ORIGINAL RESEARCH

Comparative Study of Lipid Profiles in Patients with Atherosclerosis and Healthy Individuals

[1]Dr. Sajid Hussain, [2]Dr. Mohd Abdul Lateef Junaid

[1]Associate Professor, Department of Pharmacology, Gold Field Institute of Medical Sciences, Faridabad, Haryana, India
[2]Assistant Professor, Department of Biochemistry, Major S D Singh Medical College & Hospital, Farrukhabad, Uttar Pradesh, India

Corresponding Author
Dr. Mohd Abdul Lateef Junaid
Assistant Professor, Department of Biochemistry, Major S D Singh Medical College & Hospital, Farrukhabad, Uttar Pradesh, India

Received: 22 March, 2014 Accepted: 25 April, 2014

ABSTRACT

Aim: The aim of this study was to compare the lipid profiles of patients diagnosed with atherosclerosis to those of healthy individuals to identify key lipid imbalances associated with cardiovascular risk and to assess their implications for prevention and management. **Material and Methods:** This comparative study included 100 participants, with 50 patients diagnosed with atherosclerosis and 50 age- and gender-matched healthy controls. The atherosclerosis group was diagnosed through coronary angiography, ultrasound imaging, or other established diagnostic methods. Participants were asked to fast for at least 12 hours before blood collection. Serum lipid profiles, including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG), were measured using standard enzymatic methods with an automated biochemistry analyzer. Data were analyzed using Student's t-test, with a p-value of less than 0.05 considered statistically significant. **Results:** The atherosclerosis group had significantly higher total cholesterol (245.7 ± 45.6 mg/dL), LDL-C (160.2 ± 39.4 mg/dL), and triglyceride levels (175.6 ± 42.2 mg/dL) compared to the healthy controls (193.4 ± 27.8 mg/dL, 119.6 ± 22.1 mg/dL, and 115.2 ± 28.5 mg/dL, respectively; $p < 0.001$ for all). The atherosclerosis group also exhibited significantly lower HDL-C levels (38.1 ± 10.4 mg/dL) compared to the healthy controls (56.8 ± 9.6 mg/dL; $p < 0.001$). **Conclusion:** This study demonstrates significant lipid profile differences between atherosclerosis patients and healthy individuals. Atherosclerosis patients had higher total cholesterol, LDL-C, and triglycerides, along with lower HDL-C levels, suggesting that lipid imbalances play a crucial role in the pathogenesis of atherosclerosis. These findings underscore the need for regular lipid monitoring and targeted interventions to manage atherosclerosis and improve cardiovascular health outcomes.

Keywords: Atherosclerosis, Lipid Profiles, LDL-C, HDL-C, Triglycerides, Cardiovascular Risk

INTRODUCTION

Atherosclerosis is a chronic inflammatory condition characterized by the accumulation of lipids and fibrous elements within the arterial walls, leading to the formation of plaques. This condition is one of the leading causes of cardiovascular diseases, including coronary artery disease, stroke, and peripheral artery disease. It is primarily driven by lipid imbalances, particularly elevated low-density lipoprotein cholesterol (LDL-C) levels, and a decrease in high-density lipoprotein cholesterol (HDL-C). As a major cause of morbidity and mortality worldwide, understanding the lipid profile alterations in individuals with atherosclerosis is crucial for both prevention and management.[1]Lipids, including cholesterol and triglycerides, are essential components of cellular structures and are involved in various metabolic processes. However, when present in excess, they can contribute to the development of atherosclerosis by facilitating the formation of plaques within blood vessels. The lipid profile, which typically includes total cholesterol, LDL-C, HDL-C, and triglycerides, provides valuable insights into lipid metabolism and cardiovascular health. In healthy individuals, a balanced lipid profile with low LDL-C and high HDL-C is associated with a reduced risk of atherosclerosis. Conversely, in individuals with atherosclerosis, the lipid profile is often marked by elevated total cholesterol, LDL-C, and triglyceride levels, along with decreased HDL-C.[2]The study of

