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CORRELATION OF LOW HDL AND HIGH LDL-C LEVELS WITH SEVERITY OF CORONARY ARTERY DISEASE ON CORONARY ANGIOGRAM

Sher Wali Khan[1], Ayesha Fayyaz [2], Ikram Ullah[3*], Usman Ahmad[4], Maheen Sheikh[5], Syed Muhammad Nayab Ali[6]

[1]Postgraduate Resident Adult Cardiology, Lady Reading Hospital and Medical Teaching Institute, Peshawar, Pakistan
[2]Cardiology, Lady Reading Hospital and Medical Teaching Institute, Peshawar, Pakistan
[3*]Assistant Professor, Cardiology, Lady Reading Hospital and Medical Teaching Institute, Peshawar, Pakistan
[4,5]Sheikh Mohamed Bin Zayed Al-Nahyan Institute of Cardiology, Quetta, Pakistan
[6]Medical Officer, Postgraduate Resident Adult Cardiology, Lady Reading Hospital and Medical Teaching Institute, Peshawar, Pakistan

***Correspondence to:** Dr. Ikram Ullah
*Email: ikramcardio@yahoo.com

Abstract

Background

Coronary artery disease (CAD) is the most common cause of death worldwide. CAD pathophysiology and development are strongly linked to lipid profile, especially HDL and LDL-C.

Objective

To study the effect of low HDL and high LDL-C levels on coronary artery disease severity in coronary angiography patients

Material and Methods

A descriptive comparative study with 300 coronary artery patients was planned, dividing samples into Group A (low HDL and high LDL-C) and Group B (normal HDL and LDL-C). The Gensini score evaluated coronary lesion severity based on luminal narrowing and location.

Results

Group A had a considerably higher mean Gensini score ($p < 0.05$) than Group B. 97 patients (64.6%) in Group A had severe CAD (Gensini score >20), compared to 51 (34%) in Group B, 34 patients (22.7%) in Group A and 60 patients (40%) in Group B had moderate CAD (Gensini score 11-20). Mild CAD (Gensini score ≤10) was seen in 19 patients (12.7%) in Group A and 39 patients (26%) in Group B, reporting a significant difference between groups ($p<0.01$). The correlation test found that the severity of CAD is significantly associated with diabetes and hypertension. Regression analysis found a positive association between severe CAD and LDL-C levels ($P<0.05$).

Conclusion

The study found a strong association between low HDL and high LDL-C levels and coronary angiography severity. CAD was more common and severe in patients with low HDL and high LDL-C. The severity of CAD was found to be associated with diabetes and hypertension.

Keywords: cardiovascular risk, dyslipidemia, genuine score, coronary angiography, LDL-C, HDL, coronary artery disease

Highlight box (no more than 250 words)

Key findings

Low levels of HDL and high levels of LDL-C are significantly associated with severity of CAD

Diabetes and Hypertension are significant cofounders of severity of CAD

What is known and what is new?

Dyslipidemia is found to be associated with the increasing cases of CAD

This study supports the existing literature that lipid profile is an important marker resulting in severe CAD cases.

What is the implication, and what should change now?

Lipid profile of CAD patient should be kept in focus while the follow up of CAD patients

1. Introduction

1.1 Background

Coronary artery disease (CAD) is caused by the narrowing or plaque accumulation in the arteries supplying the heart. This plaque is mainly composed of cholesterol deposits. Heart failure, angina, heart attacks, and other major cardiovascular problems can result from this narrowing or blockage, which lowers the supply of oxygen-rich blood to the heart muscle [1]. The complex pathophysiology of coronary artery disease (CAD) encompasses several risk factors, one of which is dyslipidemia. Specifically, the levels of High-Density Lipoprotein (HDL) and Low-Density Lipoprotein (LDL-C) are of paramount importance in this context [2]. High-density lipoprotein (HDL) is recognised for its cardio-protective characteristics, principally ascribed to its involvement in reverse cholesterol transfer. Conversely, low-density lipoprotein (LDL-C) leads to the development of atherosclerosis by collecting inside the walls of arteries. Literature suggests a significant association between low high-density lipoprotein (HDL) levels and an elevated risk of coronary events. This association is valid even in patients with well-managed low-density lipoprotein (LDL-C) levels [3,4].

