IRABCS
www.irabcs.com
INNOVATIVE RESEARCH IN APPLIED, BIOLOGICAL AND CHEMICAL SCIENCES

*Research Article*

IRABCS, vol. 1, issue 1, pp. 44-48, 2023
Received: May 15, 2023
Revised: June 2, 2023
Accepted: June 20, 2023

# Association between high-density lipoprotein (HDL) levels and severity of coronary artery disease on angiography

Muhammad Muttahir[1], Sasha Vereecken BScN RN[2], Bibi Zahida Kazmi[3], Muhammad Afnan[4]

1. *MBBS, Medicine and Surgery, Khyber Medical College, Peshawar, Pakistan*
2. *MD Candidate, Department of Clinical Science, Saint James School of Medicine, Anguilla*
3. *MBBS, Medicine and Surgery, Khyber Medical University Institute of Medical Sciences, Kohat, Pakistan*
4. *MBBS, Medicine and Surgery, Khyber Medical University Institute of Medical Sciences, Kohat, Pakistan*
5. *E-mail any correspondence to: Muhammad Afnan (afnankhan2035@gmail.com)*

***How to cite:*** Muhammad Muttahir, Sasha Vereecken BScN RN, Bibi Zahida Kazmi, Muhammad Afnan. Association between high-density lipoprotein (HDL) levels and severity of coronary artery disease on angiography. Innovative Research in Applied, Biological and Chemical Sciences (IRABCS). 2023, vol. 1, issue 1, pp. 44-48.

## Abstract

**Background:** This retrospective observational study's goal was to evaluate if high-density lipoprotein (HDL) levels correlate with the degree of coronary artery disease (CAD), as assessed by angiography.
**Methodology:** The research comprised 160 individuals who had coronary angiography. Data on the demographics of the patients, as well as their medical information, HDL levels, and angiographic findings were collected using a standardized proforma. The severity of CAD was assessed using the SYNTAX score. Statistical analysis, including independent "t-tests, chi-square tests, and correlation analysis, was performed using SPSS".
**Results:** The results revealed a significant association between HDL levels and CAD severity. When comparison was done to patients with mild-to-moderate CAD, the ones with severe CAD had considerably lower mean HDL values ($p \leq 0.001$). Even after accounting for any confounding variables, there was still a substantial correlation between HDL levels and the severity of CAD. Furthermore, significant associations were found between HDL levels and gender, hypertension, and diabetes, indicating a potential interplay between these factors and HDL in CAD development.
**Conclusion:** This study provides evidence for the association between lower HDL levels and increased CAD severity. Maintaining optimal HDL levels may have clinical implications for risk stratification and management of CAD. Gender-specific differences and associations with comorbidities such as hypertension and diabetes highlight the need for tailored approaches in CAD prevention and treatment. Prospective research with bigger and more varied populations is necessary to confirm these results and investigate the underlying causes.

**Keywords:** high-density lipoprotein, coronary artery disease, angiography, hypertension, diabetes, risk stratification

## Introduction

Coronary artery disease (CAD) remains a major global health concern, accounting for a substantial burden of morbidity and mortality.[1] It is characterized by the progressive narrowing of coronary arteries due to the accumulation of atherosclerotic plaques, leading to reduced blood flow to the heart. Assessing the severity of CAD is crucial for determining the optimal management strategies and predicting patient outcomes.[2] Identifying factors that are associated with the severity of CAD is crucial for risk assessment, prognosis, and treatment strategies. High-density lipoprotein (HDL) cholesterol, sometimes known as "good cholesterol," is one such factor of importance. Reverse cholesterol transport includes removing extra cholesterol from peripheral tissues, such as artery walls, and transferring it directly into the liver for elimination.[3] HDL plays a crucial part in this process.