lipid profiles in patients with atherosclerosis and healthy individuals has garnered significant attention due to its potential to identify early biomarkers of cardiovascular risk. Elevated levels of total cholesterol, especially LDL-C, have long been recognized as a major risk factor for atherosclerosis and subsequent cardiovascular diseases. LDL-C is commonly referred to as "bad cholesterol" because it transports cholesterol from the liver to the peripheral tissues, where it can deposit in the arterial walls. This process leads to the formation of atherosclerotic plaques, which can obstruct blood flow and contribute to the development of ischemic events.[3]On the other hand, HDL-C, known as "good cholesterol," plays a protective role in cardiovascular health by facilitating the reverse cholesterol transport mechanism. It helps to remove excess cholesterol from peripheral tissues and transport it back to the liver for excretion. Low levels of HDL-C are considered a major risk factor for the development of atherosclerosis, as they impair the body's ability to remove cholesterol from arterial walls. As a result, the balance between LDL-C and HDL-C is of paramount importance in determining cardiovascular risk.Triglycerides are another critical component of the lipid profile. Elevated triglyceride levels are often associated with metabolic disturbances, such as obesity, diabetes, and insulin resistance. High triglyceride levels can contribute to the formation of small, dense LDL particles, which are more atherogenic than larger, buoyant LDL particles. These small, dense LDL particles can more easily penetrate the arterial walls and contribute to plaque formation. Elevated triglycerides are also often seen in individuals with low HDL-C levels, further compounding the risk for atherosclerosis.[4]Previous studies have demonstrated significant differences in lipid profiles between individuals with atherosclerosis and healthy individuals. In general, individuals with atherosclerosis exhibit higher levels of total cholesterol, LDL-C, and triglycerides, and lower levels of HDL-C compared to healthy controls. For instance, studies have consistently shown that patients with atherosclerosis have higher LDL-C levels, which correlate with the extent of plaque buildup in the arteries. Furthermore, individuals with atherosclerosis often have lower HDL-C levels, reflecting the impaired ability of the body to clear cholesterol from the arterial walls.The primary aim of this comparative study is to examine the lipid profiles of patients with atherosclerosis and compare them to healthy individuals to identify distinct differences in lipid metabolism. By analyzing the total cholesterol, LDL-C, HDL-C, and triglyceride levels, the study aims to provide further evidence of the lipid imbalances associated with atherosclerosis and to contribute to the understanding of the role of lipid profiles in the progression of cardiovascular diseases.[5]The findings from such studies have significant clinical implications. Early detection of lipid profile abnormalities can help identify individuals at high risk for developing atherosclerosis and related cardiovascular diseases. Additionally, monitoring lipid levels can guide treatment decisions, including the use of statins and other lipid-lowering medications, which have been shown to reduce the progression of atherosclerosis and improve cardiovascular outcomes. By understanding the specific lipid profile alterations that occur in atherosclerosis, healthcare providers can better target interventions to reduce the risk of cardiovascular events.In addition to its clinical relevance, the study of lipid profiles in atherosclerosis patients also has broader public health implications. As cardiovascular diseases remain the leading cause of death globally, identifying modifiable risk factors, such as lipid imbalances, is critical for reducing the overall burden of these diseases. Public health campaigns aimed at improving lipid profiles through dietary modifications, increased physical activity, and pharmacological interventions can help prevent the onset of atherosclerosis and reduce the prevalence of cardiovascular diseases.[6]Given the strong association between lipid profiles and atherosclerosis, this study will focus on comparing the lipid profiles of atherosclerosis patients and healthy controls. By analyzing key lipid parameters—total cholesterol, LDL-C, HDL-C, and triglycerides—this study aims to identify the specific lipid imbalances that are characteristic of atherosclerosis. The results of this study will provide further insights into the pathophysiology of atherosclerosis and may contribute to the development of more targeted interventions for preventing and treating cardiovascular diseases. Furthermore, by comparing the lipid profiles of patients with atherosclerosis to those of healthy individuals, this study will help to establish reference values for lipid levels in different populations and provide a basis for future research on lipid metabolism and cardiovascular health.Understanding the complex relationship between lipid profiles and cardiovascular disease is essential for the prevention, diagnosis, and treatment of atherosclerosis. By conducting a comparative analysis of lipid profiles in patients with atherosclerosis and healthy individuals, this study seeks to enhance our understanding of how lipid imbalances contribute to the development of cardiovascular diseases and to provide valuable information for improving public health outcomes related to atherosclerosis.

MATERIAL AND METHODS

This comparative study was conducted with a total of 100 participants, consisting of 50 patients diagnosed with atherosclerosis and 50 age- and gender-matched healthy controls. The inclusion criteria for the atherosclerosis group involved individuals who had been clinically diagnosed with the condition based on coronary angiography, ultrasound imaging, or other established diagnostic methods. The healthy control

group consisted of individuals who had no history of cardiovascular disease, hypertension, or any lipid metabolism disorders, and their lipid profiles were within the normal range.

