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Evaluating the prognostic value of the Fatty Liver Index for cardiovascular events with a focus on acute coronary syndrome: A narrative review

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Abstract

Cardiovascular diseases (CVDs), including acute coronary syndrome (ACS), pose a significant global health risk, highlighting the need for early identification and intervention in high-risk individuals to reduce morbidity and mortality. The Fatty Liver Index (FLI), a surrogate marker of metabolic dysfunction-associated fatty liver disease (MASLD), has emerged as a useful tool for detecting individuals at elevated cardiovascular risk. Elevated FLI may indicate ACS risk via shared mechanisms, including insulin resistance, inflammation, dyslipidemia, and oxidative stress; however, its predictive value remains under investigation. This narrative review aims to synthesise current evidence and address gaps in the literature on the role of FLI as a predictor of ACS.

An extensive literature search was conducted in PubMed, Scopus, Embase, Web of Science, and Google Scholar (2015-2025), supplemented by manual screening of relevant journals and reference lists. Analysis of multiple cohort and observational studies indicates that elevated FLI is consistently associated with higher cardiovascular risk, including coronary events, and can serve as a practical marker for identifying individuals at heightened risk.

Despite its simplicity, non-invasiveness, and cost-effectiveness, FLI has limitations, such as variability in predictive accuracy across populations and the influence of metabolic confounders. Our study highlights FLI as a valuable tool for early detection and risk stratification of CVD and MI. Integrating FLI into global hospital screening programs could enhance preventive strategies, particularly in resource-limited settings. Further large-scale studies are needed to validate optimal cutoffs and confirm their predictive utility across diverse populations.

Key words: fatty liver index, acute coronary syndrome, cardiovascular disease, metabolic dysfunction-associated fatty liver disease

Introduction

A global overview of acute coronary syndrome

Acute coronary syndrome (ACS) is a form of coronary heart disease caused by the rupture of a sclerotic plaque in the coronary arteries, leading to thrombosis and varying levels of blood vessel blockage.[1] It consists of three subtypes: unstable angina (UA), non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI).[2] Each year, over 3 million individuals develop STEMI. Although myocardial infarction (MI) is more commonly diagnosed in developed countries, its incidence is also rising in developing nations.[3] In the United States alone, over 780,000 individuals experience ACS annually, with one-year post-discharge mortality rates of approximately 8.4% for STEMI and 18.7% for NSTEMI.[4] ACS remains a

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significant cause of global mortality. Notably, South Asian countries report higher mortality rates and premature deaths due to ACS. Two decades ago, age-standardised mortality rates (ASMRs) from ACS were highest in high-income regions such as Europe, North America, and Oceania. However, these rates have significantly declined in these areas, while remaining stable in Asia, Latin America, and the Caribbean.[5]

Fatty liver and the global population

Cardiovascular diseases (CVDs) account for nearly one-third of all deaths globally, with ischemic heart disease (IHD) being the leading single cause of death, accounting for approximately 7 million deaths annually.[6] Meanwhile, the prevalence of numerous metabolic disorders recognised to be risk factors for CVD, such as nonalcoholic fatty liver disease (NAFLD), type 2 diabetes mellitus, dyslipidemia, and obesity, has been increasing significant recently.[7] NAFLD is now recognised as the most prevalent and rapidly increasing cause of chronic liver disease worldwide,[8] affecting approximately 25% of the population and presenting serious public health and economic challenges.[9] To emphasise its connection to metabolic disorders, an international panel of experts has proposed renaming NAFLD as metabolic dysfunction-associated fatty liver disease (MASLD). This nomenclature shift encourages clinicians to assess fatty liver independently of alcohol use and other liver diseases.[10] MASLD's prevalence is rising worldwide, affecting 10-30% of the population in the United States, with similar trends reported in Europe and Asia.[11] It is most common in South America (30.45%) and the Middle East (31.79%), and least prevalent in Africa (13.48%).[12,13] In Asia and the Pacific, MASLD incidence is rising due to urbanisation, dietary changes, and the adoption of a Western lifestyle. Recent cohort studies show that MASLD affects 25% of the general population and 50-60% of people with obesity or diabetes. By 2030, its prevalence is expected to increase by 11.3% in Germany and 12% in Spain.[14]

