



Correlation of TG/HDL Ratio and LDL/HDL Ratio with The Incidence of Coronary Artery Disease (CAD) at General Hospital of Buleleng Regency

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ABSTRACT

Background: CAD is a leading cause of death in both industrialised and developing nations, primarily affecting the younger generation. Triglycerides (TG) to high-density lipoprotein (HDL) cholesterol ratios (TG/HDL) and low-density lipoprotein (LDL) to HDL ratios (LDL/HDL) have been linked to cardiovascular disease.

Objective: The objective of this research is to ascertain the relationship between the incidence of CAD and the TG/HDL and LDL/HDL ratios.

Method: Analytical observational study with a cross-sectional approach conducted on 210 CAD patients at General Hospital of Buleleng Regency in 2024-2025. Data analysis was performed using the SPSS. Determination of the cut-off value was carried out using the Receiver Operating Characteristic (ROC) curve, then followed by chi-square analysis and logistic regression.

Results: Average age of the sample was 60.53 ± 12.647 years and the majority were <65 years old (67.6%). Based on the ROC curve, the cut-off value for the TG/HDL ratio was 2.84 (AUC= 0.45; 95%CI (0.302-0.508); $p < 0.07$) and LDL/HDL ratio was 2.38 (AUC= 0.503; 95%CI (0.398-0.608); $p < 0.96$). Based on the chi-square test, there was no significant relationship between the TG/HDL ratio (OR=1.71; 95%CI=0.92-3.17; $p = 0.08$) or the LDL/HDL ratio (OR=0.94; 95%CI=0.52-1.70; $p = 0.85$) with the incidence of CAD. Based on multivariate analysis, a significant relationship was obtained between a high TG/HDL ratio and the incidence of CAD (AOR=0.42; 95%CI=1.88-0.979; $p = 0.04$).

Conclusion: There is a significant relationship between a high TG/HDL ratio and the incidence of CAD.

Keywords: TG/HDL ratio, LDL/HDL ratio, CAD

INTRODUCTION

Coronary artery disease (CAD) is a leading cause of death globally. It is largely a disease affecting the elderly. The majority of studies indicate that the prevalence rate in young adults of acute myocardial infarction (MI) and CAD with symptoms is around 2-6 percent.¹ Despite advances in coronary revascularisation, the introduction of new technology, and the development of antithrombotic medications, outcomes for high-risk patient subsets remain poor in both short- and long-term follow-ups.^{2,3}

Coronary Artery Disease (CAD) comprise a spectrum of disorders, including patients who report with recent changes in signs and symptoms, with or without electrocardiogram (ECG) modifications, and with or without sudden elevations in cardiac troponin-T enzyme levels.¹ The patient complains of acute chest discomfort, which can be described as pain, tightness, heaviness, or burning, as well as dyspnoea, epigastric pain, and pain in the left or right arm, neck, or jaw. Dyslipidaemia is a major risk factor for CAD, particularly high levels of low-density lipoproteins (LDLs), which have been identified as the most atherogenic lipoproteins. Numerous trials have shown that aggressively lowering LDL levels with high-dose statins slows atheromatous plaque progression and prevents cardiovascular events. Despite meeting therapeutic targets for LDL cholesterol (LDL-C) levels with statins, individuals with CAD have a substantial residual risk of events.^{1,4}

Recently, attention has switched to low plasma levels of high-density lipoproteins (HDLs) and high triglyceride levels as risk factors for cardiovascular disease and prospective pharmaceutical targets, with a focus on the ratio. This ratio has been demonstrated to represent insulin resistance and is associated with a poor lipid profile, as it is inversely related to the size of both HDL and LDL particles, both of which are important contributors in the atherosclerosis process.^{2,3} In addition to the TG/HDL biomarker, the LDL/HDL ratio is considered to be a reliable predictor of long-term prognosis in STEMI patients. Previous research has demonstrated that the LDL/HDL ratio is an independent risk factor for adverse cardiovascular events in patients with

CAD or acute myocardial infarction.^{5,6} In addition to the TG/HDL biomarker, the LDL/HDL ratio is expected to be a reliable indicator for predicting the long-term prognosis of STEMI patients. Previous studies have shown that the LDL/HDL ratio is an independent risk factor for adverse cardiovascular events in patients with Coronary Artery Disease or acute myocardial infarction.

