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Literature Review: Myocardial infarction in Young Adults

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Abstract

Myocardial infarction (MI) has traditionally been considered a disease of older adults; however, recent evidence indicates an increasing incidence among younger populations. This trend has raised significant clinical and public health concerns because MI occurring during productive years is associated with substantial long-term health, social, and economic consequences. Understanding the risk factors, clinical characteristics, and outcomes of MI in young adults is essential for improving prevention and management strategies. This study aimed to systematically review the current literature regarding myocardial infarction in young adults, with a particular focus on risk factors, clinical characteristics, and patient outcomes. A literature review was conducted using articles retrieved from PubMed, ScienceDirect, and Google Scholar. The search covered publications from 2021 to 2026 using keywords related to myocardial infarction, young adults, acute coronary syndrome, and cardiovascular risk factors. Articles were screened according to predefined inclusion and exclusion criteria. Following the selection process, 20 eligible studies consisting of observational studies, cohort studies, registry analyses, case series, and review articles were included in the final analysis. he findings demonstrate that myocardial infarction in young adults is a growing global health issue. Traditional risk factors, particularly smoking, dyslipidemia, obesity, hypertension, diabetes mellitus, and family history of cardiovascular disease, remain the primary determinants of disease occurrence. Emerging risk factors, including psychosocial stress, sleep disorders, autoimmune diseases, chronic inflammation, and substance abuse, also contribute significantly. Clinically, young patients commonly present with typical chest pain and predominantly single-vessel coronary artery disease, although non-atherosclerotic mechanisms such as spontaneous coronary artery dissection and myocardial infarction with non-obstructive coronary arteries are increasingly recognized. While short-term outcomes are generally more favorable than in older patients, long-term risks of recurrent cardiovascular events and persistent morbidity remain substantial. Myocardial infarction in young adults is a multifactorial condition requiring comprehensive risk assessment, early prevention, and long-term management strategies to reduce future cardiovascular burden.

Introduction

Myocardial infarction (MI) remains one of the most serious manifestations of cardiovascular disease and represents a major contributor to global morbidity and mortality. MI occurs when blood flow through the coronary arteries is significantly reduced or completely obstructed, resulting in prolonged myocardial ischemia and irreversible necrosis of cardiac muscle tissue (Thygesen et al., 2018). As a clinical manifestation of ischemic heart disease (IHD), MI contributes substantially to the global burden of cardiovascular diseases and continues to challenge healthcare systems worldwide. According to the World Health Organization (WHO),

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cardiovascular diseases were responsible for approximately 19.8 million deaths globally in 2022, accounting for nearly one-third of all deaths worldwide, with ischemic heart disease remaining the leading cause of cardiovascular mortality (World Health Organization [WHO], 2025). Recent estimates from the Global Burden of Disease (GBD) study indicate that more than 250 million individuals were living with ischemic heart disease in 2021, and the overall burden continues to rise because of population growth, aging, urbanization, and the increasing prevalence of cardiometabolic risk factors (Yang et al., 2025). Furthermore, projections suggest that the incidence, prevalence, and mortality associated with ischemic heart disease will continue to increase through 2050 if effective preventive strategies are not implemented (Shi et al., 2025).

Beyond its contribution to mortality, myocardial infarction is associated with substantial disability, reduced quality of life, loss of productivity, and considerable economic costs (Sulashvili & Nimangre, 2025; Blueher, 2025; Burzyńska et al., 2026). Survivors frequently experience long-term complications, including heart failure, recurrent ischemic events, arrhythmias, and impaired functional capacity, all of which place significant pressure on healthcare systems and national economies (Shi et al., 2025; WHO, 2025). Consequently, understanding the epidemiological patterns and risk factors associated with MI remains a critical priority for both clinical practice and public health policy.

Traditionally, myocardial infarction has been considered a disease predominantly affecting older adults. However, accumulating evidence indicates that the incidence of MI among younger individuals has increased considerably over recent decades (Cojocaru et al., 2025; Manumbu et al., 2025; Sayyora, 2025). Epidemiological studies from North America and Europe report that approximately 4–10% of all myocardial infarction cases occur in individuals younger than 45 years, while some regional studies have documented even higher proportions depending on population characteristics and risk factor distributions (Sayyora, 2025; Sood et al., 2023). Registry-based investigations have further demonstrated a gradual increase in hospital admissions for acute coronary syndrome among young adults, suggesting that premature cardiovascular disease is becoming an increasingly important public health concern (Kampka et al., 2025; Simonsson et al., 2025). This trend is particularly alarming because young adults are generally in their most productive years, and the occurrence of MI at a younger age results in substantial social, psychological, and economic consequences for patients, families, and society (Sood et al., 2023).

The increasing incidence of myocardial infarction among young adults is closely linked to the growing prevalence of traditional cardiovascular risk factors. Cigarette smoking remains the most consistently reported and dominant risk factor in this population, with prevalence rates exceeding 70% in several studies (Liang et al., 2023; Razib et al., 2025; Sarkar et al., 2025; Sood et al., 2023). Smoking contributes to endothelial dysfunction, inflammation, platelet activation, and accelerated atherosclerosis, thereby significantly increasing the risk of coronary artery disease at an early age (Cojocaru et al., 2025; Manumbu et al., 2025). In addition to smoking, dyslipidemia, hypertension, obesity, diabetes mellitus, and a family history of premature cardiovascular disease have been identified as major contributors to the development of MI among young individuals (Manumbu et al., 2025; Razib et al., 2025; Simonsson et al., 2025; Singh et al., 2024; Wahyuningsih et al., 2023). The increasing prevalence of obesity and metabolic syndrome among younger populations worldwide has further intensified concern regarding the future burden of premature cardiovascular disease (Simonsson et al., 2025).

Recent evidence suggests that the pathogenesis of myocardial infarction in young adults extends beyond traditional risk factors alone. Several emerging and non-traditional risk factors

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have been increasingly recognized, including psychosocial stress, sleep disorders, chronic inflammation, autoimmune diseases, environmental pollution, substance abuse, and genetic predisposition (Cojocaru et al., 2025; Ranjan et al., 2024; Zaheen et al., 2025). Chronic psychosocial stress and mental health disorders can contribute to endothelial dysfunction and sympathetic nervous system activation, while autoimmune and inflammatory conditions may accelerate vascular injury and atherogenesis (Cojocaru et al., 2025; Ranjan et al., 2024). Substance use, particularly cocaine and amphetamine consumption, has also been associated with coronary vasospasm, thrombosis, and acute myocardial ischemia in younger populations (Sood et al., 2023; Tudurachi et al., 2025). These findings highlight the multifactorial nature of MI in young adults and emphasize the need for broader cardiovascular risk assessment beyond conventional risk profiles.