On the other hand, elevated levels of low-density lipoprotein (LDL-C) have been well-recognised as a significant risk factor in the pathogenesis of coronary artery disease (CAD), contributing to a gradual and intricate atherosclerotic progression [5]. Nevertheless, the comprehensive investigation of the combined effect of simultaneous low HDL and high LDL-C levels on coronary artery disease (CAD) severity, as shown by coronary angiograms, still needs to be examined [6]. Coronary angiography continues to be widely regarded as the preferred method for anatomically evaluating coronary artery stenosis since it offers a thorough assessment of the magnitude and severity of coronary artery disease (CAD) [7]. Using the Gensini score, a metric that measures the extent of luminal constriction while considering the precise location of lesions, this imaging technique provides a helpful means of establishing a correlation between lipid profiles and the severity of coronary artery disease (CAD) [8].

1.2 Rationale and Knowledge Gap

The interaction between lipid profiles and the structural severity of coronary artery disease (CAD) is of utmost importance in comprehending the underlying pathophysiology of the disease and has

substantial implications for treatment interventions. Tailoring lipid-lowering treatments by the combined evaluation of HDL and LDL-C levels can enhance the precision and efficacy of coronary artery disease (CAD) therapy [9]. The primary objective of this investigation is to provide a comprehensive understanding of the correlation between decreased levels of high-density lipoprotein (HDL) and increased levels of low-density lipoprotein (LDL-C) with the severity of coronary artery disease (CAD). By doing so, this study aims to provide valuable knowledge on improved methods for assessing risk and implementing treatment strategies for individuals with dyslipidemia.

1.3 Objective

The primary objective of this investigation is to provide a comprehensive understanding of the correlation between decreased levels of high-density lipoprotein (HDL) and increased levels of low-density lipoprotein (LDL-C) with the severity of coronary artery disease (CAD).

2. Methods

The current study is a descriptive comparative analysis done at Lady Reading Hospital, Peshawar, over 09 months from January 2023 to September 2023. The sample size of this study consisted of 300 patients with coronary artery disease (CAD) on coronary angiography who were classified into two groups: Group A (low HDL and high LDL-C levels) (n= 150). Low levels of high-density lipoprotein (HDL) were defined as below 40 mg/dL, while high levels of low-density lipoprotein (LDL-C) were defined as over 130 mg/dL. Group B (normal HDL and LDL-C levels) (n=150), where the normal HDL value was more than 40 mg/dL for males and 50 mg/dL for females. In the case of LDL-C, it was less than 100 mg/dL [10]. The Gensini score was used to evaluate the severity of coronary artery disease (CAD), measuring the extent of luminal narrowing and the specific location of the lesions. As measured by the Gensini score, the severity of CAD distinguished the groups as severe CAD (Gensini score >20), score 11-20 as moderate CAD and mild when the score was ten or below. Male and female patients aged more than 18 years who had coronary angiography for diagnosing CAD were included. Patients who already had coronary artery bypass surgery, percutaneous coronary intervention, recent acute myocardial infarction or individuals suffering from concurrent severe conditions such as cancer or chronic renal disease, as well as patients who had used lipid-altering medicines within the last six months, were excluded from the research.

The demographic data, including age, sex, weight, height, smoking status, medical history, lipid profile data (HDL and LDL-C cholesterol), and concurrent conditions (hypertension, diabetes, and cardiovascular disease history), were collected from each sample. The Complete lipid profile panel test was performed within a week of angiography.

The Gensini ratings, which quantify coronary artery disease severity, were examined in coronary angiography reports. The data were anonymised and managed according to patient confidentiality policies and institutional ethical requirements to protect patient privacy during the study. Ethical approval was obtained from IRB Lady Reading Hospital (1024/LRH/MTI). Data was analysed using SPSS 25.0. Continuous data was presented as mean ± SD, whereas categorical variables were presented as frequency (n) and percentages. The Pearson correlation test and multiple logistic regression test were performed to find the correlation of the severity of CAD with other variables.

3. Results

The study included 300 patients, where 178 (59.3%) of the samples were male and 122 (40.7%) were females. The patient's mean age was 62.3 ± 10.7 years, with Group A (low HDL and high LDL-C) somewhat older at 63.5 ±11.2 years compared to 60.8 ± 9.9 years in Group B (normal lipid levels). Group A had a higher prevalence of Hypertension 100 (66.7%) than Group B 60 (57.3%). Similarly, Group A had a higher percentage of patients with diabetes, 68 (45.2%), than Group B, 59 (39.3%). Current smokers were likewise more prevalent in Group A 70 (33.3%) than in Group B 30 (21.4%). Data is represented in Table 1. The gender-based distribution of diabetes and hypertension is demonstrated in Figures 1 and 2. According to this study, 67 (22.3%) males and 80 (26.7%) females were diabetic, whereas 103(34.3%) males and 83 (27.7%) females were hypertensive.

