Original Article

Correlation between serum low-density lipoprotein cholesterol/high-density lipoprotein cholesterol ratio and clinical characteristics of patients with coronary heart disease: a cross-sectional study

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Background: The low-density lipoprotein cholesterol (LDL-C)/high-density lipoprotein cholesterol (HDL-C) ratio is a critical indicator of lipid metabolism homeostasis and significantly influences vascular health. However, its correlation with clinical characteristics in patients with coronary heart disease (CHD) remains insufficiently elucidated. This study investigates the association between the LDL-C/HDL-C ratio and clinical characteristics in CHD patients and evaluates its potential to predict the risk of progression from angina pectoris to myocardial infarction (MI).

Methods: This cross-sectional study initially enrolled 7,931 hospitalized patients from Jiangsu Provincial People's Hospital and Wuxi Second People's Hospital between September 2018 and September 2021. After excluding patients with missing data, malignancies, immune system disorders, hematologic diseases, cardiomyopathies, or severe infections, 3,707 patients who met the inclusion and exclusion criteria were included. Serum levels of LDL-C, HDL-C, and LDL-C/HDL-C ratio were measured upon admission. Participants were stratified into quartiles based on LDL-C/HDL-C ratio and clinical subtypes. Multivariate logistic regression analysis evaluated the relationship between LDL-C/HDL-C levels and clinical subtypes of CHD, and subgroup analyses assessed the association between LDL-C/HDL-C levels and clinical features in CHD patients.

Results: Among CHD patients with higher LDL-C/HDL-C ratio, a greater proportion were male, smokers, or MI participants (P<0.05), with elevated levels of heart rate (HR), body mass index (BMI), LDL-C, total cholesterol (TC), triglycerides (TG), and fasting blood glucose (FBG) (P<0.05), while a lower proportion had undergone prior percutaneous coronary intervention (PCI) (P<0.05). Multivariate logistic regression analysis revealed that for each unit increase in LDL-C/HDL-C ratio, the risk of MI in CHD patients was 99% higher compared to angina patients [odds ratio (OR) =1.99; 95% confidence interval (CI): 1.50–2.63; P<0.001]. Subgroup analysis demonstrated that elevated LDL-C/HDL-C ratios were significantly associated with the risk of MI in CHD patients across the following subgroups: age ≥65 years (OR =1.44; 95% CI: 1.23–1.70; P<0.001), male (OR =1.29; 95% CI: 1.15–1.45; P<0.001), systolic blood pressure <140 mmHg

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(OR =1.32; 95% CI: 1.15–1.52; P<0.001), receiving statin therapy (OR =1.29; 95% CI: 1.16–1.45; P<0.001), without prior PCI (OR =1.32; 95% CI: 1.18–1.48; P<0.001), without cerebral infarction history (OR =1.29; 95% CI: 1.15–1.44; P<0.001). Regardless of smoking status, BMI (<24 or ≥24 kg/m2), FBG levels (≥6.1 or <6.1 mmol/L), history of hypertension, or diabetes, LDL-C/HDL-C ratio remained significantly correlated with the risk of MI in CHD patients rather than angina pectoris (all P<0.05).

Conclusions: Compared with patients with angina pectoris, a higher LDL/HDL ratio was associated with an increased risk of MI in patients with CHD.

Keywords: Low-density lipoprotein cholesterol/high-density lipoprotein cholesterol ratio (LDL-C/HDL-C ratio); myocardial infarction (MI); coronary heart disease (CHD)

Submitted Apr 28, 2025. Accepted for publication Aug 15, 2025. Published online Oct 29, 2025. This article was updated on March 02, 2026.

The original version is available at: https://dx.doi.org/10.21037/jtd-2025-852

doi: 10.21037/jtd-2025-852

Introduction

Coronary heart disease (CHD), also known as coronary atherosclerotic heart disease, develops through the gradual accumulation of fibrous atherosclerotic plaques in coronary arteries. These plaques cause vascular narrowing, occlusion, or plaque-induced vasospasm, ultimately leading to myocardial ischemia, hypoxia, and subsequent angina pectoris or myocardial infarction (MI), with MI being its main clinical subtype. CHD is the predominant cause of mortality and morbidity in China and globally, and its incidence has shown a gradual upward trend in recent years, seriously endangering human health (1,2). Therefore, the prevention, control and treatment of CHD has emerged as an urgent public health concern that requires attention.