However, to date, there has been variation in reported results between these studies. Therefore, further research is needed to explore the predictive value of the LDL/HDL ratio in the incidence of CAD in patients. The objective of this research is to ascertain the relationship between the incidence of CAD and the TG/HDL and LDL/HDL ratios.

METHODS

Study Design

Analytical observational study with a cross-sectional approach. This study was conducted at General Hospital of Buleleng Regency in 2024-2025.

Inclusion and Exclusion Criteria

The sample of this study was CAD patients at General Hospital of Buleleng Regency during the study period. The inclusion criteria were patients diagnosed with CAD registered in the medical records of General Hospital of Buleleng Regency in 2024-2025, patients aged 18 years and above, and patients with complete medical records. Exclusion criteria included patients who refused to participate in the study.

Variables of The Study

The dependent variable in this study was the incidence of CAD, while the independent variables were the TG/HDL ratio and the LDL/HDL ratio. Other variables collected included age, education level, marital history, occupation, comorbidities, body mass index (BMI), clinical symptoms, total cholesterol, LDL, HDL, and triglyceride levels.

Statistical Analysis

Data analysis was performed using the SPSS. Determination of the cut-off value was carried out using the Receiver Operating Characteristic (ROC) curve, then followed by chi-square analysis

and logistic regression. The results are said to be significant if $p < 0.05$.

RESULTS

This study used 210 samples of CAD patients divided into two groups: 173 NSTEMI-ACS samples and 37 STEMI samples. The average age of the sample was 60.53 ± 12.647 years, and the majority were <65 years old (67.6%). Based on gender, the majority of the sample was male (65.2%). Most of the sample were high school seniors (32.9%), marital status was married (98.1%), and unemployed (66.2%). Based on the CAD category, 47.1% were NSTEMI patients, followed by UAP (35.2%), and STEMI (17.6%). The majority of patients had comorbid hypertension (39.5%) and a normal BMI (49.0%). Based on symptoms, the majority showed chest pain (61.9%). Most patients did not undergo revascularization (84.8%), and only 0.5% experienced mortality. Based on total cholesterol, the lowest value was 2.76 mg/dL, while the highest was 303 mg/dL. Based on triglyceride levels, the lowest value was 2.4 mg/dL, while the highest value was 720 mg/dL. The average LDL level was 107 mg/dL, while the HDL level was 43 mg/dL. The median TG/HDL ratio was 2.78, while the LDL/ratio was 2.38.

Table 1. Baseline Characteristic of The Sample

Variable	Frequency	Percentage
Age (Years)		
<65	142	67.6
65-75	46	21.9
>75	22	10.5
Gender		
Female	73	34.8
Male	137	65.2
Educational Status		

Elementary School	53	25.2
Junior High School	40	19.0
Senior High School	69	32.9
College	27	12.9
No	21	10.0
Maritas Status		
Married	206	98.1
Unmarried	4	1.9
Occupation		
Yes	32	15.2
No	139	66.2
Housewife	39	18.6
CAD category		
UAP	74	35.2
NSTEMI	99	47.1
STEMI	37	17.6
Comorbid Diseases		
Diabetes Mellitus	48	22.9
Hypertension	83	39.5
Dyslipidemia	7	3.3
Heart Disease	2	1.0
Hyperthyroidism	2	1.0
Pneumonia	1	0.5
Chronic Kidney Disease	13	6.2
No	54	25
Body Mass Index (BMI)		