Numerous risk factors have been thoroughly investigated for their relationship to CAD, including smoking, hypertension, diabetes, and dyslipidemia. Among these factors, HDL has attracted considerable attention due to its potential protective role against atherosclerosis. HDL, often referred to as "good cholesterol," exhibits several cardioprotective mechanisms.[4] It encourages reverse cholesterol transfer, prevents low-density lipoprotein (LDL) from oxidizing, and possesses anti-inflammatory and anti-thrombotic properties, and promotes endothelial function. [5] These effects contribute to the maintenance of arterial health and the prevention of plaque formation and progression. Therefore, it is plausible that HDL levels may correlate with the severity of CAD observed on angiography, a widely used diagnostic tool to visualize coronary arteries and assess the extent of atherosclerotic lesions.

Several studies have investigated the relationship among HDL levels as well as the level of CAD as shown by angiographic results.[6] These studies typically involve patients who undergo coronary angiography, a procedure where a contrast agent is injected into the coronary arteries, followed by imaging to visualize any blockages or narrowing. Angiography allows the assessment of the number, location, and extent of coronary artery stenosis, providing a reliable measure of the severity of CAD. The significance of this research lies in its potential clinical implications. The results of this research might add to our understanding of how HDL functions in CAD and may have implications for risk assessment, prognostication, and therapeutic interventions in the management of CAD. If a strong association is established between HDL levels and the severity of CAD, it could have several important implications for patient care. First, it may aid in risk assessment and stratification, allowing clinicians to identify individuals at higher risk for developing severe CAD. Second, it may provide valuable prognostic information, helping to predict disease progression and guiding treatment decisions. Third, it may influence the development of novel therapeutic interventions focused on raising HDL levels, thereby reducing the burden of CAD.

## Materials and methods

*Study Design*

The study adopts a retrospective observational design at the DHQ Hospital, Kohat, with a duration spanning six months from August 2022 to February 2023. The sample comprises 160 patients who underwent coronary angiography.

*Sample Selection*

The inclusion criteria for the study involve patients aged 40 and above, of both genders, undergoing coronary artery angiography, and possessing complete medical records, including HDL levels and angiographic findings. However, the exclusion criteria encompass patients with a history of prior coronary artery bypass graft surgery or angioplasty, as well as those with a history of pro-thrombotic conditions such as protein C and S deficiency.

*Data Collection*

The data collection process involved accessing the medical records of patients who meet the inclusion criteria, following the approval from the research review board. The study participants undergo a detailed history taking and a thorough physical examination. In addition, routine investigations such as fasting blood sugar and HbA1c levels were measured to assess diabetes status. Electrocardiography (ECG) and echocardiography were performed on all participants to evaluate any evidence of old ischemic changes or wall motion abnormalities.

The gold standard diagnostic procedure, coronary angiography, was conducted by a consultant cardiologist who had at least 5 years of post-fellowship experience. The researcher assisted the cardiologist during the angiography procedure. This invasive procedure involves the insertion of a catheter into the coronary arteries to visualize the blood flow and identify any stenosis or blockages.

During the data collection process, the researcher personally gathers the required information using a specifically designed proforma (Annexure 1). This proforma capture relevant data points related to the study variables, including patient demographics, medical history, results of routine investigations, and angiographic findings. The proforma was designed to ensure comprehensive data collection while maintaining consistency and accuracy.

Data was collected by the researcher himself on especially designed proforma (Annexure 1). The utilization of a standardized proforma for data collection helps to ensure that all necessary information is captured uniformly for each study participant. This approach facilitates data organization and analysis, enabling the researchers to draw reliable conclusions from the collected data.

The following information was extracted for each patient:

1. Demographic characteristics: Age (years), gender, BMI (kg/m2), ethnicity, and comorbidities (e.g., hypertension, diabetes, smoking).
2. HDL levels: The most recent measurement of HDL levels prior to the angiography procedure.
3. Angiographic findings: The severity of CAD was assessed using the SYNTAX score.

The SYNTAX score, another scoring system, evaluates the complexity and extent of CAD by considering the number of significant stenoses, their location, and their functional impact. This score considers lesion characteristics such as lesion length, location, and presence of bifurcation or trifurcation lesions. It provides a comprehensive measure of CAD severity.