The conventional risk factors for CHD encompass hypertension, diabetes mellitus, smoking, and dyslipidemia, as well as additional risk factors such as male gender, advanced age, family history of CHD, angina pectoris, prior MI, history of revascularization, elevated low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) (3-5). These features not only facilitate CHD screening and diagnosis but also hold profound implications for disease progression, prognostic assessment, and individualized treatment.

In recent years, both domestic and international guidelines for dyslipidemia prevention and management have identified LDL-C as the primary therapeutic target, with serum LDL-C reduction serving as a key strategy to mitigate the risk of atherosclerotic cardiovascular disease (6,7). Despite the significance of LDL-C in early CHD identification, studies have revealed certain limitations in the clinical benefits of solely focusing on LDL-C reduction. Even when LDL-C levels are maintained within the normal range, a substantial proportion of individuals still experience atherosclerotic cardiovascular disease events (8,9). HDL-C has been recognized as an atheroprotective lipoprotein due

Highlight box

Key findings

- Our study reveals a significant positive correlation between low-density lipoprotein cholesterol (LDL-C)/high-density lipoprotein cholesterol (HDL-C) ratio and the risk of myocardial infarction (MI) in patients with coronary heart disease (CHD).

What is known and what is new?

- LDL-C/HDL-C has certain predictive value in the degree of coronary artery stenosis, coronary plaque stability and the occurrence of adverse cardiovascular events. But the relationship between LDL-C/HDL-C levels and the clinical characteristics of CHD patients remains unclear.
- This manuscript provides more refined risk assessment data, which can help stratify the risk of patients with CHD to prevent the development of MI, an irreversible disease feature, and provide a basis for clinical diagnosis and treatment.

What is the implication, and what should change now?

- The results suggest that compared to patients with angina pectoris, a higher LDL-C/HDL-C ratio may increase the risk of MI in patients with CHD. Monitoring the LDL-C/HDL-C ratio can help identify high-risk individuals early, especially in resource-limited settings.
- Stratified analysis can better reveal the gradient changes of the risk of different clinical characteristics of CHD under different blood lipid ratio intervals, and help indicate potential differences in a smaller range, which can serve as a warning sign to guide more aggressive treatment strategies for CHD in clinical practice.

to its capacity for reverse cholesterol transport, antioxidant properties, and vascular protective functions (10). The LDL-C/HDL-C ratio integrates both pro-atherogenic and anti-atherogenic lipid components, reflecting net cholesterol efflux capacity and vascular inflammatory status. Evidence suggests that an elevated LDL-C/HDL-C ratio is predictive of acute MI, with superior predictive performance compared to LDL-C alone (11).

This study aims to investigate the association between LDL-C/HDL-C ratio and MI as a clinical subtype, as well as clinical characteristics in patients with CHD. providing potential clinical evidence and scientific value for developing clinical identification tools to actively prevent the progression from angina pectoris to MI, an irreversible pathological condition, in CHD patients with distinct clinical characteristics. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-2025-852/rc).

Methods

Study population

An observational study was conducted with 7,931 patients admitted to Jiangsu Provincial People's Hospital and Wuxi Second People's Hospital from September 2018 to September 2021, with the final sample including 3,707 participants who met the specified inclusion and exclusion criteria. Criteria for inclusion: (I) fulfil the diagnostic criteria for CHD (12) (regardless of treatment) or CHD with stent placement or bypass surgery; (II) over 18 years old; (III) the basic clinical information is complete. Exclusion criteria: (I) lacking clinical data; (II) individuals with cognitive dysfunction or psychiatric disorders; (III) history of chronic diseases such as malignant tumors, immune system disorders, and hematological disorders; (IV) pregnant and perinatal patients; (V) acute, chronic, or severe infections; and (VI) congenital heart disease, cardiac valvular disease, or cardiomyopathy. This study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. This study was approved by the Ethics Committee of the Wuxi Second People's Hospital (No. 2022Y-174). Jiangsu Provincial People's Hospital were also informed and agreed on the study. The requirement for informed consent was waived due to the retrospective nature of the study.

