borderline criteria and only 3 (10.3%) cases have normal TAG levels (Table 2).

HDL-C is known to be cardioprotective and there is an inverse relationship between HDL-C levels and cardiovascular risk. HDL enhances reverse cholesterol transport and has many proper-

Table 1. Comparison of lipid parameters with age wise and gender distribution among cases and controls

Age and gender	40-50		51-60		61-70#
	Case (*n* = 36)	Control (*n* = 76)	Case (*n* = 35)	Control (*n* = 23)	Case (*n* = 29)
			Cholesterol (mg/dl)		
Male	251.0 ± 5.8	174.2 ± 31.9	236.9 ± 54.7	157.0 ± 33.5	252.0 ± 52.4
Female	250.0 ± 66.8	172.7 ± 31.9	268.0 ± 43.8	164.1 ± 21.8	293.0 ± 29.9
			Triglyceride (mg/dl)		
Male	222.9± 61.2	131.0 ± 41.3	241.5 ± 63.9	139.0 ± 37.7	200.4 ± 42.8
Female	222.0 ± 63.6	118.0 ± 32.9	224.0 ± 54.2	127.0 ± 39.8	202.0 ± 60.4
			HDL-C (mg/dl)		
Male	37.1 ± 7.4	49.5 ± 9.4	37.2 ± 10.4	45.2 ± 10.5	37.8 ± 4.40
Female	38.1 ± 6.7	47.2 ± 7.2	37.4 ± 7.17	48.5 ± 12.3	35.2 ± 4.02
			LDL-C (mg/dl)		
Male	150.0 ± 55.4	101.3 ± 31.6	157.0 ± 59.4	89.2 ± 33.3	176.0 ± 63.4
Female	171.0 ± 52.4	103.6 ± 33.7	188.6 ± 48.8	93.8 ± 28.9	218.0 ± 28.3

Note. Mean ± SD, $P < 0.05$, # – group 61-70 without control

Table 2. Comparison of serum cholesterol and triglycerides with age groups of study subjects

Age group	Total cholesterol			Triglyceride		
	Normal value (150-200 mg/dl)	Borderline (200-239 mg/dl)	High (>240 mg/dl)	Normal value (150 mg/dl)	Borderline (150-199 mg/dl)	High (200-499 mg/dl)
40-50	9 (16.6%)	7 (19.4%)	20 (55.5%)	4 (11.1%)	10 (30.5%)	22 (61.1%)
51-60	6 (17.1%)	7 (20%)	22 (62.8%)	2 (5.71%)	8 (22.8%)	25 (71.4%)
61-70	2 (20.6%)	3 (10.3%)	24 (82.7%)	3 (10.3%)	8 (27.5%)	18 (62%)
Chi square test (x^2)		10.161			16.196	

Note. $P < 0.05$

ties such as anti-oxidative, anti-inflammatory, anti-thrombotic, and Vaso protective effects [16]. An increase in HDL-C is associated with a decreased risk of CHD. Das and Kumar et al. have reported a significant decrease in HDL-C levels in patients with CHD risks. In the present study, we have observed < 40mg/ dl in the study subjects belonging to 40-70 age groups, whereas in controls it was above > 40 mg/dl in 40-70 age groups. [17] From our results, it is visible that risk was more in study subjects whereas less in the corresponding control subjects. In the 40-50 age group there was a total of 36 subjects and out of these 20 (55.5%) had low HDL-C levels and 16 (44.4%) had normal HDL-C levels in the 51-60 age group. there was a total of 35 subjects and out of these 10 (28.5%) had low HDL-C levels and 10 (28.5%) had normal HDL-C levels and 5 (14.2%) had HDL-C levels. Only the 51-60 age groups had 5 subjects who had more than 40 mg/dl compared to that of 40-50 and 61-70 had 0 subjects. Wherein, the 61-70 age group had only a total of 29 cases in which 15 (15.7%) had low HDL-C levels and 12 (41.3%) had normal HDL-C levels (Table 3).

We have also derived ratios of various lipid parameters based on the values of total Cholesterol, HDL-C, and LDL-C. In the Study subjects TC/HDL-C, LDL-C/HDL-C ratio, and Non-HDL-C were found to be significantly high in the cases compared to controls (Table 4) ($P < 0.0001$). Das and Kumar reported TC/HDL-C, and LDL-C/HDL-C

Table 3. Comparison of serum HDL-C and LDL-C with age groups of study subjects

Age group	HDL-C			LDL-C		
	Low (<40 mg/dl)	Normal (40-59 mg/dl)	High (<60mg/dl)	Normal (100-129 mg/dl)	Borderline (130-159 mg/dl)	High (160-189 mg/dl)
40-50	20 (55.5%)	16 (44.4%)	0 %	8 (22.2%)	13 (36.1%)	15 (41.6%)
51-60	10 (28.5%)	10 (28.5%)	5 (14.2%)	4(11.4 %)	13 (37.1%)	18 (51.4%)
61-70	15 (15.7%)	12 (41.3%)	0 %	2 (41.3%)	3 (44.8%)	24 (82.7%)
Chi square test (x^2)		10.211			15.167	

Note. $P < 0.05$

rations in the subjects of CAD and they found that these ratios were significantly high in the 51-60 age group [16].

