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Association between Newly Diagnosed Diabetes Mellitus and Ejection Fraction in Patients with ST-Elevation Myocardial Infarction

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ABSTRACT

Background & Objective: ST-segment elevation myocardial infarction (STEMI) remains a leading cause of cardiovascular mortality, with left ventricular ejection fraction (LVEF) serving as a critical predictor of clinical outcomes. While diabetes mellitus (DM) is established as a major driver of poor cardiovascular prognosis, the specific impact of newly diagnosed DM on LV systolic function following an acute STEMI event remains insufficiently characterized. This study aimed to investigate the association between newly diagnosed DM and LVEF in patients presenting with STEMI.

Materials & Methods: In this cross-sectional study, 283 patients admitted with STEMI were evaluated. Data collection included demographic profiles, cardiovascular risk factors, laboratory parameters, coronary angiographic characteristics, and echocardiographic measurements. Newly diagnosed DM was defined by glycated hemoglobin (HbA1c) levels, and LVEF was assessed via transthoracic two-dimensional echocardiography.

Results: The mean age of the participants was 63.1 ± 10.5 years. Patients with reduced LVEF were significantly older than those with preserved systolic function (67.2 ± 10.8 vs. 61.4 ± 9.8 years, $P < 0.001$). Newly diagnosed DM was significantly associated with reduced LVEF ($P = 0.037$), and a similar association was observed for cigarette smoking ($P = 0.023$). No statistically significant associations were identified between LVEF and demographic, laboratory, and angiographic variables. Multivariable logistic regression demonstrated that newly diagnosed DM independently predicted reduced LVEF (OR 2.79, 95% CI 1.49–5.22, $P = 0.037$). Older age and smoking also remained independent predictors.

Conclusion: Newly diagnosed DM is independently associated with impaired LV systolic function in patients presenting with STEMI. These findings underscore the clinical importance of routine HbA1c screening in the acute STEMI setting to enhance early risk stratification and optimize post-infarction management strategies.

Keywords: *ST-segment elevation myocardial infarction; diabetes mellitus; HbA1c; left ventricular ejection fraction; echocardiography*

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1. Introduction

ST-segment elevation myocardial infarction (STEMI) is a critical medical emergency requiring rapid diagnosis and reperfusion therapy to minimize myocardial damage and improve survival rates. Despite significant advances in contemporary reperfusion strategies, STEMI remains a leading cause of substantial global morbidity and mortality (1). Assessment of left ventricular ejection fraction (LVEF) following myocardial infarction is an integral component of clinical evaluation, as impaired systolic function is a potent predictor of heart failure, malignant ventricular arrhythmias, and increased long-term mortality (2-4). The recovery of left ventricular function following STEMI is a complex process influenced by a multifaceted array of demographic, clinical, and metabolic determinants. Among these, diabetes mellitus (DM) is a well-established contributor to adverse cardiovascular outcomes. Chronic hyperglycemia drives endothelial dysfunction, oxidative stress, systemic inflammation, myocardial fibrosis, and microvascular injury, collectively precipitating structural and functional myocardial remodeling (5). Consequently, patients with diabetes generally exhibit poorer post-infarction

trajectories, including an increased risk of heart failure and cardiovascular death compared to their non-diabetic counterparts (6). While the detrimental effects of long-standing diabetes are well-documented, the impact of diabetes newly identified during the acute phase of STEMI remains poorly characterized. Metabolic derangements often precede the clinical diagnosis of DM, suggesting that myocardial dysfunction may already be underway during the period of unrecognized hyperglycemia. Measuring glycated hemoglobin (HbA1c) provides a reliable surrogate for glycemic control over the preceding months, offering a window into previously undetected diabetes in patients presenting with acute coronary syndrome (7, 8). Identifying such cases during the acute STEMI presentation holds significant clinical potential; early recognition of glucose dysregulation could refine risk stratification, prompt closer clinical surveillance, and facilitate timely interventions to mitigate adverse cardiac remodeling. However, the specific association between newly diagnosed DM and left ventricular systolic dysfunction in the context of STEMI has not been sufficiently investigated. Therefore, the present study aimed to investigate the relationship between newly diagnosed DM, identified via HbA1c screening, and LVEF in patients admitted with STEMI. We hypothesized that patients with newly diagnosed DM would demonstrate a significantly higher prevalence of reduced left ventricular systolic function compared to those without diabetes, independent of established cardiovascular risk factors.