Underweight	4	1.9
Normal	103	49.0
Overweight	89	42.4
Obesity	14	6.7
Clinical Symptoms		
Chest Pain	130	61.9
Shortness of Breath	74	35.2
Decrease Consciousness	2	1.0
Nausea and Vomiting	1	0.5
Tired	3	1.4
Revascularization		
Fibrinolytic	24	11.4
PCI	8	3.8
No	178	84.8
Mortality		
Yes	1	0.5
No	209	99.5
Total Cholesterol (mg/dL)	168 (2.76-303)	
Triglyceride (mg/dL)	115 (2.4-720)	
LDL (mg/dL)	107 ± 36.14	
HDL (mg/dL)	43 (12-107)	
TG/HDL ratio	2.78 (0.09-22.50)	
LDL/HDL ratio	2.38 (0.21-6.91)	

The ROC curve appears to be close to the diagonal line (random line), indicating that the discriminatory ability of the TG/HDL ratio and the LDL/HDL ratio in differentiating between

subjects with and without CAD events is still low. Based on the ROC curve, the cut-off value for the TG/HDL ratio was 2.84 (AUC= 0.45; 95%CI (0.302-0.508); $p < 0.07$) and the LDL/HDL ratio was 2.38 (AUC= 0.503; 95%CI (0.398-0.608); $p < 0.96$). An AUC value of 0.45 indicates that TG/HDL does not have good discriminatory ability against CAD events. Similarly, an AUC value of 0.53 indicates that the LDL/HDL ratio is only slightly better than random guessing in predicting CAD events.

Table 2. Area Under The Curve and ROC Curve

Variable	AUC	95%CI	p-value	Cut-off
TG/HDL ratio	0.45	0.302-0.508	$p < 0.07$	2.84
LDL/HDL ratio	0.503	0.398-0.608	$p < 0.96$	2.38