An additional complexity in young-onset myocardial infarction is the relatively higher prevalence of non-atherosclerotic mechanisms compared with older populations (Vital et al., 2025; Sennani et al., 2025; Li et al., 2026). Although atherosclerotic plaque rupture remains the most common underlying cause, non-obstructive coronary syndromes such as myocardial infarction with non-obstructive coronary arteries (MINOCA), spontaneous coronary artery dissection (SCAD), coronary vasospasm, and coronary embolism occur more frequently in younger patients (Cojocaru et al., 2025; Krittanawong, 2023; Tudurachi et al., 2025; Zaheen et al., 2025). MINOCA has been reported in approximately 5–25% of young patients with MI and is particularly common among women (Zaheen et al., 2025). Similarly, SCAD represents an important cause of acute myocardial infarction in young women without traditional cardiovascular risk factors and has been associated with hormonal influences, pregnancy-related conditions, and connective tissue abnormalities (Cojocaru et al., 2025; Krittanawong, 2023). These distinct etiological mechanisms indicate that myocardial infarction in young adults constitutes a heterogeneous clinical entity requiring specialized diagnostic and management approaches.

Gender differences also play a significant role in the epidemiology and clinical presentation of myocardial infarction among young adults (Bruno et al., 2022; Lu et al., 2022; Sagris et al.., 202). Although men account for the majority of cases, women often experience atypical symptoms, delayed diagnosis, and poorer clinical outcomes despite lower overall incidence rates (Cojocaru et al., 2025; Kampka et al., 2025; Lv et al., 2021). Young women are more likely to present with non-atherosclerotic causes of MI, including SCAD and MINOCA, while psychosocial stress, hormonal factors, and female-specific reproductive conditions may further influence cardiovascular risk (Cojocaru et al., 2025; Lv et al., 2021). Consequently, sex-specific considerations have become increasingly important in understanding the pathophysiology and clinical management of myocardial infarction in younger populations.

In Indonesia, cardiovascular disease remains a major public health challenge. Data from the Indonesian Health Survey (SKI) 2023 reported that the prevalence of physician-diagnosed heart disease reached approximately 0.85% of the population, indicating that cardiovascular conditions continue to affect millions of Indonesians (Yonatan, 2024). Cardiovascular disease is also among the leading causes of mortality nationally, contributing to more than 650,000 deaths annually (Badan Riset dan Inovasi Nasional, 2024). The economic burden is equally substantial. National health insurance data indicate that cardiovascular diseases constitute one of the most costly catastrophic illnesses, generating healthcare expenditures exceeding IDR 23 trillion annually, with ischemic heart disease accounting for a significant proportion of these costs (Darmawan et al., 2025; Health Development Policy Agency, 2024). These figures underscore the considerable clinical and economic impact of cardiovascular disease in

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Indonesia and highlight the importance of preventive strategies targeting high-risk populations, including younger adults.

Despite growing recognition of myocardial infarction in young adults, important gaps remain in understanding its epidemiological characteristics, risk factor profiles, clinical manifestations, and outcomes. Many studies have primarily focused on traditional cardiovascular risk factors, whereas emerging mechanisms and non-classical etiologies remain underexplored (Cojocaru et al., 2025; Tudurachi et al., 2025; Zaheen et al., 2025). Furthermore, differences in age definitions, study populations, and healthcare settings have produced heterogeneous findings that require comprehensive synthesis. Given the increasing incidence of MI among young adults and its long-term consequences on morbidity, mortality, productivity, and healthcare costs, a deeper understanding of this condition is essential to support early detection, risk stratification, and effective preventive interventions in this vulnerable population (Kampka et al., 2025; Simonsson et al., 2025; Sood et al., 2023).

Method

Study Design

This study employed a literature review design to identify, evaluate, and synthesize current scientific evidence regarding myocardial infarction in young adults. The review focused on three principal aspects of the disease: risk factors, clinical characteristics, and clinical outcomes. Through a systematic examination of published literature, the study aimed to provide a comprehensive overview of the epidemiological and clinical profile of myocardial infarction occurring in younger populations. The review incorporated findings from both primary and secondary research articles to capture a broad perspective on the topic and to identify consistent patterns across different healthcare settings and populations.

Literature Search Strategy

A comprehensive literature search was conducted using three major electronic databases: PubMed, ScienceDirect, and Google Scholar. These databases were selected because they provide extensive coverage of biomedical and clinical research publications. The search process was limited to articles published between January 2021 and January 2026 to ensure that the evidence reflected the most recent developments in the field.

The search strategy utilized combinations of keywords and Boolean operators to maximize the retrieval of relevant studies. The primary search terms included “myocardial infarction,” “acute myocardial infarction,” “young adults,” “young population,” “acute coronary syndrome,” “risk factors,” “clinical characteristics,” and “clinical outcomes.” Examples of search combinations included: (“myocardial infarction” AND “young adults”), (“acute myocardial infarction” AND “young population”), (“risk factors” AND “young adults”), and (“acute coronary syndrome” AND “young age”). Additional manual screening of reference lists from relevant articles was performed when necessary to identify potentially eligible studies not captured during the initial database search.

Eligibility Criteria

Studies were considered eligible for inclusion if they met several predefined criteria. First, the article had to be published between 2021 and 2026 in either English or Indonesian. Second, the study population consisted of young individuals diagnosed with myocardial infarction, according to the age definition adopted by each study, which generally ranged from ≤45 years to ≤50 years. Third, the article explicitly discussed myocardial infarction in young adults and reported at least one of the variables of interest, including prevalence, risk factors,

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pathophysiological mechanisms, clinical characteristics, angiographic findings, complications, or patient outcomes. Fourth, the full-text version of the article had to be accessible for comprehensive evaluation.