Data acquisition

The clinical data of the study subjects were collected through the electronic medical record system, including: demographic characteristics(sex, age, smoker), medical history(hypertension, diabetes, family history of CHD, MI, coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI), cerebral infarction, cerebral hemorrhage, renal insufficiency, heart failure, atrial fibrillation), medication history {statin therapy, antihypertensive drugs use [e.g., angiotensin-converting enzyme inhibitors (ACEI)/angiotensin II receptor blockers (ARB) drugs, beta-blockers], lipid indices [total cholesterol (TC), triglycerides (TG), LDL-C, and HDL-C], and other relevant clinical characteristics after hospital admission [heart rate (HR), body mass index (BMI), systolic blood pressure (BP), diastolic BP, fasting blood glucose (FBG) and Killip classification for acute MI patients}.

The confirmation of medical history relied on explicit physician documentation, relevant diagnostic codes, and corroborating prescriptions for medications indicative of the respective conditions. A family history of CHD was defined as a confirmed diagnosis (including MI, coronary revascularization, or angiographically documented coronary stenosis ≥50%) in any first-degree relative (parents, siblings, or children).

Diagnostic criteria and groups

The participants were stratified into four groups based on quartiles of the LDL-C/HDL-C ratio: Q1 group (LDL-C/HDL-C <1.72), Q2 group (1.72≤ LDL-C/HDL-C <2.25), Q3 group (2.25≤ LDL-C/HDL-C <2.89), and Q4 group (LDL-C/HDL-C ≥2.89).

Angina: (I) stable angina: typical symptoms of exertional angina, coronary angiography diagnosed CHD; (II) unstable angina: diagnosis of CHD and the following conditions: (i) the nature of the original stable angina changes, i.e., frequent angina attacks, the degree of severity and prolonged duration; (ii) angina attack at rest; (iii) the recent occurrence of the last month, light physical activity can also be triggered by the angina; one or more of the three conditions, accompanied by ST-T changes on the electrocardiogram. Acute MI: diagnosis according to the criteria of the "Global Definition of Myocardial Infarction" published in 2018 (13): the presence of increased

myocardial injury biomarkers, ideally troponin, exceeding the 99th percentile of the upper reference limit at least once, together with at least one clinical sign of myocardial ischemia, including: (I) symptoms of myocardial ischemia; (II) new ischemic electrocardiographic changes; (III) new pathological of Q waves; (IV) imaging revealing new loss of viable myocardium or abnormal segmental wall motion; (V) coronary angiography or autopsy verifying coronary thrombosis. Patients were divided into angina group (comprising stable angina and unstable angina) and MI group based on clinical subtype.

The Killip classification for cardiac function is defined as follows: Killip I, no signs of heart failure; Killip II, evidence of mild to moderate heart failure (e.g., third heart sound gallop, rales halfway up the lung fields, or elevated jugular venous pressure); Killip III, pulmonary edema; and Killip IV, cardiogenic shock or refractory hypotension (14). The MI patients were divided into two groups based on the Killip classification: group 1 included patients with Killip class I and II, and group 2 included patients with Killip class III and IV.

Statistical analysis

Statistical analysis was performed using SAS 9.4 and SPSS 27.0 software. Patients were stratified into quartiles based on LDL/HDL ratios, with intergroup differences subsequently analyzed. Normally distributed continuous variables were expressed as mean ± standard deviation (SD) and compared using one-way analysis of variance (ANOVA). Non-normally distributed continuous variables were presented as median (interquartile range) [M (Q_1, Q_3)] and analyzed via the Kruskal-Wallis *H* test. Categorical variables were described as frequencies (percentages) and compared using χ^2 tests or Fisher's exact tests, as appropriate. Binary multivariate logistic regression analysis was employed to examine the association between LDL/HDL levels and MI of CHD, as well as the relationship between LDL/HDL levels and Killip classification in MI patients. Subgroup analyses were conducted to further elucidate the correlation between LDL/HDL levels and clinical characteristics of CHD patients. All statistical tests were two-sided, and P value less than 0.05 was considered statistically significant.