The dietary pattern of individuals determines the levels of various biochemical parameters and which in turn extended of risk number of diseases such as diabetes mellitus, CVD, and other metabolic disorders. In this study, we have also compared Lipid parameters with various dietary patterns (i.e., vegetarian and mixed) in Case (n = 100) and control (n = 100) groups. In this study, we observed that there was a highly significant difference between cases and controls ($P < 0.0001$) (Table 5).

Among the mixed diet eaters, there was occasional consumption of non-vegetarian items such as egg, fish, chicken, and muttons. Maximum subjects consumed certain foods on daily basis like chapatti (86), green leafy vegetable (80), dal (50), Milk (30), and other vegetables (27). Food consumed on weekly basis included: Other vegetables (51), Root & Tubers (50), Paratha (35), Chana (32), and Rice (32) Food consumed on monthly basis included fruit and salad (43), Fast food (40), Fish (37), Chicken (34), curd (34). Certain food items like whole Chana/moong (66), Bread (64), fish (63), Egg (55), Curd (55), Chicken (52), and mutton (51), were never consumed by the study subjects in their life.The shift in the consumption of a diet heavily loaded with fast foods, soft drinks, and red meats in developing countries like India and its direct association with increments of cardiovascular risk factors as observed in the current study. Providing special healthy menus like preparing pizza with low calorie, low-fat cheese and high amounts of vegetables are examples of interventions to reduce the rate of harmful effects following fast food intake [17].

Table 4. Comparison of Lipid ratio and Non-HDL-C in cases and controls groups

Parameter	Case	Control
T. Chol/HDL	6.9 ± 1.9	3.7 ± 0.9
LDL/HDL	4.7 ± 1.9	0.6 ± 0.4
Non-HDL-C (mg/dl)	211.7 ± 56.4	122.4 ± 32.8

Note. n = 100, mean ± SD, $P < 0.0001$

Conclusion. In the present study of the developing Indian population, Diet has a significant effect on lipids levels and we found mixed diets were associated with high levels of total cholesterol, triglyceri-

Table 5. Diet-based distribution with lipid parameter in Case and Control groups

Diet	Vegetarian		Mixed	
	Case (n = 55)	Control (n = 57)	Case (n = 45)	Control (n = 43)
Cholesterol (mg/dl)	250.0 ± 56.5	166 ± 28.8	247.0 ± 54.9	173.5 ± 35.3
Triglyceride (mg/dl)	216.2 ± 56.3	119.7 ± 37.7	235.8 ± 64.0	128.3 ± 39.2
HDL-C (mg/dl)	37.4 ± 6.4	49.8 ± 9.6	37.0 ± 9.9	47.7 ± 8.5
LDL-C (mg/dl)	134.5 ± 56.8	94.3 ± 30.9	164.0 ± 60.1	168.2 ±34.9

Note. n = 200, mean ± SD, $P < 0.0001$

des, and other coronary heart disease risk factors compared to vegetarians. In this background, it is concluded that Patients with CAD have altered lipid profiles, with higher levels of TGs, total cholesterol, and low levels of serum HDL; this difference may play a role in the pathophysiology found in Patients with CAD.

Acknowledgement. The authors would like to thank Sumandeep Vidyapeeth research cell and Dhiraj Hospital for providing all the required facility setup for the current research work. The special thanks go to the cardiac care unit (CCU) team of Dhiraj Hospital for their immense support and guidance.

Conflict of interest. Authors have completed the Unified Conflicts of Interest form at http://ukrbiochemjournal.org/wp-content/uploads/2018/12/coi_disclosure.pdf and declare no conflict of interest.

Funding. There is no such financial support and grant for the present study.

ПОКАЗНИКИ ЛІПІДІВ У КРОВІ ХВОРИХ НА ІШЕМІЧНУ ХВОРОБУ СЕРЦЯ ЗАЛЕЖНО ВІД ВІКУ ТА ХАРЧУВАННЯ: A CASE STUDY

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Ішемічна хвороба серця (ІХС), одна з основних причин смертності в усьому світі, характеризується підвищеним рівнем атерогенного холестерину та низьким рівнем холестерину ліпопротеїдів високої щільності (ЛПВЩ). Однак, в Індії проведено дуже мало досліджень щодо залежності ліпідного профілю крові хворих на ІХС від віку та характеру харчування. Метою дослідження було оцінити ліпідні показники в крові хворих на ІХС у віці 40-70 років, які дотримуються різних дієт. Ліпідні показники аналізували ензиматичним методом із використанням автоматизованого біохімічного аналізатора ЕМ-200. Показано, що більшість пацієнтів, які страждали на ІХС, належали до вікової групи 51-60 років. Пацієнти з ІХС мали видозмінені ліпідні профілі, що характеризувалися вищими рівнями сироваткових тригліцеридів, загального холестерину і низькими рівнями ЛПВЩ. Встановлено, що у вегетаріанців ліпідні фактори ризику ішемічної хвороби серця були знижені порівняно з пацієнтами зі змішаною схемою харчування.

Ключові слова: ішемічна хвороба серця, вік, холестерин, тригліцериди, ЛПВЩ, складові харчування.

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