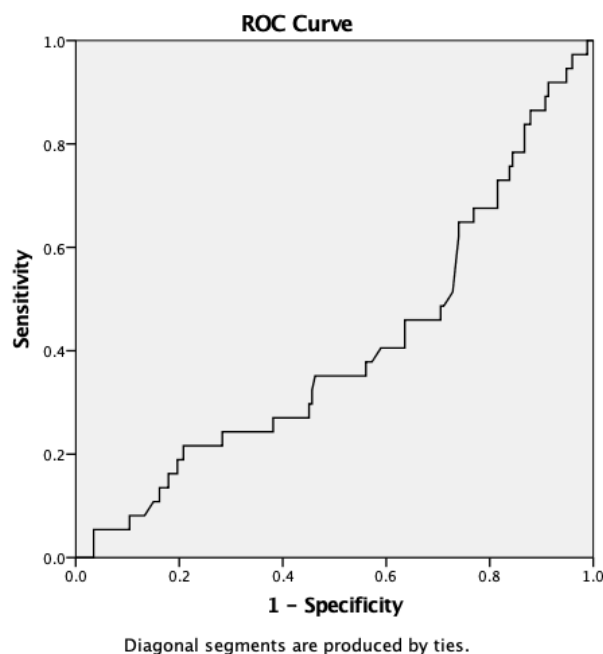


Figure 1. ROC Curve TG/HDL ratio

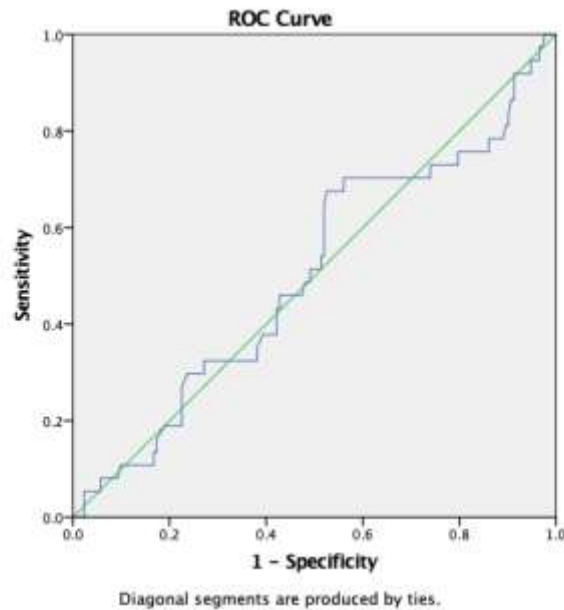


Figure 2. ROC Curve LDL/HDL ratio

Based on the chi-square test, there was no significant relationship between the TG/HDL ratio (OR=1.71; 95%CI=0.92-3.17; p=0.08) or the LDL/HDL ratio (OR=0.94; 95%CI=0.52-1.70; p=0.85) with the incidence of CAD. Based on multivariate analysis, a significant relationship was obtained between a high TG/HDL ratio and the incidence of CAD (AOR=0.42; 95%CI=1.88-0.979; p=0.04).

Table 3. Bivariate Analysis

Variable	NSTE-ACS	STEMI	p-value	OR	95%CI
LDL/HDL ratio					
Low (≤ 2.38)	87 (82.9%)	18 (17.1%)	0.85	0.94	0.52-1.70
High (> 2.38)	86 (81.9%)	19 (18.1%)			
TG/HDL ratio					

Low (≤ 2.84)	85 (78.0%)	24 (22.0%)	0.08	1.71	0.92-3.17
High (> 2.84)	88 (87.1%)	13 (12.9%)			

Table 4. Multivariate Analysis

Variable	Coefficient	S.E.	Wald	dF	p-value	OR	95%CI
LDL/HDL ratio	0.440	0.409	1.158	1	0.282	1.553	0.697-3.460
TG/HDL ratio	0.848	0.422	4.043	1	0.044	.428	1.88-0.979

DISCUSSION

The majority of the sample in this study were aged < 65 years (67.6%) and male (65.2%). This is in line with a previous retrospective cross-sectional study that included adult patients (aged > 18 years) experiencing first-time Coronary Artery Disease (CAD). The study comprised 265 patients (mean age 57.83 ± 11.4 years), with men accounting for 79.2%.⁷ Previous research found that CAD was more common in those under the age of 65, which is most likely owing to changes in modern lifestyles that increase the incidence of cardiovascular risk factors in productive age groups. Unhealthy lifestyles such as high-fat diets, a lack of physical activity, work stress, smoking, and the rising prevalence of obesity and type 2 diabetes in young people all contribute to the progression of atherosclerosis. Furthermore, younger people are frequently unaware of the necessity of preventing and regulating these risk factors, resulting in delayed action. Advances in early detection have also made it possible to diagnose CAD in younger age groups that were previously missed.⁷ Men are more prone to develop Coronary Artery Disease (CAD) because they have higher cardiovascular risk factors from a young age, such as smoking, hypertension, dyslipidaemia, and living an unhealthy lifestyle. In addition, oestrogen in women before menopause protects blood arteries, postponing the onset of heart disease. Biological differences, such as men having a poorer lipid profile and accumulating higher levels of visceral fat, can contribute to an increased risk of

atherosclerosis and CAD.⁷

Correlation of TG/HDL Ratio with The Incidence of Coronary Artery Disease (CAD)

This study showed a significant relationship between a high TG/HDL ratio and the incidence of CAD. The triglyceride-to-HDL (TG/HDL) ratio is a lipid measure that is increasingly recognised as a key factor in determining cardiovascular risk. This ratio indicates the balance of "bad" fats (triglycerides) and "good" cholesterol (HDL), both of which contribute to lipid metabolism and blood vessel wall integrity. Several studies have found a clear link between the TG/HDL ratio and insulin resistance, endothelial dysfunction, and the development of tiny, dense LDL particles that are extremely atherogenic.⁸⁻¹⁰