Results

Baseline characteristics

This study enrolled a total of 3,707 patients with CHD, including 2,736 males and 971 females, among whom 887 participants (23.9%) were diagnosed with MI. Based on LDL-C/HDL-C ratio quartiles, patients were stratified into four groups. In the highest LDL-C/HDL-C quartile group (Q4), significantly higher proportions of male patients, smokers, and MI patients were observed (all P<0.05). Additionally, this group exhibited elevated levels of HR, BMI, LDL-C, TC, TG, and FBG (all P<0.05). Notably, the proportion of patients who had prior PCI was significantly lower in Q4 (P<0.05) (*Table 1*).

Multifactorial logistic regression analysis for LDL-C/HDL-C levels and clinical performance of patients with CHD

Upon adjusting for important covariates like age, gender, and smoker, the multifactorial logistic regression analysis revealed a significant association between LDL-C/HDL-C ratio and MI in patients with CHD. Compared with the lowest quartile group (Q1) of LDL-C/HDL-C ratio, the odds ratio (OR) for MI in the highest quartile group (Q4) was 1.99 [95% confidence interval (CI): 1.50–2.63; P<0.001, *Table 2*]. In addition, each 1-SD (SD =0.17) increase in the log-transformed LDL-C/HDL-C ratio was associated with a 28% elevated risk of MI (95% CI: 1.16–1.43; P<0.001, *Table 2*).

Multifactorial logistic regression analysis of LDL-C/HDL-C levels and relationship with Killip classification in patients with MI

This study demonstrated that elevated serum LDL-C/HDL-C ratios showed a significant association with the clinical features of MI compared to those with angina pectoris in CHD patients. To investigate this relationship further, we stratified MI patients using the Killip classification into Killip I–II (n=847) and Killip III–IV (n=40) groups. After adjusting for gender, age, and smoking status, quartile analysis of serum LDL-C/HDL-C ratios revealed no significant correlation with Killip classification severity in MI patients (P=0.56, *Table 3*).

Subgroup analysis

To further clarify the association between LDL-C/HDL-C levels and clinical characteristics of patients with CHD, we conducted subgroup analyses. The results demonstrated that LDL-C/HDL-C ratio was significantly associated with