The severity of CAD, as measured by the Gensini score, distinguished the groups clearly. Severe CAD (Gensini score >20) was much more prevalent in Group A, affecting 97 (64.6%) of its participants and 51 (34%) of Group B. Moderate CAD (Gensini score 11-20) was found more prevalent in Group B 60 (40%), than Group A 34 (22.7%). Mild CAD (Gensini score 10) was more common in Group B 39 (6%) than in Group A 19 (12.7%); the correlation test revealed a significant difference in CAD severity within both groups ($p<0.01$), as shown in Table 2.

Further, the analysis was done to find the association of the severity of CAD with co-morbidities, and results revealed a significant association between diabetes, hypertension and severity of CAD, as demonstrated in Tables 3 and 4. Further, the multiple logistic regression analysis was done while keeping mild CAD as the reference category. The study showed a significant positive association between diabetes and moderate and severe CAD and a positive association of LDL-C with severe CAD (Table 5).

TABLES

Table 1: Demographic and Clinical Characteristics of the Study Population

Variable	Total Patients (n=300)	Group A (n=150) (Low HDL and High LDL-C)	Group B (n=150) (Normal HDL and LDL-C)
Age (years)			
Mean ± SD	62.3 ± 10.7	63.5 ± 11.2	60.8 ± 9.9
Gender			
Male (%)	178 (59.3%)	92 (62%)	86 (57.3%)
Female (%)	122 (40.7%)	58 (38%)	64 (42.7%)
Co-morbidities			
Hypertension (%)	186 (62%)	100 (66.7%)	86 (57.3%)
Diabetes Mellitus (%)	127 (38%)	68 (45.2%)	59 (39.3%)
Smoking Status (%)			
Current Smoker	82 (27.3%)	50 (33.3%)	32 (21.4%)
Non-Smoker	218 (72.7%)	100 (66.7%)	118 (78.6%)

Table 2: The correlation of severity of CAD with LDL-C and HDL levels as divided in Group A and B

Group	Severity of CAD			Total	P-value
	mild	moderate	severe		
A	19	34	97	150	0.00
B	39	60	51	150	
Total	58	94	148	300	

Table 3: The correlation of severity of CAD with Diabetes

Diabetes	Severity of CAD			Total	p-value
	mild	moderate	severe		
yes	15	43	89	147	0.00
no	43	51	59	153	
Total	58	94	148	300	

Table 4: The correlation of severity of CAD with hypertension

Hypertension	Severity of CAD			Total	p-value
	mild	moderate	severe		
yes	29	55	102	186	0.00
no	29	39	46	114	
Total	58	94	148	300	

Table 5: Multiple logistic regression analysis to find the association of the severity of CAD with other variables

Severity of CAD		B	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
Moderate	Intercept	3.205	.039			
	Gender	-.885	.032	.413	.184	.929
	Hypertension	-.247	.522	.781	.367	1.664
	Diabetes	.981	**.014**	.375	.172	.819
	Smokers	.267	.528	1.306	.569	2.997
	hdl	.000	.996	1.000	.943	1.060
	LDL-C	.000	.972	1.000	.992	1.008
Severe	Intercept	3.040	.039			
	Gender	-.240	.540	.787	.365	1.694
	Hypertension	-.478	.188	.620	.304	1.263
	Diabetes	1.317	**.000**	.268	.129	.555
	Smokers	.285	.493	1.330	.589	3.006
	HDL	**-.021**	.462	.980	.927	1.035
	LDL-C	**.009**	**.012**	1.009	1.002	1.017
The reference category is mild.						

