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Lipids, lipoproteins, and apolipoproteins as risk markers of myocardial infarction: A case-control study.

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Abstract:

Aim: The present study outlines the many risk variables of myocardial infarction (MI) in the patient population. Blood lipid profiles were normolipidemic in the study's subjects. Myocardial infarction patients and controls were compared concerning their lipid, lipoprotein, and apolipoprotein profiles. **Materials & methods:** In this study, 84 participants had their blood cholesterol, Apolipoprotein-A, LDL, VLDL, HDL, triacylglycerols, and malondialdehyde studied. Out of the total number of participants, 42 were individuals who had suffered a myocardial infarction (MI). In contrast, the other 42 were controls matched for age and sex. **Results:** Acute myocardial infarction (MI) patients had significantly elevated levels of total cholesterol and triacylglycerols (TAGs) ($p < 0.05$) despite the presence of low-density lipoprotein (LDL) in their blood. A significant difference was seen between the levels of apolipoprotein-A and low-density lipoprotein in the MI group and those in the control group. Researchers found that those who had a rapid heart attack exhibited significantly higher levels of malondialdehyde ($p<0.05$). **Conclusion:** For individuals diagnosed with risk factors, lipid profile monitoring, dietary antioxidant consumption, and measurement of inflammatory markers can all help lower the risk of myocardial infarction (MI). Furthermore, early detection can prevent MI.

Keywords: Myocardial infarction (MI); Low-density lipoproteins (LDL), Very low-density lipoproteins (VLDL), High-density lipoproteins (HDL), apolipoprotein-A; Malondialdehyde (MDA); Normolipidemic profile.

Introduction:

According to projections, coronary artery disease (CAD) is expected to surpass all other causes of sickness and mortality in India by the year 2030 [1]. The rapid increase in the prevalence of coronary artery disease is directly attributable to this occurrence. The number of deaths that may be ascribed to abnormalities in the circulatory system is anticipated to grow by a factor of two between the years 2025 and 2050, as shown by the study that has been conducted up to this point [2-4]. According to the findings of research [5], the risk of death from ischemic heart disease was elevated by forty per cent for Indians who were residing outside of India in comparison to Europeans. It has been shown the CAD is linked to many different factors, such as genetics, obesity, hypertension, stress, smoking, and alcohol use, in addition to environmental and lifestyle factors [6, 7]. A considerable percentage of patients who have been diagnosed with coronary artery disease also have altered lipids, according to the findings of recent comprehensive studies [4–7 in this regard]. As shown by [2,3], Asians have been found to suffer from a diverse range of dyslipidemia manifestations. Patients who have dyslipidemia have a higher risk of experiencing a heart attack [8,9]. This is because dyslipidemia is associated with an increased generation of free radicals and reduced blood flow to the heart muscle, also known as ischemia. Low HDL cholesterol

levels, an abbreviation for high-density lipoprotein, are often seen in patients who have had a myocardial infarction (MI) [10,11]. The quantity of high-density lipoprotein (HDL) in the body is one of the most significant independent variables that protect against atherosclerosis, which is the primary cause of coronary heart disease [10,11]. Following the findings of a study [12], apolipoprotein-A, which is associated with HDL, offers protection against lipid oxidation.

Several clinical trials and cohort studies have shown that low levels of HDL are directly linked to an increased risk of coronary artery disease (CAD) [8–10]. The findings of these investigations have supported these findings. It is well known that low-density lipoprotein cholesterol, often known as LDL cholesterol, is the primary factor that can potentially increase the risk of coronary artery disease [12, 13]. The oxidation of this molecule, which in turn encourages the creation of foam cells, is the first step in developing anterior atherosclerosis. Fatty streaks and complicated fibro-fatty or atheromatous plaques result from the buildup of this material in cells positioned below the endothelium [14]. The antioxidant enzyme system, which includes glutathione peroxidase, superoxide dismutase, catalase, and antioxidant vitamins C, A, and E, amongst other carotenoids, is responsible for reducing LDL oxidation [15]. Three different compounds make up the endogenous antioxidant system. These substances include total bilirubin, uric acid, and albumin. The condition referred to as oxidative stress occurs when this system is out of balance, which may be brought about by either an oversupply of free radicals or a deficit of antioxidants that can neutralize them [15].