Eligible study designs included observational studies, cohort studies, case-control studies, cross-sectional studies, retrospective and prospective investigations, registry-based studies, database analyses, case series, and narrative or systematic review articles. Including various study designs enabled a broader understanding of myocardial infarction in young populations from both clinical and epidemiological perspectives.

Studies were excluded if full-text access was unavailable, if they were editorials, letters to the editor, conference abstracts without complete manuscripts, commentaries, or non-scientific opinion papers. Articles published before 2021 were also excluded. Furthermore, studies that did not specifically analyze young patients or failed to provide separate data for the young population were not included in the final review.

Study Selection Process

The study selection process was conducted in several stages. Initially, a total of 132 articles were identified from the three electronic databases, comprising 52 articles from PubMed, 44 articles from Google Scholar, and 36 articles from ScienceDirect. All retrieved records were compiled and screened for duplicate entries based on similarities in title, authorship, and publication details. This process resulted in the removal of 32 duplicate articles, leaving 100 unique studies for further evaluation.

Subsequently, title and abstract screening was performed to assess the relevance of each article to the research topic. During this stage, 64 articles were excluded because they did not specifically address myocardial infarction in young adults, focused on cardiovascular diseases in general, or did not correspond to the objectives of the review. The remaining 36 articles proceeded to full-text assessment.

A detailed full-text review was then conducted to determine whether each study fulfilled all eligibility criteria. During this phase, 16 articles were excluded due to insufficient reporting of outcomes among young adults, unclear methodological descriptions, or inadequate presentation of relevant clinical findings. Ultimately, 20 articles met all inclusion criteria and were included in the final analysis and evidence synthesis.

Data Extraction and Variables

Data extraction was performed systematically using a standardized data collection framework. Information obtained from each article included publication year, author names, country of study, study design, sample size, age definition of young myocardial infarction, participant characteristics, identified risk factors, clinical presentations, angiographic findings, therapeutic approaches, complications, and clinical outcomes.

The primary variable examined was myocardial infarction in young adults, defined according to the diagnostic criteria applied within each study. Diagnosis generally included clinical symptoms suggestive of myocardial ischemia, electrocardiographic abnormalities, elevated cardiac biomarkers such as troponin, and coronary angiographic findings. Risk factor variables included traditional cardiovascular risk factors such as smoking, hypertension, diabetes mellitus, dyslipidemia, obesity, and family history of cardiovascular disease, as well as non-traditional factors including psychosocial stress, substance abuse, autoimmune disorders, sleep disturbances, and genetic predisposition. Clinical characteristics encompassed symptom presentation, infarction subtype, coronary anatomy, and procedural findings, while clinical

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outcomes included mortality, major adverse cardiovascular events, rehospitalization, complications, and long-term follow-up outcomes.

Data Synthesis and Analysis

A narrative synthesis approach was employed to analyze and integrate findings from the included studies. Due to substantial heterogeneity in study design, sample characteristics, outcome measures, and age definitions, quantitative meta-analysis was not considered appropriate. Instead, the evidence was synthesized descriptively to identify recurring patterns, similarities, and differences across studies.

The analysis focused on three major domains: risk factors, clinical characteristics, and clinical outcomes of myocardial infarction in young adults. Findings were compared across studies to identify dominant risk factors, common clinical presentations, angiographic patterns, and prognostic outcomes. Particular attention was given to emerging risk factors, gender-related differences, and non-atherosclerotic mechanisms of myocardial infarction that have increasingly been reported in younger populations. The synthesized evidence was subsequently interpreted to provide a comprehensive understanding of the current state of knowledge regarding myocardial infarction in young adults.

Result and Discussion

This research was conducted using a literature review method, compiling various scientific articles discussing the incidence of Myocardial Infarction (MI) in young adults. Twenty scientific articles published between 2021 and 2026 were selected and deemed most relevant to the research focus. These articles were then analyzed based on publication year, title, research method, author, and key findings. A summary of the literature review results is presented in the following table.

Table 1. Literature review Myocardial infarction in Young Adults

Authors (Year)	Title	Study Design & Sample	Main Findings
Manumbu et al. (2025)	Pathogenesis of Myocardial Infarction in Young Adults	Educational review / narrative review	Myocardial infarction (MI) in young adults is influenced by both traditional and non-traditional risk factors. Major contributors include smoking, hypertension, dyslipidemia, obesity, diabetes, family history, alcohol use, substance abuse, and sedentary lifestyle. Pathogenesis involves both obstructive MI and MINOCA mechanisms.
Cojocaru et al. (2025)	Myocardial Infarction in Young Adults: Revisiting Risk Factors and Atherothrombotic Pathways	Narrative literature review	MI in young adults has a distinct risk profile. Emerging factors include elevated lipoprotein(a), psychosocial stress, sleep disorders, autoimmune diseases, recreational drug

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			use, and genetic predisposition. Non-atherosclerotic mechanisms such as SCAD and MINOCA are increasingly recognized.
Zaheen et al. (2025)	Myocardial Infarction in the Young: Aetiology, Emerging Risk Factors, and the Role of Novel Biomarkers	Narrative review	Rising incidence of premature MI is associated with obesity, hypertension, diabetes, hyperlipidemia, chronic inflammation, and autoimmune disorders. Atherosclerosis remains the primary cause, although SCAD, vasospasm, and MINOCA are more common among young patients.
Tudurachi et al. (2025)	Myocardial Infarction in Young Adults: A Case Series and Comprehensive Review of Molecular and Clinical Mechanisms	Case series and narrative review (4 cases)	Young-adult MI demonstrates multifactorial etiology including premature atherosclerosis, vasospasm, SCAD, vasculitis, hypercoagulability, and drug-induced injury. Early diagnosis and risk-factor modification are essential for improved outcomes.
Razib et al. (2025)	Comparison of Clinical Characteristics and Risk Factor Profile Between Very Young and Older Patients Presenting with First Acute Myocardial Infarction	Cross-sectional observational study (n = 160)	Younger patients exhibited higher rates of smoking, obesity, dyslipidemia, family history, and substance abuse, whereas hypertension and diabetes predominated among older patients.
Kampka et al. (2025)	Clinical Characteristics and Outcomes of Young Patients with Acute Myocardial Infarction: The YAMI Registry	Registry study (n = 221 young MI patients)	Young patients were predominantly male, had lower mortality rates, and often presented with elevated lipid levels and smoking history. Approximately 15.8% of cases involved non-classical etiologies.
Kamalova (2025)	Myocardial Infarction in Young Adults: Risk Factors and Trends	Narrative epidemiological review	MI incidence among young adults continues to increase. Approximately 4–10% of all MI cases occur in individuals younger than 45 years. Lifestyle modification and

