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UNDERSTANDING THE CORRELATION BETWEEN APOLIPOPROTEIN B AND LDL CHOLESTEROL

Cardiology

Sheetal Kamat Apollo Hospitals, Near Mantri Mall, Sheshadri Puram, Bangalore
Mohd Shahid Department of Cardiology, Moti Lal Nehru Medical College, Prayagraj,
Lalit Kumar Garg Santokba Durlabhji Memorial Hospital, Jaipur
Santosh Revankar* Scientific Services, USV Private Limited. Mumbai *Corresponding Author

ABSTRACT

Background: Elevated levels of apolipoprotein B lipoproteins increase the risk of cardiovascular disease (CVD). This study aimed to understand the correlation between apolipoprotein B and low-density lipoprotein cholesterol (LDL-C). **Methods:** This cross-sectional observational study was conducted among conference attendees including healthcare professionals and pharma professionals. All study participants were requested to provide written informed consent for the collection and analysis of their clinical data, including blood samples for lipid profile check-ups. Data related to age and sex were gathered from the participants, and blood samples were collected immediately after an event. **Results:** A total of 69 participants were included, with a mean age of 44.4 years, and 89.9% were male. The mean levels of apolipoprotein B, high-density lipoprotein cholesterol (HDL-C), and LDL-C were 94.5 mg/dL, 41.3 mg/dL, and 109.4 mg/dL, respectively. The mean apolipoprotein B and LDL-C were significantly higher in participants aged between 36 and 50 years compared to ≤35 years and >50 years (P=0.025 and P=0.005, respectively). The mean LDL-C was significantly higher in participants with apolipoprotein B levels≥130 mg/dL compared to <130 mg/dL (P=0.001). Apolipoprotein B was positively correlated with cholesterol/HDL-C ratio (r=0.784; P<0.001), LDL-C (r=0.914; P<0.001), LDL-C/HDL-C ratio (r=0.779; P<0.001), non-HDL-C (r=0.973; P<0.001) and total cholesterol (r=0.945; P<0.001). **Conclusion:** The association between high apolipoprotein B levels and LDL-C, indicates a potential risk factor for CVD among study participants. This emphasizes the necessity of monitoring and managing apolipoprotein B levels to reduce the risk of CVD in clinical settings

KEYWORDS

Cardiovascular disease, healthcare professionals, apolipoprotein B, lipid profile

INTRODUCTION

Cardiovascular diseases (CVDs) have collectively remained the leading causes of mortality worldwide, significantly contributing to health deterioration and imposing considerable financial burden on healthcare systems [1,2]. According to the American Heart Association, one in three people is expected to experience some type of CVD during their lifetime [3]. Low-density lipoprotein cholesterol (LDL-C), non-high-density lipoprotein cholesterol (non-HDL-C), and apolipoprotein B have all been suggested as markers for assessing the atherogenic damage attributed to apolipoprotein B particles. [4].

Apolipoprotein B serves as a pivotal structural protein constituent across primary atherogenic lipoproteins, serving various functions in lipid metabolism regulation. It is deemed a physiologically significant indicator of the actual number of atherogenic lipid particles [5]. Increased levels of apolipoprotein B are associated with an altered lipid profile [6]. Moreover, altered serum lipid and lipoprotein levels are considered as independent modifiable risk factors for hypertension. These alterations can be addressed through dietary adjustments, medications, and physical activity [7].

Evaluating apolipoprotein B and lipid profile is essential for preventing CVD and for effective clinical management. Treatment and prevention are mostly achieved through pharmacotherapy based on lipid profile and cholesterol management [5]. The lack of routine health checkups elevates the risk of cardiovascular events. Early detection and intervention can significantly contribute to reducing the level of apolipoprotein B and mitigating the risk of CVD. To shed light on this, the present study aimed to understand the correlation between apolipoprotein B and LDL-C.

METHODS

This cross-sectional observational study was conducted among conference attendees including healthcare professionals and pharma professionals. All study participants were requested to provide written informed consent for the collection and analysis of their clinical data, including blood samples for lipid profile check-ups. Data related to age and sex were gathered from the participants, and blood samples were collected immediately after an event.