Dyslipidemia of the lipid profile, apolipoprotein (a), lipid peroxidation, and lipid profile are additional risk factors associated with coronary artery disease (CAD). This study sought to answer the question, “What are the many risk variables associated with myocardial infarction in individuals with normolipidemic blood lipid profiles?” by examining this population. Patients with a myocardial infarction had normal blood lipid levels; this was done.

Materials & methods:

In all, there were 84 people. During the course of the prospective case-control study, a total of 62 men and 22 females were admitted to the intensive care unit (ICCU) after a diagnosis of myocardial infarction, which necessitated immediate medical intervention. MI was diagnosed based on the following criteria: an elevation of two millimetres in at least two leads of the electrocardiogram (ECG), an increase in blood creatine phosphokinase and aspartate aminotransferase levels, and chest discomfort that lasted for three hours. A total of forty-four healthy participants were matched according to gender and age. Eleven women and sixty-two men made up the study population. Following approval from the project’s institutional ethics committee board, patients and controllers provided their informed permission to participate in the research. Any patient diagnosed with myocardial infarction with a normal lipid profile was eligible to enrol.
No one could participate in the trial if they smoked, had liver illness, diabetes, renal insufficiency, used medicine to decrease cholesterol, or used antioxidant vitamins. A person was considered to be in a normolipidemic state if their total cholesterol (TC) level was less than 200 mg/dl, their high-density lipoprotein (HDL) level was less than 35 mg/dl, their low-density lipoprotein (LDL) level was less than 160 mg/dl, and their total cholesterol (TG) level was less than 150 mg/dl, as stated by the National Committee on End-Stage Hypercholesterolemia (NCEP) and ATP-III

(2001). A patient who had fasted the previous night needed 10 millilitres of blood drawn from them to do a lipid profile. An assay kit purchased from an Indian company was used to test the enzymes TC, TAG, HDL, apolipoprotein-A, and MDA. When calculating LDL-C, the values of TC and HDL-C were utilized as inputs into the formula that is shown below:

$$\text{LDL-C} = \frac{\text{TC} - \text{TG} - \text{HDL-C}}{5}$$

Results:

Table 1 shows the anthropometric measurements of MI patients and control groups. Levels of total cholesterol, total cholesterol/high-density lipoprotein (TC/HDL), and total cholesterol adipose tissue (TAG) were much higher in patients (male and female) compared to controls. Cardiomyopathy (MI) patients had elevated levels of bad cholesterol (LDL) and the ratio of LDL to HDL compared to healthy controls. The role of genetics and lifestyle choices in the development of cardiovascular disease is an issue of contention. Here, we have the present, which comprises the case-control risk factor distribution and the relative risk depending on future risk variables. You can find all of the antioxidant and lipid peroxidation test results here. The patients' levels of antioxidants were much lower than the controls' levels across the board. The patients' mean MDA levels were higher than the controls. It was shown that the levels of Apolipoprotein-A in patients were greater than in the controls. Compared to the controls, the cases exhibited significantly lower levels of high-density lipoprotein (HDL) activity and significantly higher levels of total and low-density lipoprotein (LDL) in their blood.

Figure 1: Gender distribution in the study population.