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			early screening are emphasized.
Simonsson et al. (2025)	Trends in Risk Factors Among Young Patients with Acute Myocardial Infarction: A Nationwide Cohort Study	Nationwide cohort registry (44,254 MI patients)	Approximately 75% of young patients had at least one cardiovascular risk factor. Obesity showed the greatest increase over time and was associated with higher mortality, especially among women.
Moysidis et al. (2025)	Clinical Characteristics and Outcomes of Patients with Acute Myocardial Infarction Without Standard Modifiable Risk Factors (SMuRFs)	Prospective cohort (n = 1,011)	Patients without traditional risk factors experienced more severe clinical presentations and poorer short-term outcomes. Inflammation and psychiatric disorders contributed significantly.
Liang et al. (2023)	Clinical Risk Factors and Outcomes of Young Patients with Acute ST-Segment Elevation Myocardial Infarction	Retrospective observational study (n = 701)	Smoking, alcohol use, and elevated lipid levels were common. Diabetes mellitus predicted major adverse cardiovascular events.
Sood et al. (2023)	Myocardial Infarction in Young Individuals: A Review Article	Narrative review	Smoking remains the most important risk factor. MI in young adults has substantial psychological, social, and economic consequences.
Ranjan et al. (2024)	Young Hearts at Risk: Unveiling Novel Factors in Myocardial Infarction Susceptibility and Prevention	Narrative review	Novel risk factors include air pollution, sleep apnea, autoimmune diseases, and energy drink consumption, all of which contribute through inflammatory pathways and endothelial dysfunction.
Dimitrova (2023)	Acute Myocardial Infarction in Young Individuals: Demographic and Risk Factor Profile	Retrospective observational study (n = 172)	Young patients were predominantly male, had more single-vessel disease, and demonstrated lower mortality rates compared with older populations.
Wahyuningsih et al. (2023)	Risk Factors for Acute Myocardial Infarction in Young Adults	Literature review (16 studies)	Smoking, lifestyle habits, comorbidities, genetic predisposition, and gender-related factors were identified as major determinants of MI risk.

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Krittanawong et al. (2023)	Acute Myocardial Infarction: Etiologies and Mimickers in Young Patients	Contemporary narrative review	Approximately 90% of MI cases are attributable to atherosclerosis, while 10% result from non-atherosclerotic mechanisms, highlighting the importance of accurate etiological assessment.
Khraishah et al. (2022)	Clinical Characteristics and Cardiovascular Outcomes Among Young Patients with AMI in Kerala, India	Secondary analysis (n = 21,374)	Young patients generally had better outcomes than older patients, although smoking prevalence remained high. Women experienced poorer outcomes than men.
Lv et al. (2021)	Clinical Characteristics, Prognosis, and Gender Disparities in Young AMI Patients	Prospective registry (n = 24,125)	Young adults showed better prognosis overall, but gender disparities in presentation and outcomes were evident.
Singh et al. (2024)	Incidence and Risk Factors of MI Among Young Adults in Punjab	Cross-sectional study (n = 131)	Smoking, family history, hypertension, diabetes mellitus, and socioeconomic factors were associated with increased MI risk.
Sarkar et al. (2025)	Evaluation of Risk Factors, Clinical Characteristics and Angiographic Patterns in Young MI Patients	Retrospective observational study (n = 100)	Smoking was the most dominant risk factor. Young patients frequently exhibited single-vessel disease and favorable short-term outcomes.
Mesmar et al. (2025)	Changing Trends in MI Mortality Among Young Adults in the United States	Population-based epidemiological study (91,482 deaths)	MI mortality declined over time but increased during the COVID-19 pandemic. Significant disparities were observed according to gender, race, and geographic region.

Myocardial Infarction in Young Adults

The findings of this review collectively indicate that myocardial infarction (MI) in young adults should no longer be regarded as an uncommon clinical event confined to a small subset of high-risk individuals. Rather, the contemporary evidence suggests that premature myocardial infarction has emerged as a distinct cardiovascular phenotype characterized by unique epidemiological patterns, heterogeneous pathophysiological mechanisms, and substantial long-term socioeconomic consequences. Across the studies included in this review, the proportion of young adults among all MI cases ranged from approximately 4% to 22%, reflecting substantial geographic and demographic variation but consistently demonstrating that premature coronary events constitute a clinically meaningful component of the global ischemic

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heart disease burden (Khraishah et al., 2022; Lv et al., 2021; Singh et al., 2024; Kamalova, 2025).

The increasing incidence of MI among younger populations appears to reflect a broader epidemiological transition occurring in both developed and developing countries. Historically, myocardial infarction was predominantly considered a disease of aging, largely attributable to cumulative exposure to atherosclerotic risk factors over several decades. However, the evidence reviewed here suggests that the temporal compression of cardiovascular risk exposure has fundamentally altered this paradigm. Contemporary young adults are increasingly exposed to obesity, insulin resistance, sedentary lifestyles, poor dietary patterns, chronic psychosocial stress, sleep disruption, and environmental risk factors from early adulthood, thereby accelerating vascular aging and atherogenesis (Manumbu et al., 2025; Simonsson et al., 2025). Consequently, chronological age alone no longer adequately reflects cardiovascular risk, and the concept of "premature cardiovascular aging" may provide a more appropriate framework for understanding contemporary patterns of young-onset myocardial infarction.

A notable finding emerging from this review is the persistent predominance of male patients among young MI cohorts. While this observation has traditionally been attributed to the cardioprotective effects of endogenous estrogen, such an explanation is increasingly insufficient when considered in isolation. The evidence suggests that biological protection interacts with behavioral, environmental, and social determinants of health. Young men exhibit disproportionately higher exposure to smoking, alcohol consumption, recreational drug use, occupational stress, and other adverse lifestyle factors that collectively amplify cardiovascular risk (Sood et al., 2023; Sarkar et al., 2025). Thus, sex disparities in myocardial infarction cannot be interpreted solely through a biological lens but must be understood as the product of complex interactions between biological susceptibility and socially patterned risk exposures.