*Data Analysis*

Utilizing SPSS (version 23.0), statistical analysis were carried out. The research population's demographic details, HDL levels, and angiographic results were summed up using descriptive statistics like means, standard deviations, and frequencies. An independent t-test were carried out to contrast the mean HDL values between patients with various levels of CAD severity. Mild-to-moderate CAD patients and severe CAD patients were separated into two categories among the patients. Based on the Gensini score, the severity was assessed. In order to evaluate if there is a significant difference in HDL levels between these two groups, the t-test was used. Using a chi-square test, it was possible to determine if HDL values are related to categorical factors like gender or the presence of comorbidities. With the use of this test, we assessed that if there was a meaningful connection between HDL levels and certain category characteristics. To evaluate the connection between HDL levels and the severity of CAD, a correlation analysis, such as Pearson's correlation coefficient, was carried out. The results of this analysis revealed the degree and direction of the relationship between these variables. Multivariate analysis, like multiple regression analysis, was carried out to account for any confounding variables. After comorbidities, age, gender, and other factors have been taken into account, this study assisted establish if the correlation between HDL levels and CAD severity is still present and significant. A p-value of less than 0.05 was be regarded as statistically significant, according to the statistical significance threshold, which was be set at p 0.05.

### *Ethical considerations*

This study was adhering to ethical guidelines and obtains approval from the ASRB of DHQ Hospital, Kohat, Pakistan. Written informed consents were obtained from the patients. Patient data were anonym zed and handled confidentially to ensure privacy and confidentiality.

## Results

The sample for the research comprised 160 patients who underwent coronary angiography at the Department of Cardiology, Lady Reading Hospital, with a mean age of 57.4 years (range: 41-75 years). The participants were 60% men and 40% women. The most prevalent comorbidity observed was hypertension (65%), followed by diabetes (42%) and smoking (28%). In terms of HDL levels, the mean was 45.2 mg/dL (SD = 8.3), with a distribution ranging from 32 mg/dL to 62 mg/dL.

The relationship between HDL levels and CAD severity is shown in Table 1 and is divided into two categories: mild-to-moderate CAD and severe CAD. Each group's mean HDL values are included along with their standard deviations. Patients with severe CAD had considerably lower mean HDL levels than those with mild-to-moderate CAD, according to an independent t-test that revealed a significant difference between the two groups (p 0.001).

**Table 1:** Association between HDL Levels and CAD Severity

| CAD Severity | Mild-to-Moderate CAD (n=90) | Severe (n=70) | p |
|---|---|---|---|
| Mean HDL Levels | 47.8 mg/dL | 41.3 mg/dL | <0.001 |
| Standard Deviation | 7.5 | 9.2 | |

The study assessed the correlation between HDL levels and coronary artery disease (CAD) severity using the SYNTAX score (mean: 16.7, SD = 6.2). Based on the Gensini score, participants were categorized into mild-to-moderate CAD (n = 90) and severe CAD (n = 70). An independent t-test revealed significantly lower mean HDL levels in individuals with severe CAD (M = 41.3, SD = 9.2) compared to mild-to-moderate CAD (M = 47.8, SD = 7.5), indicating an inverse relationship. Chi-square tests showed a significant association between lower HDL levels and male gender (p = 0.004) and comorbidities like diabetes and hypertension (p = 0.009). Pearson's correlation coefficient confirmed an inverse relationship ($r = -0.34$, $p < 0.001$) between HDL levels and CAD severity. In multivariate analysis, accounting for age, gender, and comorbidities, lower HDL levels independently associated with greater CAD severity ($\beta = -0.24$, $p = 0.02$). These findings underscore the independent role of lower HDL levels in predicting increased CAD severity.

Table 2 illustrates the association between HDL levels and categorical variables, namely gender, hypertension, and diabetes. The frequencies or percentages of patients with low and high HDL levels are presented for each category. Chi-square tests were conducted to determine the significance of the association. The results show a significant association between HDL levels and gender (p = 0.004), with a higher proportion of males having low HDL levels compared to females. Similarly, significant associations were found between HDL levels and the presence of hypertension (p = 0.001) and diabetes (p = 0.009), indicating that patients with these comorbidities had a higher prevalence of low HDL levels.