The link between FLI and ACS

Emerging research is investigating the link between MASLD and ACS, including its association with complex multivessel coronary artery disease (CAD) and higher mortality in ACS patients.[15] MASLD has been identified as a major contributor to cardiovascular disease development.[16,17] One longitudinal cohort study showed that patients with MASLD had a higher coronary heart disease mortality rate compared to those with liver cirrhosis.[18] Patients with MASLD may exhibit a higher prevalence of subclinical atherosclerosis, regardless of traditional cardiovascular risk factors.[19] Patients with NAFLD have an independently elevated risk of developing ACS, especially in Asian populations, while results remain inconsistent in North American and European groups.[15]

Fatty liver index Vs ultrasonography

Ultrasound serves as a non-invasive, readily accessible, and reliable tool for identifying MASLD. When combined with ultrasound results, clinical risk factors demonstrate a high level of accuracy in detecting patients with MASLD.[20] Advanced methods such as transient elastography (Fibro Scan) and magnetic resonance elastography (MRE) are valuable for assessing liver stiffness, a key indicator of fibrosis or scarring, offering essential information about disease progression. Magnetic resonance imaging (MRI) and computed tomography (CT) scans further enhance accuracy by precisely measuring liver fat and identifying early-stage fibrosis.[21] However, these advanced tools are costly, less widely available, and may not distinguish MASLD from more severe conditions like MASH. In contrast, the Fatty Liver Index represents a practical, cost-effective, and broadly applicable tool for the early detection of MASLD. Beyond hepatic assessment, it holds significant value in preventive healthcare and cardiovascular risk stratification. Patients with elevated FLI should be counselled regarding their increased susceptibility to future cardiovascular disease.[22]

Predictive value of the fatty liver index for ACS

The fatty liver index, a simple and non-invasive tool for assessing hepatic steatosis, has garnered attention as a potential predictor of cardiovascular risk.[23] The FLI algorithm is a valuable tool for predicting the presence of MASLD. It combines body mass index (BMI), waist circumference (WC), gamma-glutamyl transferase (GGT), and triglyceride (TG) levels. The FLI algorithm has been shown to have a strong correlation with imaging and histological criteria for MASLD.[24] It is calculated using the formula proposed by Bedogni et al. (2006).[23]

$$FLI = (e^{0.953 \times \log_e(\text{triglycerides}) + 0.139 \times BMI + 0.718 \times \log_e(GGT) + 0.053 \times \text{waist circumference} - 15.745}) / (1 + e^{0.953 \times \log_e(\text{triglycerides}) + 0.139 \times BMI + 0.718 \times \log_e(GGT) + 0.053 \times \text{waist circumference} ? 15.745}) \times 100.$$

This formula was developed in an Italian population aged 40-75 years, comprising both individuals with suspected liver disease and healthy subjects. An FLI ≥60 indicates MASLD with elevated diabetes and cardiovascular risk, while an FLI ≤20 excludes steatosis. One study showed a correlation between FLI and the 12-year risk of cardiovascular

disease and all-cause mortality in post-myocardial infarction patients.[25] Recently, multiple studies have investigated whether the Fatty Liver Index can predict a higher risk of acute coronary syndrome, the severity of coronary artery disease (CAD), and increased mortality in ACS patients. However, the findings remain inconsistent and inconclusive. FLI is a valuable predictor for evaluating ASCVD risk. Individuals with high FLI levels should be assessed for ASCVD risk and provided with suitable treatment to prevent cardiovascular disease.[26] Accordingly, we conducted this narrative review to examine existing studies, the pathophysiological mechanisms linking fatty liver and ACS, the clinical utility of FLI in predicting cardiovascular risk, and epidemiological data on coronary artery disease (CAD) and ACS in the global population.