Paradoxically, although young women experience myocardial infarction less frequently, they often encounter disproportionately adverse clinical trajectories. Multiple studies identified delayed diagnosis, atypical symptom presentation, and worse short-term outcomes among women compared with age-matched men (Cojocaru et al., 2025; Lv et al., 2021). This finding has important implications because it challenges the traditional assumption that lower disease incidence necessarily translates into lower disease burden. Indeed, the under-recognition of cardiovascular disease in young women represents a persistent clinical blind spot. Diagnostic algorithms and risk prediction models have historically been derived from predominantly male populations, potentially reducing their sensitivity in identifying women with acute coronary syndromes. Consequently, gender disparities in outcomes may reflect not only biological differences but also systemic biases embedded within contemporary cardiovascular care pathways.

Perhaps the most important conceptual insight arising from this review is the recognition that myocardial infarction in young adults is not simply an earlier manifestation of the same disease observed in older populations. Instead, accumulating evidence suggests that young-onset MI represents a partially distinct pathobiological entity. While premature atherosclerosis remains the dominant mechanism, a substantially greater proportion of young patients experience infarction through non-atherosclerotic pathways, including spontaneous coronary artery dissection (SCAD), coronary vasospasm, coronary embolism, thrombophilia, and myocardial infarction with non-obstructive coronary arteries (MINOCA) (Tudurachi et al., 2025; Krittanawong, 2023; Zaheen et al., 2025). These findings challenge the traditional atherosclerosis-centered model that has dominated cardiovascular medicine for decades.

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The increasing recognition of MINOCA is particularly significant because it exposes the limitations of conventional diagnostic frameworks. The historical assumption that myocardial infarction necessarily requires significant coronary obstruction is increasingly untenable in light of contemporary evidence. Young patients, particularly women, frequently present with ischemic myocardial injury despite the absence of obstructive coronary disease on angiography (Zaheen et al., 2025). Such observations suggest that coronary pathology must be understood as extending beyond macroscopic luminal stenosis to include microvascular dysfunction, endothelial abnormalities, inflammatory processes, and transient disturbances in coronary blood flow regulation. Consequently, future diagnostic strategies will likely require greater integration of advanced imaging, functional testing, and molecular biomarkers to adequately characterize disease mechanisms in younger populations.

Furthermore, the evidence synthesized in this review highlights the inadequacy of relying exclusively on traditional cardiovascular risk factors when assessing risk in young adults. While smoking, dyslipidemia, obesity, hypertension, and diabetes remain critically important determinants of disease, they do not fully explain the occurrence of myocardial infarction in younger individuals. Several studies documented substantial proportions of patients presenting without standard modifiable cardiovascular risk factors, yet experiencing severe clinical manifestations and adverse outcomes (Moysidis et al., 2025). This finding suggests that current risk stratification paradigms may fail to identify a clinically relevant subset of vulnerable individuals. Emerging evidence implicates chronic inflammation, autoimmune disorders, thrombophilic states, psychosocial stress, sleep disorders, environmental exposures, and genetic susceptibility as important contributors to disease development (Cojocaru et al., 2025; Ranjan et al., 2024; Zaheen et al., 2025). Therefore, future prevention strategies will require a broader conceptualization of cardiovascular risk that extends beyond conventional biomedical models.

Taken together, these findings support a paradigm shift in the understanding of myocardial infarction among young adults. The disease should no longer be conceptualized as merely a premature manifestation of age-related atherosclerosis but rather as a multifactorial syndrome arising from complex interactions among traditional cardiovascular risk factors, emerging biological pathways, psychosocial determinants, environmental exposures, and sex-specific mechanisms. Such a perspective has important implications for clinical practice, public health policy, and future research. Effective prevention will require earlier identification of high-risk individuals, broader incorporation of non-traditional risk markers, and greater recognition of sex-specific and age-specific disease mechanisms. Without such changes, the growing burden of myocardial infarction among young adults is likely to continue despite advances in cardiovascular therapeutics.

Risk Factors

The evidence synthesized in this review demonstrates that myocardial infarction in young adults cannot be adequately explained through a traditional risk-factor framework alone. Although conventional cardiovascular risk factors remain highly prevalent, their interaction with emerging biological, behavioral, and psychosocial determinants suggests a more complex and multidimensional disease model than has historically been recognized. The contemporary epidemiology of young-onset myocardial infarction therefore challenges the longstanding assumption that coronary events are primarily the cumulative consequence of aging-related atherosclerotic exposure.

Among all conventional risk factors, smoking remains the most consistently reported and influential determinant of myocardial infarction in young adults. Across observational studies,

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smoking prevalence frequently exceeds 60–70%, substantially higher than that observed in older myocardial infarction populations (Liang et al., 2023; Sarkar et al., 2025; Sood et al., 2023). The persistence of smoking as the dominant risk factor is not surprising given its unique ability to simultaneously affect multiple pathophysiological pathways. Cigarette smoke promotes endothelial dysfunction, oxidative stress, platelet activation, vascular inflammation, and prothrombotic states, thereby accelerating every stage of atherogenesis. Unlike many cardiovascular risk factors that exert their effects gradually over decades, smoking appears capable of substantially shortening the timeline between exposure and clinical manifestation. Consequently, smoking may function not merely as a risk factor but as a biological accelerator of vascular aging.

However, the current evidence also suggests that the risk profile of young myocardial infarction patients is undergoing a significant epidemiological transformation. Historically, smoking was regarded as the principal driver of premature coronary disease. Contemporary studies, however, increasingly identify obesity as a rapidly emerging contributor to cardiovascular risk among younger populations (Simonsson et al., 2025). This shift likely reflects broader societal changes characterized by reduced physical activity, increased consumption of ultra-processed foods, and growing prevalence of metabolic dysfunction. Importantly, obesity should not be viewed as an isolated risk factor. Rather, it represents a complex metabolic state that amplifies multiple downstream pathological processes, including insulin resistance, systemic inflammation, hypertension, dyslipidemia, and endothelial injury. The increasing prominence of obesity therefore signals a transition from a predominantly behavioral risk profile toward a more metabolically driven cardiovascular disease landscape.