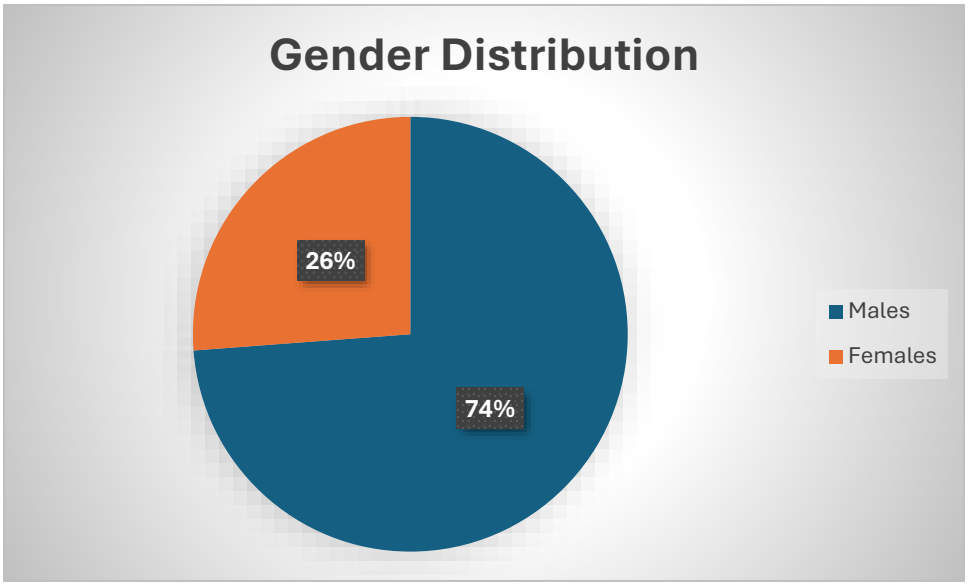

Table 1: Anthropometric data of the MI patients and controls

Parameters	Controls (n=42)	Myocardial Infarction patients (n=42)
Total cholesterol (mg/dl)	179.69 ± 13.27	197.55 ± 14.06

Triacylglycerols (mg/dl)	118.9 ± 14.6	130 ± 17.8
Low-density lipoprotein (mg/dl)	88.9 ± 13.4	120.5 ± 11.2
High-density lipoprotein (mg/dl)	39.93 ± 4.8	34.65 ± 9.4
Body mass index (BMI) ($kg/m^{2)}$	24.1 ± 4.23	27.67 ± 3.92
Apolipoprotein-A (mg/dl)	128.9 ± 23.4	72.8 ± 18.9
Malondialdehyde (nmol/l)	3.8 ± 1.2	6.9 ± 2.4

Discussion:

In both industrialized and developing countries, including India, coronary artery disease is a significant contributor to the patient's level of discomfort [1,2]. Dyslipidemia is one of the risk factors for coronary artery disease that may be reversed with the least amount of effort [3-5]. In the majority of cases, coronary artery disease risk factors are not able to accurately predict the development of myocardial infarction [3,11]. Specifically, this is because South Asian individuals have a wide variety of lifestyles and eating habits, resulting in different risk factors. Taking these findings into consideration, we set out to identify areas of Indians that may pose a threat to the community.

Anthropometric measures of patients who had suffered a myocardial infarction revealed significantly different values for the waist-to-hip ratio and the thickness of the skin folds on the biceps compared to the values obtained from controls. It has been shown that the waist-to-hip ratio is the most significant predictor in determining the likelihood of CAD and mortality associated with CAD in men [16]. When determining CAD, the ratio is a more reliable predictor than the body mass index alone. An evaluation of the possible risk of myocardial infarction may be carried out with the assistance of this very helpful and non-invasive technique.

While the control group had a total cholesterol level of 197.55 ± 14.06 mg/dl, the average total cholesterol level in patients with myocardial infarction was 179.69 ± 13.27 mg/dl. This difference is statistically significant ($p<0.05$). While the HDL level was significantly lower on average ($p<0.05$) in individuals who had experienced myocardial infarction, the control group had a significantly higher HDL level. In the group of patients who had suffered a myocardial infarction, the mean TAG level was 130 mg/dl. In contrast, the control group had a 118.9 mg/dl TAG. The mean LDL level of the patients was substantially greater than that of the control group member, which was 120.5 mg/dl compared to the patients. Patients diagnosed with myocardial infarction (MI) had a significantly elevated triglyceride-to-high-density lipoprotein (TC/HDL) ratio of 5.7 ($p<0.05$) in comparison to the control group, which exhibited a ratio of 4.5. Studies [18–20] that investigated the lipid profiles of patients who had suffered a myocardial infarction found that the patient group fared better than the control group in terms of the ratios of total cholesterol to high-density lipoprotein (HDL), low-density lipoprotein (LDL) to HDL, and TAG to HDL.