Definitions

Elevated level of apolipoprotein B defined as ≥130 mg/ dL [8]

An LDL-C value >160 mg/dL has been classified as high, and an optimal value as < 100 mg/dL [9]

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23. Descriptive statistics were used to describe categorical variables and continuous variables in the form of frequency (percentage) and mean (standard deviation [SD]), respectively. Comparison of qualitative data between the two groups was done using an independent sample t-test and 2 Independent sample t-tests depending on the normality distribution. A comparison of qualitative data with more than two groups was done using ANOVA. The variables were correlated with the apolipoprotein B levels using Pearson's correlation analysis. A P value of <0.05 was considered statistically significant.

RESULTS

A total of 69 participants were included, with a mean age of 44.4 years, and 89.9% were male. The mean levels of apolipoprotein B, high-density lipoprotein cholesterol (HDL-C), and LDL-C were 94.5 mg/dL, 41.3 mg/dL, and 109.4 mg/dL, respectively (Table 1). The mean apolipoprotein B level was significantly higher in participants aged between 36 and 50 years compared to ≤35 years and >50 years (101.2 mg/dL vs 94.1 mg/dL vs 82.6 mg/dL; P=0.025). The participants aged ≤35 years had a significantly increased mean cholesterol/HDL-C ratio and platelet counts compared to those aged 36-50 years and >50 years (P=0.031 and P<0.001, respectively). The mean fibrosis index-4 (FIB-4) score was significantly higher in participants aged >50 years compared to 36-50 years and ≤35 years (P<0.001). Participants aged between 36 and 50 years had a significantly higher mean LDL-C level compared to those aged ≤35 years and >50 years (120.4 mg/dL vs 112.5 mg/dL vs 86.2 mg/dL; P=0.005). The mean level of non-HDL-C, serum glutamic pyruvic transaminase (SGPT)/alanine aminotransferase (ALT) and total cholesterol were significantly higher in participants aged between 36 and 50 years compared to ≤35 years and >50 years (P=0.002, P=0.045 and P=0.002, respectively) (Table 2).

Table 1: Demographic Characteristics

Parameter	Number of participants (N=69)
Age (years)	44.4 (12.9)
Gender, n (%) Male Female	 62 (89.9) 7 (10.1)
Apolipoprotein B (mg/dL)	94.5 (23.7)
Cholesterol/HDL-C ratio	4.5 (1.1)
FIB-4 score	1.0 (0.6)

HDL-C (mg/dL)	41.3 (8.3)
HDL-C/ LDL-C ratio	0.5 (0.5)
LDL-C (mg/dL)	109.4 (36.8)
LDL-C/HDL-C ratio	2.5 (1.0)
Non-HDL-C (mg/dL)	141.8 (38.4)
Platelet count (103/mL)	273.6 (61.8)
SGOT/AST (U/L)	30.5 (8.9)
SGPT/ALT (U/L)	32.6 (18.2)
Total cholesterol (mg/dL)	183.1 (40.1)
Triglycerides (mg/dL)	198.0 (126.3)
VLDL-C (mg/dL)	39.6 (25.3)

Data presented as mean (SD), unless otherwise specified.
ALT, alanine aminotransferase; AST, aspartate aminotransferase; FIB, fibrosis; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SD, standard deviation; SGPT, serum glutamic pyruvic transaminase; SGOT, serum glutamic-oxaloacetic transaminase; VLDL-C, very-low-density lipoprotein cholesterol.

The mean level of apolipoprotein B and LDL-C was comparable between both males and females. The mean platelet counts were significantly higher in females compared to males (P=0.02). Male participants had a significantly increased level of mean serum glutamic-oxaloacetic transaminase (SGOT)/aspartate amino-transferase (AST) and SGPT/ALT compared to females (P=0.016 and P=0.004, respectively) (Table 3).