All participants provided informed consent, and the study was approved by the institutional ethics review board. Prior to the study, participants were asked to fast for at least 12 hours overnight to ensure accurate lipid profile measurements. Blood samples were collected in the morning after the fasting period using standard venipuncture techniques. Serum was separated by centrifugation and stored at -80°C for later analysis. Lipid profiles, including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG), were measured using standard enzymatic methods. The assays were performed using an automated biochemistry analyzer to ensure consistency and accuracy of the results.

Statistical analysis was performed to compare the lipid profile levels between the two groups. The mean values for each lipid parameter were compared using Student's t-test for normally distributed data, and a p-value of less than 0.05 was considered statistically significant. The results were further analyzed to examine any significant differences in lipid concentrations between the atherosclerosis patients and the healthy controls.

RESULTS

Table 1: Demographic Characteristics of the Study Participants

Table 1 shows the demographic characteristics of the participants in both groups. The atherosclerosis group had an average age of 60.2 ± 10.1 years, while the healthy control group had a similar average age of 59.8 ± 9.7 years. This indicates that the age distribution between the two groups was comparable, ensuring that age did not significantly impact the comparison of lipid profiles. Both groups consisted of 30 males and 20 females, which helps maintain gender balance across both the atherosclerosis and control groups. The average Body Mass Index (BMI) of the atherosclerosis group was 28.5 ± 4.3 kg/m², which is higher than the healthy control group's average BMI of 26.1 ± 3.9 kg/m².

Table 2: Total Cholesterol Levels in Both Groups

In Table 2, total cholesterol levels are compared between the atherosclerosis patients and the healthy control group. The mean total cholesterol level in the atherosclerosis group was 245.7 ± 45.6 mg/dL, which is significantly higher than the healthy control group's mean of 193.4 ± 27.8 mg/dL ($p < 0.001$).

Table 3: LDL-C Levels in Both Groups

Table 3 presents the comparison of low-density lipoprotein cholesterol (LDL-C) levels between the two groups. Atherosclerosis patients exhibited a mean LDL-C of 160.2 ± 39.4 mg/dL, which is significantly higher than the healthy controls' mean of 119.6 ± 22.1 mg/dL ($p < 0.001$).

Table 4: HDL-C Levels in Both Groups

Table 4 compares high-density lipoprotein cholesterol (HDL-C) levels between the two groups. The atherosclerosis group had a mean HDL-C of 38.1 ± 10.4 mg/dL, which is substantially lower than the healthy control group's mean of 56.8 ± 9.6 mg/dL ($p < 0.001$).

Table 5: Triglyceride Levels in Both Groups

Table 5 compares the triglyceride levels between the two groups. Atherosclerosis patients had a mean triglyceride level of 175.6 ± 42.2 mg/dL, significantly higher than the healthy controls' mean of 115.2 ± 28.5 mg/dL ($p < 0.001$).

Table 1: Demographic Characteristics of the Study Participants

Parameter	Atherosclerosis Group (n=50)	Healthy Control Group (n=50)
Age (Years)	60.2 ± 10.1	59.8 ± 9.7
Gender (Male/Female)	30/20	30/20
BMI (kg/m²)	28.5 ± 4.3	26.1 ± 3.9

Table 2: Total Cholesterol Levels in Both Groups

Group	Mean ± SD	p-value
Atherosclerosis Patients	245.7 ± 45.6	<0.001
Healthy Controls	193.4 ± 27.8	

Table 3: LDL-C Levels in Both Groups

Group	Mean ± SD	p-value
Atherosclerosis Patients	160.2 ± 39.4	<0.001
Healthy Controls	119.6 ± 22.1	

Table 4: HDL-C Levels in Both Groups

Group	Mean ± SD	p-value
Atherosclerosis Patients	38.1 ± 10.4	<0.001

Healthy Controls	56.8 ± 9.6	

Table 5: Triglyceride Levels in Both Groups

Group	Mean ± SD	p-value
Atherosclerosis Patients	175.6 ± 42.2	<0.001
Healthy Controls	115.2 ± 28.5	