Table 1 Baseline of participants according to clinical characteristics

Characteristics	Total (n=3,707)	Q1 (n=926)	Q2 (n=928)	Q3 (n=927)	Q4 (n=926)	F/H/χ^2	P
Demographics							
Male	2,736 (73.8)	665 (71.8)	665 (71.7)	679 (73.2)	727 (78.5)	14.859	0.002
Age (years)	65.33±11.11	68.15±10.62	66.12±10.75	64.78±10.73	62.26±11.52	47.535	<0.001
Smokers	1,721 (46.4)	397 (43.0)	407 (43.9)	433 (46.7)	484 (52.3)	19.898	<0.001
Clinical features							
Heart rate (beats per minute)	74 [66, 80]	72 [65, 80]	73 [67, 80]	73 [66, 80]	75 [68, 82]	23.008	<0.001
BMI (kg/m^2)	24.40 [22.71, 26.60]	23.82 [22.00, 25.90]	24.40 [22.70, 26.20]	24.60 [23.00, 26.89]	25.00 [23.30, 27.37]	98.518	<0.001
Systolic BP (mmHg)	131 [120, 144]	130 [120, 142]	131 [120, 144]	132 [120, 145]	132 [120, 145]	6.298	0.10
Diastolic BP (mmHg)	78 [70, 86]	77 [70, 83]	78 [70, 85]	80 [71, 87]	80 [71, 88.75]	41.290	<0.001
LDL-C (mmol/L)	2.22 [1.73, 2.84]	1.52 [1.28, 1.80]	2.03 [1.73, 2.34]	2.45 [2.10, 2.85]	3.14 [2.70, 3.65]	2,134.173	<0.001
HDL-C (mmol/L)	1.00 [0.86, 1.16]	1.12 [0.96, 1.33]	1.02 [0.88, 1.19]	0.97 [0.84, 1.11]	0.90 [0.79, 1.02]	479.551	<0.001
TC (mmol/L)	3.84 [3.18, 4.64]	3.05 [2.65, 3.58]	3.57 [3.11, 4.08]	4.07 [3.53, 4.66]	4.90 [4.30, 5.63]	1,509.596	<0.001
TG (mmol/L)	1.33 [0.99, 1.93]	0.98 [0.79, 1.25]	1.23 [0.96, 1.65]	1.50 [1.12, 2.06]	1.89 [1.38, 2.64]	910.333	<0.001
FBG (mmol/L)	5.23 [4.66, 6.46]	5.06 [4.57, 6.08]	5.13 [4.59, 6.23]	5.29 [4.70, 6.43]	5.52 [4.82, 6.98]	69.080	<0.001
MI	887 (23.9)	142 (15.3)	208 (22.4)	236 (25.5)	301 (32.5)	77.356	<0.001
Medical history							
History of hypertension	2,458 (66.3)	626 (67.6)	593 (63.9)	643 (69.4)	596 (64.4)	8.544	0.04
History of diabetes	1,103 (29.8)	278 (30.1)	275 (29.6)	261 (28.2)	289 (31.2)	2.110	0.56
Family history of CHD	162 (4.4)	34 (3.7)	41 (4.4)	39 (4.2)	48 (5.2)	2.611	0.46
History of MI	265 (7.2)	89 (9.6)	75 (8.1)	61 (6.6)	40 (4.3)	21.294	<0.001
History of PCI surgery	634 (17.1)	225 (24.4)	173 (18.7)	146 (15.8)	90 (9.7)	72.169	<0.001
History of CABG surgery	38 (1.0)	15 (1.6)	7 (0.8)	9 (1.0)	7 (0.8)	4.587	0.20
History of cerebral infarction	484 (13.1)	146 (15.8)	138 (14.9)	105 (11.4)	95 (10.3)	17.509	<0.001
History of cerebral hemorrhage	25 (0.7)	9 (1.0)	4 (0.4)	4 (0.4)	8 (0.9)	3.357	0.34
History of renal insufficiency	118 (3.2)	28 (3.0)	21 (2.3)	31 (3.4)	38 (4.1)	5.250	0.15
History of heart failure	267 (7.2)	58 (6.3)	78 (8.4)	65 (7.0)	66 (7.1)	3.288	0.40
History of atrial fibrillation	193 (5.2)	51 (5.5)	55 (6.0)	41 (4.4)	46 (5.0)	2.406	0.49
History of statin therapy	3,412 (92.0)	843 (91.0)	858 (92.5)	849 (91.6)	862 (93.1)	3.144	0.37
History of antihypertensive drug use	2,823 (76.2)	675 (72.9)	710 (76.5)	720 (77.7)	718 (77.5)	7.632	0.053

Data are presented as n (%), mean ± standard deviation or median [interquartile range]. Q1: LDL-C/HDL-C <1.72. Q2: 1.72≤ LDLC/HDL-C <2.25. Q3: 2.25≤ LDL-C/HDL-C <2.89. Q4: LDL-C/HDL-C ≥2.89. BMI, body mass index; BP, blood pressure; CABG, coronary artery bypass grafting; CHD, coronary heart disease; FBG, fasting blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MI, myocardial infarction; PCI, percutaneous coronary intervention; TC, total cholesterol; TG, triglycerides.

Table 2 Odds ratios and 95% confidence intervals for clinical characteristics of patients with CHD according to LDL-C/HDL-C quartiles

Variable	LDL-C/HDL-C				P	Each SD (0.17) increase in log10-(LDL-C/HDL-C)
	Q1 (<1.72)	Q2 (1.72–<2.25)	Q3 (2.25–<2.89)	Q4 (≥2.89)		
Clinical features of MI						
Model 1	1.00	1.56 (1.23–1.98)	1.81 (1.44–2.29)	2.49 (1.98–3.13)	<0.001	1.40 (1.28–1.52)
Model 2	1.00	1.46 (1.14–1.87)	1.63 (1.27–2.10)	1.99 (1.50–2.63)	<0.001	1.28 (1.16–1.43)