Since lipids are an atherogenic component that contributes to the development of myocardial infarction and other coronary disorders, the current research demonstrates that it is essential to monitor lipid ratios even in individuals with normal cholesterol levels. As a routine component, the ratio should be determined in every comprehensive health screening program that includes both sexes. This is something that is recommended. According to a study published in [21], a large

hip circumference concerning one's weight and waist size was a more accurate predictor of a lower risk of coronary artery disease.

Although India has a relatively low obesity incidence, the country's population is at a significant risk of developing cardiovascular disease [21]. In this particular research study, the average body mass index (BMI) of the patients was 27.67, which was significantly higher than the BMI of the group that served as the control. Since lipids constitute an atherogenic factor in the development of coronary artery disease and myocardial infarction, this research emphasizes the need to monitor lipid ratios even in individuals with normal cholesterol levels. Any comprehensive health screening program must include the determination of the ratio as a standard component to be considered complete. There is a possibility that coronary artery disease (CAD) may not always coincide with elevated levels of troponin C. The findings of this study bring to light significant problems and highlight the need to scrutinize a greater number of risk variables to ascertain risk. This is because individuals who have normal levels of total cholesterol nonetheless have the potential to develop coronary artery disease. When compared to individuals who did not have CAD, our findings indicate that patients who had MI had TAG levels that were within the normal range.

Individuals who had suffered from MI showed lower levels of endogenous antioxidants as compared to the group that served as the control. Furthermore, it was observed that the ill group's levels of enzyme antioxidants were much lower than those of the control group.

According to these findings, the hypothesis that individuals who have had a myocardial infarction (MI) have reduced antioxidant levels is supported by the fact that oxidative damage is the contributing factor. According to one theory, the decreased levels of endogenous and enzyme antioxidants in the circulation might be attributed to these antioxidants being used more often to scavenge potentially hazardous lipid peroxides. Individuals who had suffered a myocardial infarction had significantly greater mean levels of MDA in comparison to the group that served as the control. Although one study [22] found that there were no changes in apolipoprotein-A levels in patients with CAD and came to the conclusion that lipoprotein-A is not an independent risk factor in CAD patients, another study [23] discovered that alterations in apolipoprotein-A levels continued to occur in MI patients even after apolipoprotein in the form of CSL112 levels was infused. According to some studies [15, 20, 24, 25], patients who have had a myocardial infarction have higher levels of MDA than healthy individuals. According to the findings of the current research, individuals who had suffered a myocardial infarction exhibited higher levels of MDA and lower levels of apolipoprotein-A activity when compared to the control group. When individuals who have had a myocardial infarction have low levels of apolipoprotein-A, the authors of the current research conclude that this may induce monocytes to create the tissue factor that initiates the process of clotting their blood. Fibrinogen and macrophages are examples of chemotactic factors, respectively.

Additionally, it is their responsibility to go into the intima and adhere to the surface of the endothelium. This is because elevated levels of MDA and fibrinogen bring on the condition. Studies have shown a correlation between lower levels of apolipoprotein-A and cardiovascular issues such as myocardial infarction and sudden cardiac death [23].

Conclusion:

It's conceivable that other indicators, such as a higher risk of repeat cardiac events, should be assessed in addition to the lipid profile. Antioxidants should be consumed in greater quantities through food for those whose risk factors for myocardial infarction have been established. Regular evaluation of inflammatory markers starting in the early forties may be a cost-effective way to identify individuals who need to be monitored to prevent MI.

Conflict of interest:

There is no conflict of interest among the present study authors.

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