DISCUSSION

The demographic characteristics of the study participants were well balanced between the atherosclerosis group and the healthy controls, as shown in **Table 1**. The average age of the participants in both groups was nearly identical, with the atherosclerosis group averaging 60.2 ± 10.1 years and the control group averaging 59.8 ± 9.7 years, indicating that age was not a confounding factor in lipid profile comparisons. Additionally, the gender distribution (30 males and 20 females in each group) ensured a balanced comparison between sexes. The Body Mass Index (BMI) of the atherosclerosis group (28.5 ± 4.3 kg/m²) was significantly higher than that of the healthy controls (26.1 ± 3.9 kg/m²), which is consistent with previous studies linking higher BMI to an increased risk of atherosclerosis (Alpert et al., 2012).[7] However, both groups in the current study were within a similar age range, and BMI differences did not appear to substantially affect lipid parameters within each group.

The total cholesterol levels in the atherosclerosis group were significantly higher than those in the healthy control group, with means of 245.7 ± 45.6 mg/dL and 193.4 ± 27.8 mg/dL, respectively ($p < 0.001$), as seen in **Table 2**. These results are consistent with studies showing elevated total cholesterol levels as a key risk factor for the development of atherosclerosis (Castro et al., 2010).[8] For example, a study by Villard et al. (2012) reported that patients with atherosclerosis had total cholesterol levels averaging around 240 mg/dL, similarly indicating a link between high total cholesterol and atherosclerotic disease. These findings underscore the importance of monitoring cholesterol levels in atherosclerosis management and prevention. Elevated cholesterol, particularly total cholesterol, contributes to plaque formation in arterial walls, leading to further cardiovascular complications.[9]

In terms of LDL-C levels, **Table 3** indicates that the atherosclerosis group had significantly higher LDL-C levels (160.2 ± 39.4 mg/dL) compared to the healthy controls (119.6 ± 22.1 mg/dL) ($p < 0.001$). This finding aligns with previous research, which consistently shows that high LDL-C is one of the strongest contributors to atherosclerotic plaque formation (Brouwers et al., 2011).[10] In a study by Mancia et al. (2011), patients with atherosclerosis had LDL-C levels ranging from 150 to 160 mg/dL, further supporting the results of this study. Elevated LDL-C facilitates the accumulation of cholesterol in the arterial walls, promoting the progression of atherosclerosis. The present findings confirm that LDL-C remains a critical target for therapeutic intervention in atherosclerosis management.[11]

The significantly lower HDL-C levels observed in the atherosclerosis group (38.1 ± 10.4 mg/dL) compared to the healthy controls (56.8 ± 9.6 mg/dL) in **Table 4** ($p < 0.001$) is consistent with the well-established role of HDL-C as a protective factor against cardiovascular diseases. Several studies have reported that low HDL-C levels are associated with a higher risk of atherosclerosis and other cardiovascular conditions (Brousseau et al., 2010).[2] For instance, a study by Rader et al. (2012) found that HDL-C levels below 40 mg/dL were common in patients with advanced atherosclerosis, reinforcing the current study's results. HDL-C helps clear excess cholesterol from the bloodstream, and its deficiency is a known risk factor for the development of atherosclerosis.[12]

In **Table 5**, triglyceride levels in the atherosclerosis group were significantly higher (175.6 ± 42.2 mg/dL) than in the healthy controls (115.2 ± 28.5 mg/dL) ($p < 0.001$), which is consistent with previous findings indicating that high triglycerides are associated with increased atherosclerotic risk (Belfort et al., 2009).[13] A study by Nordestgaard et al. (2011) reported that patients with triglyceride levels above 150 mg/dL had an increased risk of cardiovascular diseases, which aligns with the current study's results. Elevated triglycerides contribute to the formation of small, dense LDL particles that are more atherogenic, enhancing the risk of developing atherosclerosis.[14]

CONCLUSION

In conclusion, this comparative study highlights significant differences in lipid profiles between patients with atherosclerosis and healthy individuals. Atherosclerosis patients exhibited elevated levels of total cholesterol, LDL-C, and triglycerides, while showing lower levels of HDL-C, which are characteristic lipid imbalances contributing to cardiovascular risk. These findings underscore the importance of regular lipid profile monitoring in assessing atherosclerotic risk and provide valuable insights for targeted therapeutic interventions. Early detection and management of these lipid abnormalities could significantly reduce the progression of atherosclerosis and improve cardiovascular health outcomes.

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