2. Materials and Methods

2.1 Study design and Participant Selection

This cross-sectional study was conducted at Mousavi Hospital in Zanjan, Iran, between April 2024 and May 2025.

The study protocol was approved by the Ethics Committee of Zanjan University of Medical Sciences (Approval No. IR.ZUMS.REC.1403.249). During the enrollment period, a total of 1,562 patients were admitted with acute coronary syndrome (ACS). From this cohort, consecutive patients diagnosed with ST-segment elevation myocardial infarction (STEMI) were screened for eligibility.

Patients were included if they met the diagnostic criteria for STEMI and had no prior history of metabolic or structural cardiac disease.

We excluded patients with: 1. a pre-existing diagnosis of diabetes mellitus; 2. a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG); 3. known heart failure; 4. prior valvular heart surgery; or 5. myocardial infarction with non-obstructive coronary arteries (MINOCA). Following the application of these criteria, 283 patients were enrolled in the final study population (Figure 1).

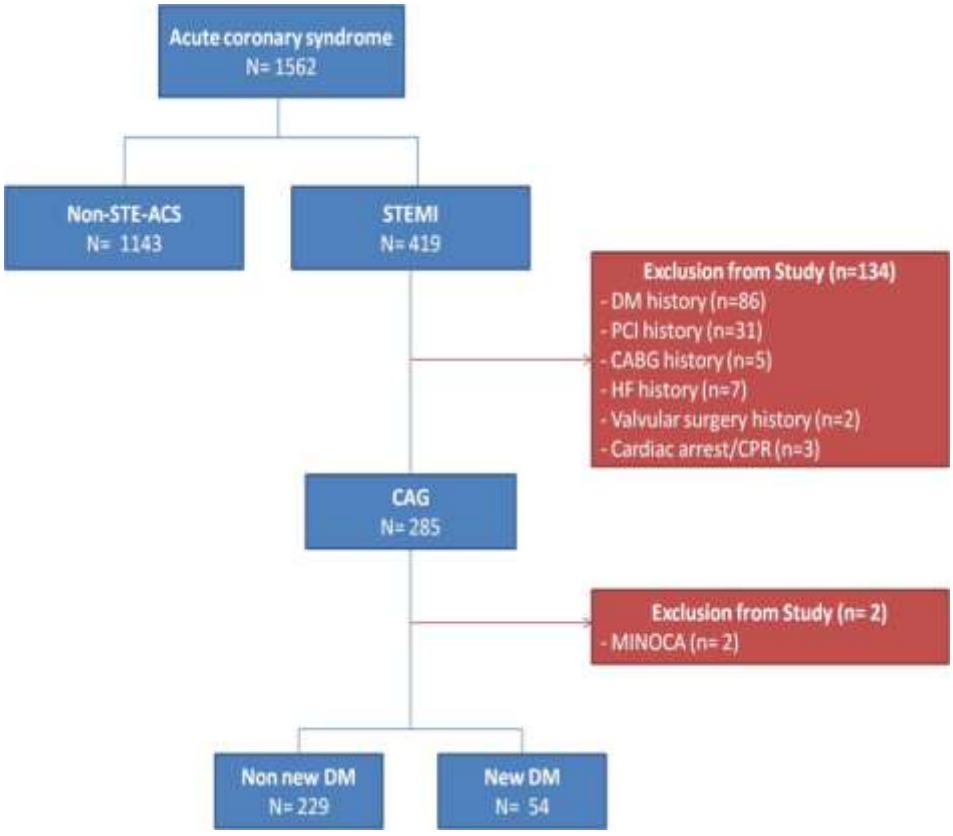


Figure 1. Sampling flowchart of the study. **(Prepared by Authors, 2026)**.