The mean LDL-C was significantly higher in participants with apolipoprotein B level ≥130 mg/dL compared to <130 mg/dL (169.1 mg/dL vs 105.7 mg/dL; P=0.001). The mean cholesterol/HDL-C ratio, LDL-C/HDL-C ratio, non-HDL-C and total cholesterol were significantly higher in participants with apolipoprotein B level ≥130 mg/dL compared to <130 mg/dL (P=0.001, P<0.001, P<0.001 and P=0.001, respectively) (Table 4). Participants with LDL-C ≥160 mg/dL showed high abnormal (≥130 mg/dL) apolipoprotein B levels compared to normal (<130 mg/dL) apolipoprotein B levels (75.0% vs 3.1%) (Table 5).

Apolipoprotein B was positively correlated with cholesterol/HDL-C ratio (r=0.784; P<0.001), LDL-C (r=0.914; P<0.001), LDL-C/HDL-C ratio (r=0.779; P<0.001), non-HDL-C (r=0.973; P<0.001) and total cholesterol (r=0.945; P<0.001) (Figure 1).

DISCUSSION

CVDs are among the leading global causes for concern due to the increasing prevalence and the resulting impact on mortality and disability, accompanied by a substantial economic burden. [10]. Dysfunctions in lipoprotein metabolism account for approximately 50% of the population-attributable risk associated with the development of CVDs [11]. Therefore, early identification and management of modifiable CVD risk factors prove highly effective in preventing disease onset and improving outcomes [12]. This study emphasizes that despite study participants' knowledge about the potential health risks related to lipid profiles, there remains a lack of awareness regarding their own health.

In the present study, the mean age of participants was 44.4 years, and the majority of patients were male. A previous study conducted by Lim Y et al evaluated the relationship between apolipoprotein B and metabolic syndrome in patients with type 2 diabetes mellitus (T2DM). This study included 912 patients with a mean age of 58.4 years, and the majority of patients were male [13]. In the current study, the mean levels of apolipoprotein B, HDL-C, and LDL-C were 94.5 mg/dL, 41.3 mg/dL, and 109.4 mg/dL, respectively. Similar results were observed in a previous study, where the mean values for apolipoprotein B, HDL-C, and LDL-C were 99.5 mg/dL, 45.6 mg/dL, and 109.4 mg/dL, respectively [13].

In the current study, the mean apolipoprotein B and non-HDL-C were significantly higher in the age group of 36 to 50 years. A previous study conducted by Sniderman AD, et al. reported that the mean apolipoprotein B and non-HDL-C was significantly higher in younger individuals than older individuals [4]. In a prior study, the mean HDL-C was significantly greater in the older subjects than the younger ones [4]. Similar results were observed in the present study. A previous study by Sherpa LY, et al. reported that the mean total cholesterol and LDL-C increased significantly with age (P=0.001 and P=0.04, respectively) [14]. In contrast, in the present study, the mean total cholesterol and LDL-C were significantly higher in the participants aged between 36 and 50 years compared to those aged between ≤35 years and >50 years (P=0.002 and P=0.005, respectively).

A study conducted by Feng L, et al. reported that the mean LDL-C and total cholesterol were significantly higher in males compared to females [15]. In contrast, in the present study, the LDL-C and total cholesterol were comparable between male and female participants. In a previous study, the mean HDL-C was significantly lower in males compared to females [15]. On the contrary, in the current study, HDL-C levels were comparable between males and females.

In the present study, the mean LDL-C and total cholesterol were significantly higher in participants with apolipoprotein B levels ≥130 mg/dL compared to those with apolipoprotein B levels <130 mg/dL. The mean HDL-C and triglycerides were comparable between both groups. A previous study done by Dorobantu M et al, where the LDL-C, total cholesterol and triglycerides were significantly higher in participants with apolipoprotein B level ≥130 mg/dL compared to those with apolipoprotein B level <130 mg/dL. The mean HDL-C were significantly lower in participants with apolipoprotein B level ≥130 mg/dL compared to those with apolipoprotein B level <130 mg/dL [16].

Patients with elevated levels of apolipoprotein B presented significantly higher levels of serum lipids (total cholesterol, LDL-C and triglycerides) and significantly lower values of HDL-C [16]. In the present study, participants with LDL-C ≥160 mg/dL showed high abnormal (≥130 mg/dL) apolipoprotein B levels compared to normal (<130 mg/dL) apolipoprotein B levels.