The role of dyslipidemia deserves particular attention because several studies suggest that lipid abnormalities in young myocardial infarction patients differ qualitatively as well as quantitatively from those observed in older populations. Elevated triglycerides, increased low-density lipoprotein cholesterol, reduced high-density lipoprotein cholesterol, and unfavorable apolipoprotein profiles are frequently reported among young patients (Liang et al., 2023; Sarkar et al., 2025). Moreover, emerging biomarkers such as lipoprotein(a), homocysteine, and ApoB/ApoA1 ratios have demonstrated strong associations with premature coronary events (Zaheen et al., 2025). These findings suggest that young-onset myocardial infarction may involve a particularly aggressive atherogenic phenotype characterized by enhanced thrombogenicity and inflammatory activation. Such observations raise important questions regarding whether current lipid management strategies are sufficiently aggressive for younger high-risk populations.

A particularly noteworthy finding emerging from this review is the increasing recognition of non-traditional cardiovascular risk factors. Psychosocial stress, sleep disturbances, depression, autoimmune diseases, chronic inflammatory conditions, environmental pollution, and substance abuse have all been implicated in the pathogenesis of myocardial infarction among younger individuals (Cojocaru et al., 2025; Ranjan et al., 2024; Zaheen et al., 2025). Collectively, these factors challenge the historical distinction between cardiovascular disease and broader social or psychological determinants of health. Chronic psychosocial stress, for example, activates neuroendocrine pathways that promote sympathetic overactivity, inflammation, endothelial dysfunction, and metabolic disturbances. Similarly, autoimmune diseases create persistent inflammatory states capable of accelerating vascular injury independent of traditional risk factors. These observations support the growing recognition that cardiovascular disease should be understood not merely as a disorder of lipid accumulation but as a systemic disease influenced by complex interactions among biological, environmental, and psychosocial processes.

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Perhaps the most provocative finding in the contemporary literature is the existence of myocardial infarction among individuals without standard modifiable cardiovascular risk factors. Moysidis et al. (2025) reported that a substantial subgroup of patients developed myocardial infarction despite lacking conventional risk factors such as smoking, hypertension, diabetes, dyslipidemia, or obesity. Furthermore, these individuals often experienced more severe clinical presentations and worse short-term outcomes. Such findings expose a fundamental limitation of current risk prediction models, which remain heavily dependent on traditional cardiovascular variables. If clinically significant coronary events continue to occur among ostensibly low-risk individuals, then existing prevention frameworks may be systematically underestimating disease susceptibility within certain populations.

From a broader theoretical perspective, these findings suggest that myocardial infarction in young adults may represent the convergence of multiple pathogenic pathways rather than the linear progression of atherosclerosis alone (Simonetto et al., 2022; Młynarska et al., 2024). Traditional risk factors undoubtedly remain important; however, they interact with genetic susceptibility, inflammatory mechanisms, psychosocial exposures, environmental conditions, and sex-specific biological factors in ways that are not yet fully understood. Consequently, future cardiovascular research should move beyond reductionist models that focus exclusively on individual risk factors and instead adopt systems-based approaches capable of capturing the complex network of interactions that ultimately culminate in myocardial infarction.

The implications for prevention are substantial. Current cardiovascular prevention strategies remain largely centered on conventional risk assessment tools developed from middle-aged and older populations. Yet the evidence reviewed here indicates that such approaches may inadequately identify younger individuals at risk. Earlier screening, incorporation of non-traditional risk markers, assessment of psychosocial determinants, and greater emphasis on lifetime cardiovascular risk rather than short-term risk estimates may therefore be necessary. Without a fundamental shift in preventive paradigms, the continuing rise of myocardial infarction among young adults is likely to remain an unresolved challenge despite ongoing advances in cardiovascular therapeutics.

Clinical Characteristics

The clinical characteristics identified across the reviewed studies reinforce the notion that myocardial infarction in young adults constitutes a distinct clinical syndrome rather than merely an age-shifted version of conventional coronary artery disease. While the cardinal manifestations of myocardial ischemia remain broadly similar across age groups, important differences emerge regarding symptom presentation, angiographic patterns, underlying mechanisms, and disease severity. Collectively, these differences provide important insights into the biological heterogeneity of myocardial infarction and underscore the limitations of applying diagnostic frameworks developed predominantly from older populations to younger patients.

Chest pain remains the most frequently reported presenting symptom among young adults with myocardial infarction (Dimitrova, 2023; Liang et al., 2023). However, focusing exclusively on symptom prevalence risks obscuring clinically meaningful variations in presentation. The reviewed literature consistently demonstrates that younger patients, particularly women, are more likely to present with atypical manifestations including nausea, fatigue, dyspnea, dizziness, epigastric discomfort, and generalized weakness (Cojocaru et al., 2025; Lv et al., 2021). Importantly, these symptoms are often interpreted as non-cardiac in origin, contributing to delays in diagnosis and treatment. Such findings expose a persistent challenge in

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cardiovascular medicine: diagnostic reasoning remains heavily influenced by traditional symptom patterns that were originally derived from predominantly male populations.

This issue is particularly relevant because contemporary cardiovascular care continues to rely heavily on symptom-based risk stratification. Yet the evidence synthesized in this review suggests that symptom presentation is strongly influenced by biological sex, age, hormonal status, and underlying pathophysiological mechanisms. Consequently, the classical image of myocardial infarction characterized by crushing substernal chest pain may inadequately represent a substantial proportion of young patients. Failure to recognize these variations may contribute to underdiagnosis, delayed reperfusion therapy, and avoidable adverse outcomes.

Beyond symptom presentation, angiographic findings provide compelling evidence that the coronary anatomy of young myocardial infarction patients differs substantially from that observed in older populations. Multiple studies reported a predominance of single-vessel disease, with the left anterior descending artery being the most frequently affected vessel (Liang et al., 2023; Sarkar et al., 2025; Dimitrova, 2023). In contrast, diffuse multivessel atherosclerosis, which characterizes many older patients, appears considerably less common among younger cohorts.

At first glance, these findings may appear reassuring because limited coronary involvement is traditionally associated with better prognosis. However, such an interpretation may be overly simplistic. The occurrence of myocardial infarction despite relatively localized coronary disease suggests that plaque vulnerability rather than plaque burden may play a particularly important role in younger patients. In other words, young individuals may not necessarily have extensive atherosclerosis, but the lesions they do possess appear more susceptible to rupture, erosion, thrombosis, or vasomotor dysfunction. This distinction is clinically important because it shifts attention away from the quantity of atherosclerotic disease toward its biological behavior.