**Table 2:** Association between HDL Levels and Categorical Variables

| Variable | Low HDL Levels (%) | High HDL Levels (%) | p-value |
|---|---|---|---|
| Gender | | | |
| Male | 55 | 45 | 0.004 |
| Female | 35 | 65 | |
| Hypertension | | | |
| Yes | 60 | 40 | 0.001 |
| No | 30 | 70 | |
| Diabetes | | | |
| Yes | 50 | 50 | 0.009 |
| No | 40 | 60 | |

## Discussion

The objective of the current research was to determine if HDL levels and the severity of CAD as determined by angiography are related. Insights into the possible involvement of HDL in CAD etiology and its implications for clinical therapy are provided by the results of this retrospective observational research.[7,8] The findings showed a substantial correlation between HDL levels and the SYNTAX score of CAD severity. The severity of CAD was shown to be greater in patients with lower HDL levels, demonstrating an antagonistic link between HDL and the development of atherosclerotic lesions. This result is consistent with other studies showing HDL's cardioprotective properties and its function in delaying the onset of CAD.[9,10]

Furthermore, even after accounting for possible confounding variables including age, gender, and comorbidities, the relationship between HDL levels and CAD severity remained significant. This suggests that HDL may independently contribute to the progression and severity of CAD, emphasizing the importance of maintaining optimal HDL levels for cardiovascular health.[11,12] The observed association between HDL levels and gender highlights a potential gender disparity in HDL metabolism and its impact on CAD. The higher proportion of males with low HDL levels indicates a greater susceptibility to CAD among males. This gender-specific difference could be attributed to hormonal factors, lifestyle choices, or genetic variations affecting HDL metabolism.[13,14]

In addition, the significant associations between HDL levels and comorbidities, such as hypertension and diabetes, suggest a potential interplay between these risk factors and HDL in the development of CAD. Patients with hypertension and diabetes exhibited a higher prevalence of low HDL levels, underscoring the importance of managing these comorbidities to improve HDL profiles and potentially mitigate CAD progression.[15,16] Although this study provides valuable insights, several limitations should be acknowledged. Firstly, the retrospective design introduces inherent biases associated with secondary data analysis. Prospective studies would offer stronger evidence and minimize the influence of confounding factors. Second, since just one medical facility was used for the research, the results cannot be applied to other populations or environments. It is necessary to conduct further multi-center research with bigger sample numbers to confirm these results. Lastly, reliance on medical records for data collection may introduce information bias, emphasizing the need for standardized and accurate documentation.

### *Limitation of the Study*

The study's primary limitation is its smaller sample size, suggesting the need for larger studies with a sex and age-standardized population at DHQ Hospital, Kohat. These future investigations, with long-term follow-ups, could better assess the association between HDL levels and CAD severity, offering valuable insights for diagnostic and prognostic purposes. The retrospective design introduces inherent biases due to secondary data use, and the single-facility focus may limit generalizability. Additionally, reliance on accurate and complete medical records poses a potential information bias, varying among records.

## Conclusion

The link between HDL levels and the severity of CAD, as assessed by angiography, is convincingly supported by this retrospective observational research. Independent of confounding variables, the results show a substantial relationship between lower HDL levels and greater CAD severity. These findings highlight HDL's role in CAD etiology and imply that maintaining healthy HDL levels may have clinical repercussions for CAD risk assessment and treatment. Additionally, the identified gender-specific variations and the links to concomitant conditions like diabetes and hypertension underline the need for customized strategies in CAD prevention and treatment. To validate these results and delve into the underlying processes connecting HDL concentrations to CAD, more prospective research involving bigger and more varied populations are necessary.

### *Conflict Of Interest*

The authors declared no potential conflicts of interest in this research; the authors wish to acknowledge the support of the staff members of DHQ Hospital, Kohat, Pakistan.

## References

[1]. Ralapanawa U, Sivakanesan R. Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: a narrative review. Journal of epidemiology and global health. 2021 Jun;11(2):169.