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, smokers, heart rate, BMI, systolic BP, diastolic BP, TC, TG, FBG, history of hypertension, history of diabetes, family history of CHD, history of MI, history of PCI surgery, history of CABG surgery, history of cerebral infarction, history of cerebral hemorrhage, history of renal insufficiency, history of heart failure, history of atrial fibrillation, history of statin therapy, and history of antihypertensive drug use. BMI, body mass index; BP, blood pressure; CABG, coronary artery bypass grafting; CHD, coronary heart disease; FBG, fasting blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MI, myocardial infarction; PCI, percutaneous coronary intervention; SD, standard deviation; TC, total cholesterol; TG, triglycerides.

Table 3 Odds ratios and 95% confidence intervals for Killip classification in patients with MI according to LDL-C/HDL-C quartiles

Variable	LDL-C/HDL-C				P	Each SD (0.16) increase in log10-(LDL-C/HDL-C)
	Q1 (<1.92)	Q2 (1.92–2.48)	Q3 (2.48–3.19)	Q4 (≥3.19)		
Killip classification						
Model 1	1.00	0.50 (0.20–1.26)	0.62 (0.25–1.50)	0.94 (0.40–2.20)	0.82	0.91 (0.67–1.25)
Model 2	1.00	0.39 (0.14–1.07)	0.58 (0.21–1.62)	0.69 (0.22–1.62)	0.56	0.84 (0.57–1.23)

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, smokers, heart rate, BMI, systolic BP, diastolic BP, TC, TG, FBG, history of hypertension, history of diabetes, family history of CHD, history of MI, history of PCI surgery, history of CABG surgery, history of cerebral infarction, history of cerebral hemorrhage, history of renal insufficiency, history of heart failure, history of atrial fibrillation, history of statin therapy, and history of antihypertensive drug use. BMI, body mass index; BP, blood pressure; CABG, coronary artery bypass grafting; CHD, coronary heart disease; FBG, fasting blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MI, myocardial infarction; PCI, percutaneous coronary intervention; SD, standard deviation; TC, total cholesterol; TG, triglycerides.

MI risk in CHD patients rather than angina pectoris among the following subgroups: age ≥65 years (OR =1.44; 95% CI: 1.23–1.70; P<0.001), male (OR =1.29; 95% CI: 1.15–1.45; P<0.001), systolic BP <140 mmHg (OR =1.32; 95% CI: 1.15–1.52; P<0.001), receiving statin therapy (OR =1.29; 95% CI: 1.16–1.45; P<0.001), without prior PCI (OR =1.32; 95% CI: 1.18–1.48; P<0.001), without cerebral infarction history (OR =1.29; 95% CI: 1.15–1.44; P<0.001). Notably, the LDL-C/HDL-C ratio remained significantly associated with MI risk in CHD patients regardless of smoking status, BMI level (<24 or ≥24 kg/m^2), FBG level (above or below 6.1 mmol/L), history of hypertension, or diabetes (all P<0.05) (*Table 4*).

Discussion

Our findings demonstrate that the LDL-C/HDL-C ratio is significantly associated with the clinical subtypes of MI in patients with CHD. Elevated LDL-C/HDL-C ratios may increase the risk of MI compared to angina pectoris in CHD patients, independent of established CHD risk factors. Subgroup studies further validated these results. By refining the grouping of LDL-C/HDL-C ratios, it provides more granular risk assessment data than most of the literature, which only uses a single threshold of the LDL-C/HDL-C ratio as the criterion for high-risk analysis. This study employed subgroup analysis to better untangle the relationship between the LDL-C/HDL-C ratio and both clinical subtypes of CHD and distinct clinical characteristics across different lipid ratio intervals, facilitating the identification of subtle differences within narrower ranges. These findings offer potential clinical and scientific value for developing early identification tools to prevent the irreversible progression from angina pectoris to

Table 4 Subgroup analyses of the association between serum LDL-C/HDL-C and clinical characteristics of CHD patients