A high TG/HDL ratio is related with a higher incidence of events in Coronary Artery Disease (CAD). This ratio may suggest atherogenic dyslipidaemia, a disease in which high triglyceride levels and low HDL cause inflammation and plaque buildup in the coronary arteries. The resulting plaque is unstable and quickly ruptures, causing thrombus formation that can unexpectedly obstruct coronary blood flow, an important mechanism in the development of CAD, such as acute myocardial infarction and unstable angina.^{7,11,12}

Furthermore, a high TG/HDL ratio is linked to metabolic syndrome and type 2 diabetes mellitus, both of which are significant risk factors for coronary heart disease. These diseases worsen systemic inflammation and metabolic abnormalities, increasing the risk of acute cardiovascular events. As a result, the TG/HDL ratio is regarded a more sensitive and predictive indication of CAD risk than LDL-C levels alone.¹¹⁻¹³

Based on a prior study that sought to establish the association between triglyceride and HDL cholesterol ratios and Coronary Artery Disease. From August 2009 to May 2010, a cross-sectional study was done at Mymensingh Medical College Hospital's Cardiology Department. A total of 100 respondents were divided into 50 cases (patients) and 50 healthy individuals (controls). In multivariable regression analysis, the TG/HDL ratio showed a high correlation with CAD. The study revealed that a high TG/HDL ratio is linked to CAD. Categorising individuals with CAD based on their TG/HDL ratio will aid in risk assessment and therapy.¹⁴

Another retrospective cross-sectional study of adult patients (aged >18 years) experiencing their first Coronary Artery Disease (CAD) found that the TG/HDL-C ratio was significantly negatively correlated with STEMI ($p=0.048$), but not with NSTEMI ($p=0.264$) or angina ($p=0.326$).¹¹

Correlation of LDL/HDL Ratio with The Incidence of Coronary Artery Disease (CAD)

This study showed no significant relationship between a high TG/HDL ratio and the incidence of CAD. The specific mechanism by which the LDL/HDL ratio influences long-term cardiac revascularisation in STEMI patients has yet to be determined. Previous research has confirmed that the occurrence of adverse cardiovascular events, including coronary revascularisation, is associated with biomarkers such as myeloperoxidase (MPO), glutathione peroxidase, and gamma-glutamyl transferase (GGT), all of which can reflect the level of human oxidation reaction, as well as the LDL/HDL ratio. Previous research suggests that the LDL/HDL ratio can indicate the extent of oxidative reactions and predict the long-term risk of coronary revascularisation in STEMI patients.⁶

A case-control research discovered that the LDL/HDL ratio was an independent risk factor for acute myocardial infarction in male patients. An LDL/HDL ratio higher than 3.36 was associated with a significantly higher risk of acute myocardial infarction.^{4,15} In a cohort study, the LDL/HDL ratio was demonstrated to predict the long-term risk of coronary revascularisation in STEMI patients undergoing PCI. STEMI patients with an LDL/HDL ratio of ≥ 2.595 had a considerably higher risk of coronary revascularisation. After correcting for characteristics such as gender, age, and medical history, a high LDL/HDL ratio was an independent risk factor for long-term coronary revascularisation in STEMI patients.⁵

The limitations of this study lie in its cross-sectional design, which makes it impossible to establish a causal relationship between lipid ratios (TG/HDL and LDL/HDL) and the incidence of Coronary Artery Disease (CAD). Furthermore, the study sample was drawn from only one hospital, so the results may not be generalizable to a broader population with different characteristics. Confounding variables such as lipid-lowering medication use, diet, physical activity, and family

history of heart disease were not fully controlled, which may affect the validity of the results. The relatively limited sample size may also reduce statistical power in detecting a significant association. Therefore, further studies with prospective designs and larger populations are needed to confirm these findings.

CONCLUSION

There is a significant relationship between a high TG/HDL ratio and the incidence of CAD. There was no significant association between LDL/HDL and the incidence of CAD. Further research is needed with larger samples and different study designs.

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