[2]. Sintek M, Zajarias A. Patient evaluation and selection for transcatheter aortic valve replacement: the heart team approach. Progress in cardiovascular diseases. 2014 May 1;56(6):572-82.

[3]. Bruce IN, Urowitz MB, Gladman DD, Ibañez D, Steiner G. Risk factors for coronary heart disease in women with systemic lupus erythematosus: the Toronto Risk Factor Study. Arthritis & Rheumatism. 2003 Nov;48(11):3159-67.

[4]. Gable DR, Hurel SJ, Humphries SE. Adiponectin and its gene variants as risk factors for insulin resistance, the metabolic syndrome and cardiovascular disease. Atherosclerosis. 2006 Oct 1;188(2):231-44.

[5]. Ganjali S, Momtazi AA, Banach M, Kovanen PT, Stein EA, Sahebkar A. HDL abnormalities in familial hypercholesterolemia: Focus on biological functions. Progress in lipid research. 2017 Jul 1;67:16-26.

[6]. Frohlich J, Dobiasova M. Fractional esterification rate of cholesterol and ratio of triglycerides to HDL-cholesterol are powerful predictors of positive findings on coronary angiography. Clinical chemistry. 2003 Nov 1;49(11):1873-80.

[7]. Chidambaram V, Shanmugavel Geetha H, Kumar A, Majella MG, Sivakumar RK, Voruganti D, Mehta JL, Karakousis PC. Association of lipid levels with COVID-19 infection, disease severity and mortality: a systematic review and meta-analysis. Frontiers in Cardiovascular Medicine. 2022 Mar 24;9:862999.

[8]. Liao P, Zeng R, Zhao X, Guo L, Zhang M. Prognostic value of non-high-density lipoprotein cholesterol for mortality in patients with coronary heart disease: a systematic review and meta-analysis. International journal of cardiology. 2017 Jan 15;227:950-5.

[9]. Taylor RS, Brown A, Ebrahim S, Jolliffe J, Noorani H, Rees K, Skidmore B, Stone JA, Thompson DR, Oldridge N. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. The American journal of medicine. 2004 May 15;116(10):682-92.

[10]. Liou L, Kaptoge S. Association of small, dense LDL-cholesterol concentration and lipoprotein particle characteristics with coronary heart disease: a systematic review and meta-analysis. PloS one. 2020 Nov 9;15(11):e0241993.

[11]. Sacks FM. The role of high-density lipoprotein (HDL) cholesterol in the prevention and treatment of coronary heart disease: expert group recommendations. American Journal of Cardiology. 2002 Jul 15;90(2):139-43.

[12]. Vallee A, Lelong H, Lopez-Sublet M, Topouchian J, Safar ME, Blacher J. Association between different lipid parameters and aortic stiffness: clinical and therapeutic implication perspectives.

Journal of hypertension. 2019 Nov 1;37(11):2240-6.

[13]. Adorni MP, Ronda N, Bernini F, Zimetti F. High density lipoprotein cholesterol efflux capacity and atherosclerosis in cardiovascular disease: pathophysiological aspects and pharmacological perspectives. Cells. 2021 Mar 5;10(3):574.

[14]. Lv S, Zhang H, Chen J, Shen Z, Zhu C, Gu Y, Yu X, Zhang D, Wang Y, Ding X, Zhang X. The effect of triglycerides to high-density lipoprotein cholesterol ratio on the reduction of renal function: findings from China health and retirement longitudinal study (CHARLS). Lipids in Health and Disease. 2021 Dec;20(1):1-9

[15]. Kim SH, Son KY. Association between lipoprotein cholesterol and future cardiovascular disease and mortality in older adults: a Korean nationwide longitudinal study. Lipids in Health and Disease. 2021 Dec;20(1):1-1.

[16]. Lind L, Ingelsson M, Sundstrom J, Ärnlöv J. Impact of risk factors for major cardiovascular diseases: a comparison of life-time observational and Mendelian randomisation findings. Open heart. 2021 Sep 1;8(2):e001735.