Subgroup	Clinical features of MI/total patients	OR (95% CI)	P value
Age (years)			
<65	439/1,667 (26.33)	1.17 (1.02–1.35)	0.03
≥65	448/2,040 (21.96)	1.44 (1.23–1.70)	<0.001
Sex			
Male	724/2,736 (26.46)	1.29 (1.15–1.45)	<0.001
Female	163/971 (16.79)	1.28 (0.97–1.69)	0.08
Smokers			
No	385/1,986 (19.39)	1.30 (1.10–1.54)	0.002
Yes	502/1,721 (29.17)	1.27 (1.11–1.46)	0.001
BMI (kg/m^2)			
<24	299/1,301 (22.98)	1.27 (1.07–1.51)	0.008
≥24	588/2,406 (24.44)	1.28 (1.11–1.46)	<0.001
Systolic BP (mmHg)			
<140	620/2,431 (25.50)	1.32 (1.15–1.52)	<0.001
≥140	267/1,276 (20.92)	1.14 (0.95–1.37)	0.17
FBG (mmol/L)			
<6.1	525/2,582 (20.33)	1.24 (1.07–1.43)	0.004
≥6.1	362/1,125 (32.18)	1.29 (1.09–1.53)	0.004
History of hypertension			
No	327/1,249 (26.18)	1.25 (1.03–1.52)	0.02
Yes	560/2,458 (22.78)	1.30 (1.14–1.49)	<0.001
History of diabetes			
No	647/2,604 (24.85)	1.22 (1.09–1.37)	0.001
Yes	240/1,103 (21.76)	1.49 (1.17–1.88)	0.001
History of PCI surgery			
No	807/3,073 (26.26)	1.32 (1.18–1.48)	<0.001
Yes	80/634 (12.62)	1.14 (0.88–1.47)	0.33
History of cerebral infarction			
No	780/3,223 (24.20)	1.29 (1.15–1.44)	<0.001
Yes	107/484 (22.11)	1.25 (0.89–1.77)	0.20
History of statin therapy			
No	88/295 (29.83)	1.22 (0.85–1.75)	0.27
Yes	799/3,412 (23.42)	1.29 (1.16–1.45)	<0.001

In addition to the stratified variable, OR (95% CI) was calculated for each standard deviation (0.17) increase in log10-transformed LDL-C/HDL-C after adjustment for sex, age, smokers, heart rate, BMI, systolic BP, diastolic BP, TC, TG, FBG, history of hypertension, history of diabetes, family history of CHD, history of MI, history of PCI surgery, history of CABG surgery, history of cerebral infarction, history of cerebral hemorrhage, history of renal insufficiency, history of heart failure, history of atrial fibrillation, history of statin therapy, and history of antihypertensive drug use. BMI, body mass index; BP, blood pressure; CABG, coronary artery bypass grafting; CHD, coronary heart disease; CI, confidence interval; FBG, fasting blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MI, myocardial infarction; OR, odds ratio; PCI, percutaneous coronary intervention; TC, total cholesterol; TG, triglycerides.

MI in CHD patients.

CHD arises from the proliferation of subintimal plaques in coronary arteries. Elevated LDL-C or reduced HDL-C levels strongly correlate with plaque formation and progression. Oxidatively modified LDL-C readily infiltrates the arterial subendothelium, inducing endothelial damage and subsequent macrophage phagocytosis, which generates foam cells. These foam cells accumulate beneath the endothelium, undergo disintegration and necrosis, and ultimately form atheromatous plaques. Progressive plaque development occurs through sustained LDL-C exposure and inflammatory mediators, culminating in rupture and acute MI. HDL-C exerts anti-atherosclerotic effects through reverse cholesterol transport and possesses cardiovascular protective properties, including anti-inflammatory and antioxidant functions (15-18). A study revealed that while LDL-C and HDL-C were correlated with CHD in univariate analysis, their predictive value was not found in multivariate analysis. The LDL-C/HDL-C ratio exhibited a substantial correlation with CHD in regression analysis, with high sensitivity (65%) and specificity (61%). Even in patients with normal LDL-C and HDL-C levels, the incidence of CHD remains elevated. Indicating that LDL-C or HDL-C alone often fails to fully reflect the dynamic balance of an individual's lipid metabolism. The LDL-C/HDL-C ratio can simultaneously capture the interaction between the two and effectively reflect the severity of coronary atherosclerosis, which has obvious clinical advantages over a single lipid index (19).