The concept of plaque vulnerability is increasingly supported by contemporary evidence demonstrating heightened inflammatory activity among younger myocardial infarction patients. Elevated inflammatory biomarkers, including C-reactive protein and other markers of systemic inflammation, have been associated with acute coronary events in younger populations (Razib et al., 2025; Zaheen et al., 2025). These observations suggest that inflammatory activation may function as a critical trigger converting subclinical atherosclerosis into clinically apparent myocardial infarction. Consequently, inflammatory pathways may represent particularly promising therapeutic targets for future prevention strategies.

Perhaps the most transformative finding emerging from the recent literature is the growing recognition of non-atherosclerotic myocardial infarction mechanisms. For decades, myocardial infarction was conceptualized almost exclusively as a consequence of progressive coronary atherosclerosis culminating in plaque rupture and thrombotic occlusion. While this paradigm remains valid for many patients, the evidence reviewed here indicates that it is insufficient to explain the full spectrum of disease observed in younger populations.

Contemporary studies increasingly identify spontaneous coronary artery dissection (SCAD), coronary vasospasm, coronary embolism, hypercoagulable states, and myocardial infarction with non-obstructive coronary arteries (MINOCA) as clinically important mechanisms among young adults (Tudurachi et al., 2025; Krittanawong, 2023; Zaheen et al., 2025). These findings fundamentally challenge the traditional equation of myocardial infarction with obstructive coronary artery disease. Indeed, a substantial proportion of young patients experience ischemic myocardial injury despite the absence of significant coronary stenosis on angiography.

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The increasing recognition of MINOCA is particularly important because it exposes conceptual limitations within contemporary cardiovascular diagnostics. Conventional angiography primarily visualizes epicardial coronary anatomy and is therefore poorly suited to detecting microvascular dysfunction, endothelial abnormalities, transient vasospasm, or inflammatory coronary processes. Consequently, patients with genuine myocardial ischemia may be incorrectly classified as having normal coronary arteries. This diagnostic gap suggests that future approaches to myocardial infarction assessment will require greater integration of multimodal imaging, intracoronary physiology testing, and molecular biomarkers capable of identifying mechanisms that extend beyond visible luminal obstruction.

Sex-specific differences are especially apparent in the distribution of non-atherosclerotic mechanisms. Several studies identified SCAD and MINOCA as disproportionately affecting women, particularly those without conventional cardiovascular risk factors (Cojocaru et al., 2025; Zaheen et al., 2025). This observation carries significant clinical implications because many diagnostic algorithms continue to prioritize atherosclerotic disease pathways. As a result, clinicians may underestimate the likelihood of myocardial infarction among women who lack traditional risk factors, potentially delaying diagnosis and treatment.

The emerging evidence therefore supports a more nuanced understanding of myocardial infarction in young adults. Rather than representing a single disease entity, myocardial infarction should be conceptualized as a clinical syndrome arising from multiple pathophysiological pathways that converge upon a common endpoint of myocardial ischemia and necrosis. Atherosclerotic plaque rupture remains important, but it is only one mechanism among many. Recognizing this heterogeneity is essential for improving diagnostic accuracy, individualizing treatment strategies, and advancing future research into age-specific and sex-specific cardiovascular disease mechanisms.

Taken together, the clinical characteristics observed among young myocardial infarction patients challenge several longstanding assumptions within cardiovascular medicine. They demonstrate that myocardial infarction can occur in the absence of extensive coronary disease, that symptom presentation is often more heterogeneous than traditionally recognized, and that non-atherosclerotic mechanisms play a far greater role than previously appreciated. Consequently, the clinical evaluation of young adults presenting with possible acute coronary syndromes requires a broader diagnostic perspective that extends beyond conventional atherosclerotic paradigms and incorporates the growing complexity of contemporary cardiovascular disease.

Clinical Outcomes

At first glance, the clinical prognosis of young adults with myocardial infarction appears favorable when compared with older populations. Multiple studies included in this review consistently reported lower in-hospital mortality, reduced complication rates, shorter lengths of hospitalization, and better preservation of left ventricular function among younger patients (Kampka et al., 2025; Khraishah et al., 2022; Lv et al., 2021). These findings are generally attributed to superior physiological reserve, fewer chronic comorbidities, and a lower burden of diffuse coronary artery disease. However, interpreting these observations as evidence that myocardial infarction is a relatively benign condition in younger individuals would represent a significant oversimplification. The contemporary literature increasingly suggests that the apparent survival advantage observed during the acute phase masks a substantial long-term burden of disease that extends far beyond traditional mortality indicators.

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The concept of favorable short-term outcomes among young myocardial infarction patients should therefore be interpreted cautiously. While survival rates are generally higher than those observed in older cohorts, survival itself represents only one dimension of clinical outcome. Young patients who survive an acute coronary event must often live for several decades with the consequences of myocardial injury, ventricular remodeling, recurrent ischemic events, and lifelong exposure to cardiovascular risk factors. Consequently, the cumulative burden of disease may ultimately be greater than that experienced by older patients despite lower early mortality. This phenomenon highlights an important limitation of outcome assessment in cardiovascular research, where short-term mortality often receives disproportionate attention relative to long-term morbidity and quality-of-life outcomes.

An important paradox emerging from the reviewed literature is that young patients frequently demonstrate better survival despite presenting with severe clinical manifestations. Several studies reported that cardiogenic shock, ventricular arrhythmias, cardiac arrest, and complete heart block can occur even among otherwise healthy young individuals experiencing their first myocardial infarction (Razib et al., 2025; Tudurachi et al., 2025). This observation suggests that age alone does not protect against catastrophic acute presentations. Rather, younger patients may possess greater physiological resilience that allows recovery from events that would otherwise prove fatal in older populations. Therefore, favorable mortality statistics should not obscure the potentially severe nature of acute myocardial infarction in this age group.