Methodology

We conducted a narrative review of the literature using five databases: PubMed, Scopus, Embase, Web of Science, and Google Scholar, covering the period from 2015 to 2025. The selection criteria included cross-sectional, case-control, cohort, and retrospective studies. We searched electronic databases for studies with titles or abstracts containing the terms “acute coronary syndrome” OR “myocardial infarction” OR “cardiovascular diseases” AND “Fatty Liver Index” OR “non-alcoholic fatty liver disease” OR “non-alcoholic steatohepatitis” OR “metabolic dysfunction-associated fatty liver disease”. English-language publications were screened. Furthermore, to minimise bias in the results, manual screening of reference lists was conducted to identify relevant studies missed during database searches.

Results

Association between FLI and ACS /CVDs: Key studies

Table 1. Studies investigating the association between fatty liver index and ACS or CVDs across Europe, Asia, and Latin America

Study	*No. of Subjects (n)*	*Study design*	*ACS/CVDs Prevalence*	*MASLD Prevalence*	*Main findings*
Kunutsor et.al 2017 The Netherlands[27]	6340	Prospective cohort study	631 (CVD; 9.95%)	FLI ≥60 showed a higher risk of CVD	FLI is not an independent predictor of CVD overall, but its association with CVD risk differs by age, highlighting the need for further research.
Olubamwo et. al. 2018 Finland[28]	1205	Prospective population-based cohort study	Acute MI: 269 (22.32%)	FLI ≥60 265 (22%)	FLI predicted CVD, but its independent predictive power for MI was limited due to confounding metabolic variables.
Kim et al 2020 Republic of Korea[29]	3,011,588	Retrospective cohort study	Acute MI: 16,574 (0.55%)	By FLI quartiles	The FLI, serving as a surrogate indicator of NAFLD, holds prognostic significance in identifying individuals at elevated risk of cardiovascular events.

(Continued)

Study	*No. of Subjects (n)*	*Study design*	*ACS/CVDs Prevalence*	*MASLD Prevalence*	*Main findings*
Seo et.al 2021 South Korea[30]	334 280	Nationwide population-based cohort study	2447 (CVD; 0.73%)	FLI > 31 83575 (25%)	An elevated FLI was independently linked to a higher risk of CVD (HR for Q4 and Q1, 1.92; 95% CI, 1.63-2.25; P<0.001)
Lee et.al 2021 South Korea[31]	3,003,068	Population-based cohort study	4534 (MI; 0.73%)	FLI ≥60 623,081 (20.74%)	A consistently high FLI was associated with a greater incidence of myocardial infarction (aHR 1.3, 95% CI,1.21-1.40)
Park et.al 2022 South Korea[32]	139,633	Cohort study	3,079 (MI; 2.2%)	FLI ≥60 was associated with increased risk for MI (HR [95% CI], 1.28 [1.14-1.44])	The FLI-based assessment of hepatic steatosis and advanced fibrosis was strongly linked to an increased risk of CVD.
Chung et.al 2022 South Korea[33]	5,324 410	Cohort study	13 051 (MIs; 0.39%)	FLI ≥60 9.8%	NAFLD independently predicted MI in young adults (HR: 1.69, 95% CI: 1.61-1.77)
Zhou et. al 2023 China[26]	9044	Population-Based Cross-Sectional Study	26 (MI; 9.38%)	FLI ≥60 902 (10.0%)	FLI is a useful indicator for the early detection of ASCVD, emphasizing its role in clinical practice for risk evaluation and preventive measures.
Garofolo et al 2024 Italy[34]	774	Prospective observational study	41 (CVD; 5.3%)	FLI ≥60 90 (11.6%)	In patients with type 1 diabetes, FLI demonstrated an association with both all-cause mortality and elevated cardiovascular event risk.