FIGURE 1. The Distribution of hypertension among CAD patients based on gender

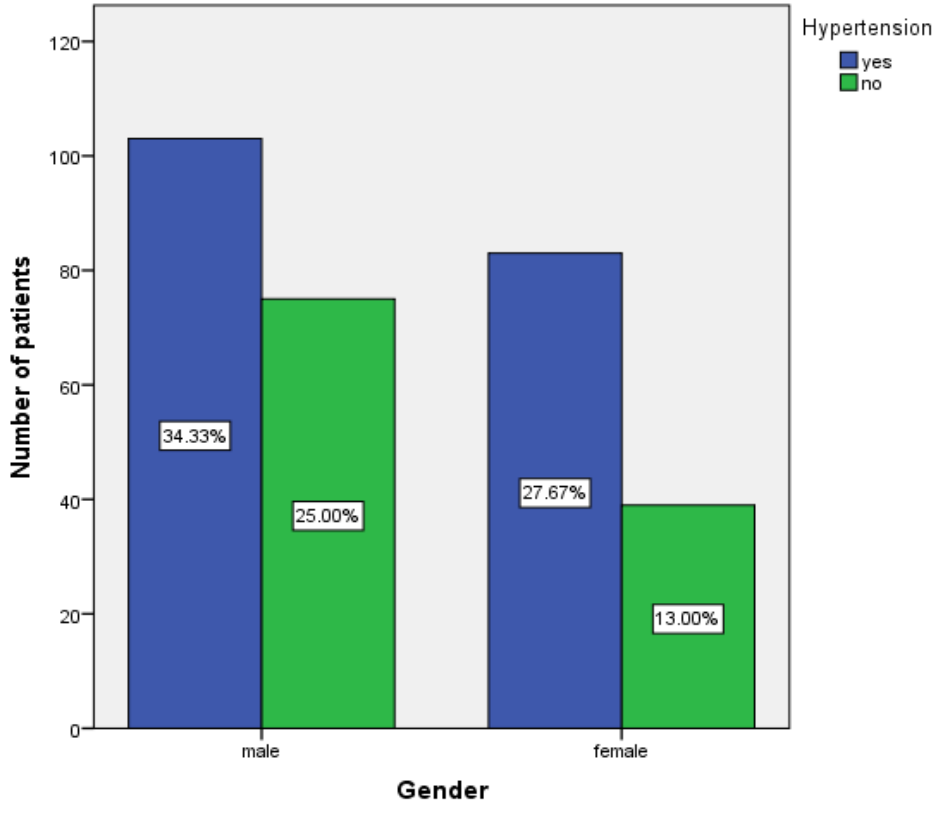
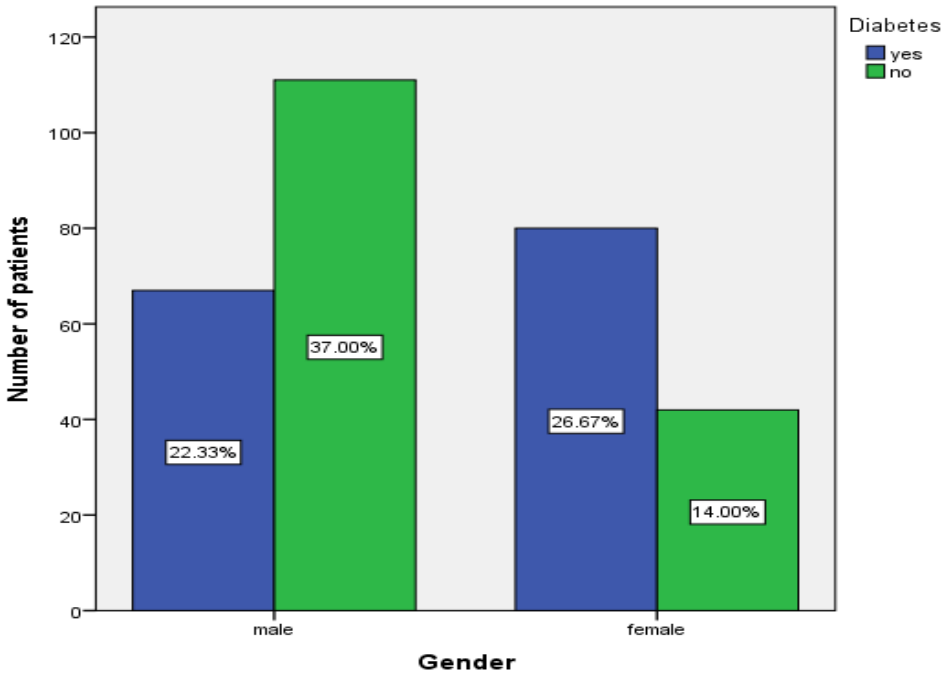