In recent years, increasing studies have established a strong association between LDL-C/HDL-C and CHD progression, demonstrating its predictive value regarding the severity of coronary artery stenosis, stability of coronary plaques, and the occurrence of unfavourable cardiovascular events (20-23). Gao *et al.* (11) discovered that elevated LDL-C/HDL-C ratios are indicative of lipid-rich atherosclerotic plaques that are prone to rupture, potentially causing thrombosis, acute MI, cerebral vascular embolism, and ischemic stroke. Yuan *et al.* (24) similarly discovered that elevated LDL-C/HDL-C ratios correlate with increased severity of coronary artery stenosis, matching with the findings of our investigation.

Our findings demonstrate a profound association between LDL-C/HDL-C levels and the clinical classification of MI in patients with CHD. Subgroup analyses revealed that this correlation remained significant across various patient strata, including: smoking status, BMI level (<24 or ≥24 kg/m^2), FBG level (above or below 6.1 mmol/L), history of hypertension, history of diabetes mellitus. Notably, the association was particularly pronounced in: male, systolic BP <140 mmHg, receiving statin therapy, without prior PCI, without a history of cerebral infarction. In addition, after adjusting for potential confounders (such as age, sex, and other significant factors), no statistically significant relationship was observed between LDL-C/HDL-C levels and Killip classification in MI patients (P>0.05). Although it has been found that among MI patients, the risk of death and adverse cardiovascular events was higher with higher Killip classifications (hazard ratio =4.155; 95% CI: 1.558–11.082; P=0.004) (25). The link between the LDL-C/HDL-C ratio and Killip classification remains unclear. To better understand how blood lipid levels relate to cardiac function damage, it is important to incorporate cardiac ultrasound, brain natriuretic peptide, and additional indicators.

Our study has several limitations. The retrospective, monocentric design introduces selection bias in baseline characteristics, which may affect the generalizability of the findings. Consequently, these results may not extend to broader populations. The cross-sectional nature of the analysis also presents numerous confounding factors. While we accounted for several potential variables, other unmeasured covariates could influence the outcomes. Future studies with expanded sample sizes in population-based cohorts are warranted to explore the causal relationship between LDL-C/HDL-C levels and MI.

Conclusions

In summary, our findings demonstrate that a higher LDL-C/HDL-C ratio is significantly associated with MI as a clinical subtype in patients with CHD, as compared to angina pectoris. This association is more pronounced in male patients, those with systolic BP <140 mmHg, individuals receiving statin therapy, patients without prior PCI, and those without a prior cerebral infarction. These observations may facilitate the assessment of potential MI risk in CHD patients with distinct clinical characteristics and provide early warning sign for guiding therapeutic strategies in clinical practice.

Acknowledgments

We thank all the patients and researchers who participated in this study.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-2025-852/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-2025-852/dss

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-2025-852/prf

Funding: This work was supported by the Wuxi Double Hundred Top Talents in Healthcare (Nos. BJ2023029 and HB2023023); the Foundation of Wuxi Science and Technology Development (No. Y20222010), and the Foundation of Wuxi Municipal Health Commission (No. M202207).

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-2025-852/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study conformed to the provisions of the Declaration of Helsinki and its subsequent amendments. The current study was approved by the Ethics Committee of the Wuxi Second People's Hospital (No. 2022Y-174). Jiangsu Provincial People's Hospital were also informed and agreed on the study. Individual consent for this retrospective analysis was waived.

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Cite this article as: Yang X, Zhang T, Wang J, Zhang K, Wang J, Han Z, Wang R. Correlation between serum low-density lipoprotein cholesterol/high-density lipoprotein cholesterol ratio and clinical characteristics of patients with coronary heart disease: a cross-sectional study. J Thorac Dis 2025;17(10):8105-8114. doi: 10.21037/jtd-2025-852