(Continued)

Study	*No. of Subjects (n)*	*Study design*	*ACS/CVDs Prevalence*	*MASLD Prevalence*	*Main findings*
Miao et al 2024 China[35]	8,647	Cohort study	484 (CHD; (5.59%)	FLI ≥60 1034 (11.95%)	High FLI values are closely linked to a greater risk of coronary heart disease, suggesting their potential as a prognostic marker for the condition.
Arafa et al 2024 Japan[36]	6,475	Prospective cohort study	244 (CHD; 41.35%)	FLI ≥60 showed a higher risk of CVD [95% CI], 1.69 [1.16, 2.46]	NAFLD, as assessed by the FLI, has been significantly associated with an increased risk of CVD among Japanese women.
Álvares et.al 2025 Brazil[37]	255	Cross-sectional study	110 (CVD cases)	60 (54.5%)	Patients with steatosis had increased cardiovascular risk. MASLD diagnosis (via FLI) exceeded 60%.

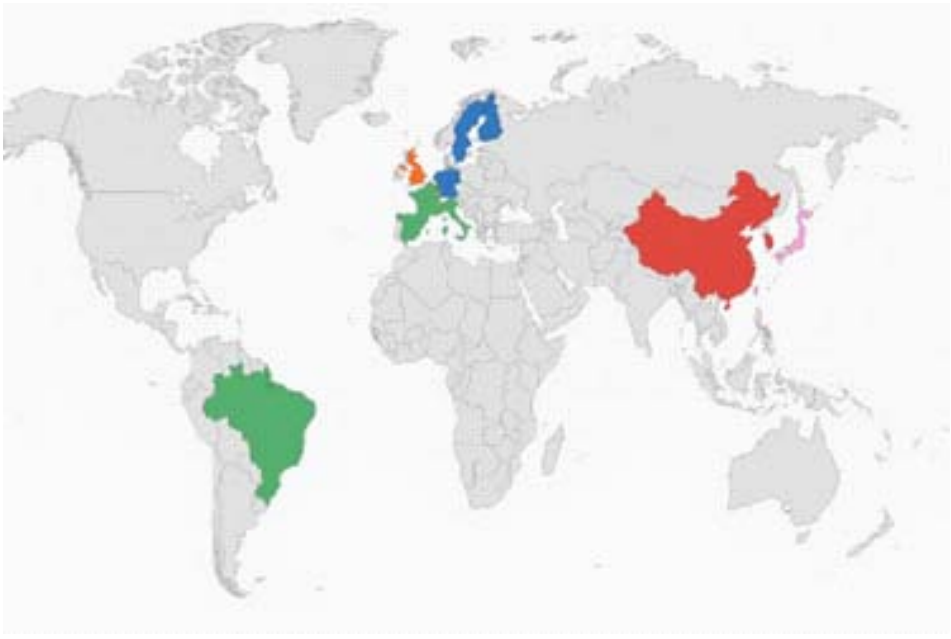

Figure 1. Global overview of countries studied for FLI as a predictor of CVDs.

Several studies across Europe (the Netherlands, Finland, Italy), Asia (South Korea, Japan, China), and Latin America (Brazil) have investigated the association between the FLI and acute coronary syndrome or broader cardiovascular diseases. In European cohorts (Netherlands, Finland, Italy), FLI ≥60 was generally associated with higher CVD risk, although its independent predictive value was sometimes attenuated by confounding factors such as age and metabolic comorbidities. In contrast, large-scale population studies from Asia, particularly South Korea, China, and Japan, consistently demonstrated that elevated FLI was independently linked to increased risk of myocardial infarction and other cardiovascular outcomes, with stronger associations observed in younger adults and in those with persistently high FLI levels. In Latin America, evidence from Brazil confirmed that patients with MASLD, as identified by high FLI, showed markedly elevated cardiovascular risk. Overall, these findings highlight FLI as a globally relevant, non-invasive marker with significant potential for early risk stratification and preventive interventions in MI and related CVDs.