A study done by Lim Y et al, reported that the apolipoprotein B and LDL-C, and the number of metabolic syndrome factors showed a significant positive correlation [13]. Another study done by Dorobantu M et al showed a direct and strong relationship between apolipoprotein B and serum levels of total cholesterol, LDL-C, and triglycerides [16]. Similarly in the present study, a positive correlation was observed between apolipoprotein B and LDL-C, triglycerides, and total cholesterol. This indicates that the level of LDL-C, triglycerides, and total cholesterol increased with increasing the level of apolipoprotein B.

This study has several limitations. The limited sample size might restrict the generalizability of the findings to a wider population. Additionally, being a real-world study, there may be inherent variability and confounding factors that could impact the accuracy of the results. Moreover, further studies are necessary to validate and expand upon the current findings.

CONCLUSION

This study revealed a significant correlation between elevated apolipoprotein B levels and increased LDL-C, suggesting a potential risk factor for CVD among study participants. This underscores the importance of monitoring and managing apolipoprotein B levels in clinical practice to mitigate cardiovascular risk.

Table 2: Comparison Of Laboratory Parameter According To Age Group

Parameter	Age group			P value
	≤35 years (n=18)	36-50 years (n=33)	>50 years (n=18)	
Apolipo-protein B (mg/dL)	94.1 (22.2)	101.2 (20.4)	82.6 (27.3)	0.025a, 0.857b, 0.410c, 0.021d
Cholesterol/ HDL-C ratio	4.8 (1.4)	4.7 (0.9)	4.0 (1.0)	0.031a, 1.000b, 0.079c, 0.046d
FIB-4 score	0.6 (0.1)	0.9 (0.2)	1.7 (0.6)	<0.001a, 0.023b, <0.001c, <0.001d
HDL-C (mg/dL)	39.8 (7.4)	42.5 (8.7)	40.5 (8.7)	0.513a, 0.866b, 1.000c, 1.000d
HDL-C/LDL-C ratio	0.5 (0.2)	0.5 (0.6)	0.6 (0.4)	0.630a, 1.000b, 1.000c, 1.000d
LDL-C (mg/dL)	112.5 (31.9)	120.4 (34.2)	86.2 (36.9)	0.005a, 1.000b, 0.074c, 0.003d
LDL-C/HDL-C ratio	2.6 (1.1)	2.6 (1.0)	2.2 (0.9)	0.239a, 1.000b, 0.511c, 0.335d
Non-HDL-C (mg/dL)	143.1 (34.4)	154.8 (33.2)	116.7 (40.4)	0.002a, 0.794b, 0.088c, 0.002d

Platelet count (103/mL)	306.6 (68.5)	279.5 (47.6)	230.1 (55.5)	<0.001a, 0.304b, <0.001c, 0.011d
SGOT/AST (U/L)	29.7 (8.9)	32.1 (10.0)	28.2 (6.3)	0.309a, 1.000b, 1.000c, 0.422d
SGPT/ALT (U/L)	29.7 (14.2)	38.0 (21.8)	25.4 (10.5)	0.045a, 0.346b, 1.000c, 0.054d
Total cholesterol (mg/dL)	182.9 (32.8)	197.3 (35.7)	157.2 (43.2)	0.002a, 0.575b, 0.124c, 0.001d
Triglycerides (mg/dL)	204.8 (131.5)	216.8 (147.2)	156.8 (57.0)	0.262a, 1.000b, 0.768c, 0.323d
VLDL-C (mg/dL)	41.0 (26.3)	43.4 (29.4)	31.4 (11.4)	0.262a, 1.000b, 0.768c, 0.323d

Data presented as mean (SD).
a overall; b comparison between group 1 and 2; c comparison between group 1 and 3; d comparison between group 2 and 3.
ALT, alanine aminotransferase; AST, aspartate aminotransferase; FIB, fibrosis; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SD, standard deviation; SGPT, serum glutamic pyruvic transaminase; SGOT, serum glutamic-oxaloacetic transaminase; VLDL-C, very-low-density lipoprotein cholesterol.