Furthermore, the reviewed evidence demonstrates that prognosis is strongly influenced by the underlying mechanism of infarction rather than chronological age alone. Young patients with preserved left ventricular systolic function generally experience excellent long-term outcomes, whereas those presenting with reduced ejection fraction, extensive myocardial damage, or cardiac arrest face substantially elevated mortality risks (Kampka et al., 2025; Lv et al., 2021). These findings reinforce the notion that biological severity is a more important determinant of prognosis than age itself. Consequently, clinicians should avoid assuming favorable outcomes solely on the basis of youth and instead focus on objective indicators of myocardial injury and ventricular function.

A particularly important finding concerns the subgroup of patients who develop myocardial infarction despite lacking standard modifiable cardiovascular risk factors. Moysidis et al. (2025) demonstrated that these individuals frequently experience more severe presentations and worse short-term outcomes than patients with traditional risk profiles. This observation challenges conventional assumptions regarding cardiovascular risk stratification. The absence of recognized risk factors may delay diagnosis, reduce clinical suspicion, and limit opportunities for preventive intervention. Moreover, these patients may possess underlying biological vulnerabilities that remain poorly understood, including genetic predisposition, inflammatory dysregulation, thrombophilia, or endothelial dysfunction. The existence of this subgroup underscores significant gaps in current cardiovascular risk prediction models and highlights the need for more sophisticated approaches to identifying vulnerable individuals.

Beyond survival and recurrent events, the long-term consequences of myocardial infarction in young adults extend into broader psychosocial and socioeconomic domains. Unlike older patients who may already be retired or approaching retirement, young adults experience myocardial infarction during periods of peak educational, occupational, and family responsibilities. Consequently, the disease imposes a disproportionate burden on workforce participation, productivity, income stability, and family well-being (Kamalova, 2025; Sood et al., 2023). The loss of productive years resulting from cardiovascular disability may generate

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societal costs that substantially exceed the direct medical expenses associated with acute treatment. From a public health perspective, the economic implications of premature myocardial infarction are therefore particularly profound.

The psychological impact of myocardial infarction in young adults also deserves greater attention. Experiencing a life-threatening cardiovascular event at a young age frequently challenges an individual's perception of health, invulnerability, and future expectations. Several studies have reported elevated rates of anxiety, depression, emotional distress, and reduced quality of life following myocardial infarction among younger patients (Sood et al., 2023; Cojocaru et al., 2025). These psychological consequences may adversely affect medication adherence, participation in rehabilitation programs, and adoption of healthy lifestyle behaviors. Thus, optimal post-infarction care requires not only biological management but also comprehensive psychosocial support.

Another critical issue highlighted by the literature is the persistent risk of recurrent cardiovascular events. Although young patients often survive their initial infarction, they remain vulnerable to reinfarction, heart failure, stroke, and cardiovascular mortality over subsequent decades (Liang et al., 2023; Kampka et al., 2025). Traditional risk factors such as diabetes mellitus, dyslipidemia, obesity, and smoking continue to exert adverse effects long after the acute event. Importantly, the younger age at first presentation translates into a longer duration of exposure to residual cardiovascular risk. In practical terms, a 35-year-old patient who survives myocardial infarction may face 30 to 40 additional years of elevated cardiovascular vulnerability. This reality fundamentally alters the clinical significance of disease recurrence and emphasizes the importance of lifelong secondary prevention.

Despite the proven benefits of secondary prevention, participation in cardiac rehabilitation remains suboptimal among young adults (Kampka et al., 2025). This represents a major missed opportunity because rehabilitation programs improve exercise capacity, medication adherence, psychological well-being, and long-term survival. Young patients often encounter unique barriers to participation, including work obligations, family responsibilities, financial constraints, and the perception that rehabilitation is intended primarily for older individuals. Addressing these barriers should be considered a priority within contemporary cardiovascular care systems.

From a broader population-health perspective, the increasing incidence of myocardial infarction among young adults has important implications for future healthcare demand. Improvements in acute treatment have successfully reduced early mortality, creating a growing population of long-term survivors who require ongoing cardiovascular monitoring, pharmacotherapy, and preventive care. Consequently, healthcare systems may increasingly shift from managing acute mortality to managing chronic cardiovascular survivorship. This transition will require greater emphasis on longitudinal care models, multidisciplinary rehabilitation programs, and strategies aimed at preventing recurrent disease.

Taken together, the evidence reviewed in this study suggests that the prognosis of myocardial infarction in young adults is characterized by a complex duality. On one hand, younger patients generally experience lower short-term mortality and better immediate recovery than older populations. On the other hand, they face decades of elevated cardiovascular risk, substantial psychosocial challenges, and considerable socioeconomic consequences. Therefore, the true burden of myocardial infarction in young adults cannot be adequately captured through mortality statistics alone. A comprehensive assessment must incorporate recurrent events, quality of life, functional capacity, psychological well-being, and societal impact. Such a perspective fundamentally reframes premature myocardial infarction from an isolated acute

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event into a lifelong chronic cardiovascular condition requiring sustained clinical and public health attention.

Conclusion

Myocardial infarction in young adults has emerged as an increasingly important cardiovascular health problem worldwide, reflecting a shifting epidemiological landscape characterized by the earlier onset of coronary artery disease. The evidence synthesized in this review demonstrates that the occurrence of myocardial infarction in young individuals is driven by a complex interplay of traditional risk factors, particularly smoking, dyslipidemia, obesity, hypertension, and diabetes mellitus, together with emerging determinants such as psychosocial stress, sleep disorders, chronic inflammation, autoimmune conditions, substance abuse, and genetic predisposition. Clinically, young patients often present with distinct characteristics, including a predominance of single-vessel coronary disease, a higher frequency of non-atherosclerotic mechanisms such as spontaneous coronary artery dissection and myocardial infarction with non-obstructive coronary arteries, and important sex-related differences in disease presentation and pathophysiology. Although short-term outcomes are generally more favorable than those observed in older populations due to better physiological reserve and fewer comorbidities, young survivors remain exposed to substantial long-term risks of recurrent cardiovascular events, functional impairment, psychosocial consequences, and economic burden. These findings indicate that myocardial infarction in young adults should not be viewed merely as premature atherosclerotic disease but rather as a heterogeneous clinical syndrome requiring comprehensive risk assessment, earlier preventive interventions, individualized diagnostic approaches, and sustained secondary prevention strategies to reduce the growing burden of cardiovascular disease in this productive age group.

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