Discussion

The FLI, initially developed as a non-invasive surrogate for diagnosing MASLD, has emerged as a potential tool for assessing cardiovascular risk. FLI offers a less invasive and more economical alternative, utilising anthropometric parameters such as body mass index (BMI), waist circumference (WC), and serum levels of triglycerides (TGs) and gamma-glutamyl transferase (GGT). Its diagnostic accuracy has been consistently validated in diverse populations through numerous epidemiological and clinical studies.

This review highlights findings from multiple population-based and cohort studies across countries, including South Korea, China, Japan, Finland, Brazil, Italy, and other European countries. Most studies demonstrate a consistent association between elevated FLI values (particularly ≥60) and an increased risk of acute coronary syndrome, including myocardial infarction and broader cardiovascular disease events. Notably, large-scale studies from South Korea (Kim et al., Park et al., Seo et al., Chung et al.)[29,30,32] and China (Zhou et al., Miao et al.)[26,35] have established that higher FLI levels are predictive of cardiovascular events, even after adjusting for confounding variables.

These findings suggest that hepatic steatosis, as estimated by FLI, may be part of a broader metabolic disturbance contributing to atherosclerosis and cardiovascular complications. However, evidence from a Finnish cohort study by Olubamwo et al.[28] indicates that the predictive power of FLI for MI diminishes after adjusting for metabolic factors such as insulin resistance and obesity, highlighting the complex interplay among metabolic determinants. Furthermore, cross-sectional studies, such as those by Álvares et al., support the association between FLI and cardiovascular risk but also highlight the need for longitudinal data to strengthen causal inferences.[37]

Conclusion

This narrative review highlights the growing body of evidence supporting the FLI as a reliable, non-invasive indicator for predicting ACS, such as myocardial infarction, ischemic stroke, and cardiovascular mortality. Elevated FLI levels have shown a consistent, linear correlation with poor cardiovascular outcomes, independent of conventional metabolic risk factors. These findings suggest that FLI may serve not only as a marker of hepatic fat accumulation but also as a useful prognostic tool for identifying individuals at increased risk of major cardiovascular events. Large prospective studies are needed to clarify the link between NAFLD and cardiovascular outcomes, and to assess whether early treatment can lower disease incidence in hospital settings worldwide.

Future directions

Most of the available studies investigating the association between FLI and CVDs/ACS have been conducted in Asia, particularly in South Korea and China, which together account for the majority of large-scale cohort evidence. So far, such studies have not been undertaken in Sri Lanka. Future studies should be large and long-term to confirm the extent to which FLI predicts ACS across populations, while accounting for factors such as diabetes and obesity. Incorporating the FLI into existing cardiovascular risk assessment tools could help identify individuals at high risk earlier. At the same time, further research is needed to understand the biological mechanisms through which hepatic steatosis contributes to atherosclerosis and the development of acute coronary syndrome. To optimise clinical application, standardised guidelines for the use of FLI in routine practice should be developed to define its indications and appropriate management strategies. Moreover, well-designed prospective studies and randomised clinical trials are needed to determine whether treating high FLI reduces the risk of heart disease. It is also essential to refine FLI cut-offs, compare them with imaging tests, and test their usefulness in special groups like non-obese people, women, and those with metabolic disorders. Incorporating FLI screening into hospital settings in developing countries such as Sri Lanka could facilitate

early identification of high-risk cardiac patients and strengthen preventive care strategies, including lifestyle modifications, management of metabolic risk factors (diabetes, hypertension, dyslipidemia), patient education, and timely clinical interventions to reduce cardiovascular events.

Author declaration

Conflict of interests

The authors declare no conflict of interests.

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