FIGURE 2. The Distribution of diabetes among CAD patients based on gender



4. Discussion

4.1 Key findings

The findings of this research provide evidence of a significant correlation between reduced levels of high-density lipoprotein (HDL) and elevated levels of low-density lipoprotein (LDL-C) and the extent of coronary artery disease (CAD). This finding aligns with prior research, exemplified by the Framingham Heart Study, that has shown a robust association between low levels of high-density lipoprotein (HDL) and the risk of coronary artery disease (CAD) and cardiovascular events [11]. The research's findings indicate a comparable occurrence of low HDL levels (45.2%) to that seen in other investigations, including the INTERHEART study [12]. The elevated event of hypertension and diabetes mellitus in Group A (characterised by low HDL and high LDL-C) in comparison to Group B (with normal lipid levels) is in line with prior research findings that have established these disorders as risk factors for coronary artery disease (CAD) [13,14]. The elevated prevalence of individuals who currently smoke within Group A is consistent with other studies that have shown smoking as a significant risk factor for coronary artery disease (CAD) [15]. Previous studies have also shown evidence for the association between elevated levels of low-density lipoprotein (LDL-C) cholesterol (>160 mg/dL) and Group A, as well as the severity of coronary artery disease (CAD). According to the findings of the INTERHEART trial, there was a significant correlation between elevated levels of low-density lipoprotein (LDL-C) and a 2.5-fold greater possibility of developing coronary artery disease (CAD) [16]. The research conducted by Prospective Cardiovascular Münster (PROCAM) showed a significant association between elevated levels of low-density lipoprotein (LDL-C) and the occurrence of coronary artery disease (CAD) [17]. The observed frequency of normal LDL-C levels (<100mg/dL) in Group B is in keeping with other research findings, which have shown an increased risk of borderline LDL-C levels (100-130mg/dL) among individuals with normal lipid levels [16]. The observed increased frequency of ideal LDL-C levels (<100 mg/dL) in Group B is consistent with other studies that have shown a correlation between normal lipid levels and optimal LDL-C levels [18].

The Gensini score was used to evaluate the severity of coronary artery disease (CAD) in the study participants. The results indicated a distinct difference between the two groups, with Group A having a higher incidence of severe CAD (Gensini score >20) and Group B showing a greater prevalence of mild CAD (Gensini score ≤10). This finding aligns with other research, which has shown a correlation between decreased levels of high-density lipoprotein (HDL) and increased levels of low-density

lipoprotein (LDL-C) and the presence of more advanced coronary artery disease (CAD) [19,20]. The multivariate logistic regression study revealed that low HDL significantly predicted severe CAD, with an odds ratio (OR) of 2.56. This finding aligns with other research, which has shown that reduced levels of high-density lipoprotein (HDL) are a significant and autonomous determinant of coronary artery disease (CAD) [21,22]. Elevated levels of low-density lipoprotein (LDL-C) were shown to be an essential risk factor (odds ratio [OR] = 1.89), consistent with other studies that have demonstrated a positive correlation between high LDL-C levels and the likelihood of developing coronary artery disease (CAD) [23,24]. The correlation between age and diabetes mellitus and the heightened probability of severe coronary artery disease (CAD) aligns with other research that has recognised these parameters as risk factors for CAD [25,26]. Still, it is noteworthy that the absence of statistically significant correlations between gender, hypertension, and smoking status with the presence of severe coronary artery disease (CAD) in this particular group of individuals is unexpected and might perhaps be attributed to the limited size of the sample used in this research.

Overall results showed a substantial correlation between dyslipidemia, especially low HDL and high LDL-C values, and coronary artery disease severity. The results are similar across demographic and clinical characteristics, supporting the idea that cholesterol control should be a focus in CAD prevention and therapy. The significant difference in Gensini score severity across groups suggests these lipid measures may be CAD risk markers. These findings may help physicians stratify risk and adjust CAD therapy.

4.2 Limitations

The primary limitation of the research is its design, which naturally hinders the establishment of causation. Pre-existing medical data also presents the potential for information bias in correctly documenting patients' lifestyle characteristics and adherence to medicine.

5. Conclusions

This research found a strong link between dyslipidemia (low HDL and high LDL-C) and CAD severity. The Gensini score showed that individuals with imbalanced lipid profiles have a significantly higher risk of severe CAD. Current studies also found diabetes and hypertension as strong cofounders, and further research can be done to find its association with CAD. These findings emphasise the need for complete lipid management in clinical assessments to better stratify cardiovascular risk and adapt treatment therapies, mainly focusing on HDL and LDL-C-C maintenance.

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Ethical Statement: Consent was obtained or waived by all participants in this study. Lady Reading Hospital medical teaching institution IRB issued approval 1024/LRH/MTI. This is to certify that Ethical Approval is granted to Dr Ikram Ullah, Assistant Professor, Department of Cardiology LRH-MTI Peshawar, to conduct a study on the project "CORRELATION OF LOW HDL AND HIGH LDL-C LEVELS WITH SEVERITY OF CORONARY ARTERY DISEASE ON CORONARY ANGIOGRAM".

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