Table 3: Comparison Of Laboratory Parameter According To Gender

Parameters	Gender		P value
	Male (n=62)	Female (n=7)	
Apolipoprotein B (mg/dL)	95.2 (23.8)	88.1 (23.6)	0.458
Cholesterol/HDL-C ratio	4.6 (1.1)	4.2 (0.9)	0.342
FIB-4 score	1.0 (0.6)	0.8 (0.3)	0.223
HDL-C (mg/dL)	41.1 (8.5)	42.3 (7.4)	0.734
HDL-C/LDL-C ratio	0.5 (0.5)	0.5 (0.2)	0.715
LDL-C (mg/dL)	110.3 (36.8)	101.2 (38.1)	0.536
LDL-C/HDL-C ratio	2.5 (1.0)	2.4 (0.9)	0.783
Non-HDL-C (mg/dL)	143.0 (38.6)	131.3 (37.2)	0.447
Platelet count (103/mL)	265.9 (59.3)	342.0 (38.0)	0.02
SGOT/AST (U/L)	31.2 (8.6)	23.7 (9.1)	0.016
SGPT/ALT (U/L)	34.2 (17.6)	17.9 (17.9)	0.004
Total cholesterol (mg/dL)	184.2 (40.4)	173.6 (38.8)	0.512
Triglycerides (mg/dL)	203.4 (129.7)	150.4 (82.5)	0.207
VLDL-C (mg/dL)	40.7 (25.9)	30.1 (16.5)	0.207

Data presented as mean (SD).
ALT, alanine aminotransferase; AST, aspartate aminotransferase; FIB, fibrosis; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SD, standard deviation; SGPT, serum glutamic pyruvic transaminase; SGOT, serum glutamic-oxaloacetic transaminase; VLDL-C, very-low-density lipoprotein cholesterol.

Table 4: Comparison Of Laboratory Parameter According To Apolipoprotein B Groups

Parameters	Apolipoprotein B		P value
	<130 mg/dL (n=65)	≥130 mg/dL (n=4)	
Cholesterol/HDL-C ratio	4.4 (1.1)	6.3 (0.7)	0.001
FIB-4 score	1.0 (0.6)	0.6 (0.1)	0.299
HDL-C (mg/dL)	41.4 (8.5)	39.8 (4.0)	0.711
HDL-C/LDL-C ratio	0.5 (0.5)	0.2 (0)	0.207
LDL-C (mg/dL)	105.7 (34.5)	169.1 (12.7)	0.001
LDL-C/HDL-C ratio	2.4 (0.9)	4.3 (0.8)	<0.001
Non-HDL-C (mg/dL)	137.8 (35.6)	207.8 (14.4)	<0.001
Platelet count (103/mL)	272.7 (63.0)	289.5 (36.7)	0.600
SGOT/AST (U/L)	30.4 (8.9)	32.2 (10.0)	0.682
SGPT/ALT (U/L)	32.0 (18.4)	40.8 (15.3)	0.358
Total cholesterol (mg/dL)	179.1 (37.7)	247.5 (14.6)	0.001
Triglycerides (mg/dL)	198.3 (129.6)	193.3 (57.1)	0.939
VLDL-C (mg/dL)	39.7 (25.9)	38.7 (11.4)	0.939

Data presented as mean (SD).
ALT, alanine aminotransferase; AST, aspartate aminotransferase; FIB, fibrosis; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SD, standard deviation; SGPT, serum glutamic pyruvic transaminase; SGOT, serum glutamic-oxaloacetic transaminase; VLDL-C, very-low-density lipoprotein cholesterol.

Table 5: Comparison Of Apolipoprotein B With Ldl Cholesterol

Parameter	Apolipoprotein B	
LDL-C	<130 mg/dL (N=65)	≥130 mg/dL (N=4)
<100	27 (41.5)	0
≥100 to <160	36 (55.4)	1 (25.0)
≥160	2 (3.1)	3 (75.0)

Data presented as n (%).
LDL-C, low-density lipoprotein cholesterol.

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Conflict of Interest: SR is an employee of USV Private Limited. All other authors have no conflict of interest to declare.

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