2.2 Data collection

Data regarding demographic characteristics, cardiovascular risk factors, laboratory findings, coronary angiographic parameters, and echocardiographic measurements were retrieved from electronic medical records. STEMI was diagnosed in accordance with established clinical guidelines, requiring persistent ST-segment elevation in at least two contiguous electrocardiographic leads, symptoms indicative of acute myocardial ischemia, and angiographic confirmation of an atherosclerotic culprit lesion. Glycemic status was assessed via HbA1c levels in all participants; an HbA1c ≥ 6.5% was utilized as the diagnostic threshold for diabetes mellitus, consistent with international clinical recommendations. Left ventricular systolic function was evaluated via transthoracic two-dimensional echocardiography, with the ejection fraction (EF) calculated using the modified Simpson's biplane method by an experienced cardiologist.

2.3 Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD) or median depending on data distribution, whereas categorical variables are reported as frequencies and percentages. Normality of continuous variables was assessed before analysis. Group comparisons were performed using the independent-samples *t*-test for normally distributed variables and the Mann–Whitney *U* test for variables with non-normal distributions. Associations between reduced ejection fraction and demographic, clinical, and angiographic characteristics were examined using appropriate statistical methods. A two-sided P value <0.05 was considered statistically significant. Multivariable logistic regression analysis was used to determine independent predictors of reduced left ventricular ejection fraction. Variables considered clinically important or demonstrating a univariable association with P <0.10 were entered into the regression model. Results are reported as adjusted odds ratios (aOR) with corresponding 95% confidence intervals (CIs).

3. Result

During the study period, 1,562 patients were admitted with acute coronary syndrome. After screening according to the predefined eligibility criteria, 283 patients with STEMI were included in the final analysis (Figure 1). The mean age of the study population was 63.1 ± 10.5 years.

3.1 Baseline Characteristics

Comparative analysis based on left ventricular systolic function revealed that patients with reduced ejection fraction (EF <40%) were significantly older than those with preserved systolic function (67.2 ± 10.8 vs. 61.4 ± 9.8 years, P <0.001).

Newly diagnosed diabetes mellitus was identified in 54 patients (19.1%). The prevalence of newly diagnosed diabetes was significantly higher in the reduced EF group compared to the preserved EF group (32.0% vs. 14.4%, P = 0.037). Similarly, cigarette smoking was more prevalent among patients with reduced EF (70.7% vs. 53.8%, P = 0.023).

While patients with impaired systolic function exhibited a trend toward later presentation following symptom onset and higher serum troponin concentrations, these differences did not reach statistical significance. Furthermore, no significant associations were observed between reduced EF and sex, body mass index (BMI), hypertension, dyslipidemia, or family history of coronary artery disease (Table 1).

Table 1. Baseline Characteristics of the Study Population.

Variable	Total (n=283)	EF ≥ 40% (n=208)	EF < 40% (n=75)	p-value
Age (years, mean ± SD)	63.1 ± 10.5	61.4 ± 9.8	67.2 ± 10.8	<0.001*
Male sex (%)	198 (70%)	144 (69.2%)	54 (72%)	0.655
BMI (kg/m², mean ± SD)	27.3 ± 3.8	27.1 ± 3.7	27.8 ± 4.0	0.226
Hypertension (%)	138 (48.8%)	100 (48%)	38 (50.7%)	0.684
New DM (%)	54 (19.1%)	30 (14.4%)	24 (32%)	0.037*
DLP (%)	122 (43.1%)	93 (44.7%)	29 (38.7%)	0.384
FH of CAD (%)	63 (22.3%)	50 (24%)	13 (17.3%)	0.208
Smoking (%)	165 (58.3%)	112 (53.8%)	53 (70.7%)	0.023*
Symptom to ED (hours)	4.8 ± 2.1	4.6 ± 2.0	5.2 ± 2.4	0.081
Troponin (ng/mL, mean ± SD)	8341 ± 4972	7292 ± 4188	11251 ± 5347	0.078

3.2 Multivariable Analysis

To identify independent predictors of reduced left ventricular ejection fraction, a multivariable logistic regression model was constructed. Variables demonstrating a univariate association with P<0.10, or those considered clinically significant, were included in the model. After adjusting for potential confounding factors, newly diagnosed diabetes mellitus remained an independent predictor of reduced LVEF (aOR 2.79; 95% CI 1.49–5.22; P=0.037). Older age and cigarette smoking were also identified as independent predictors of impaired systolic function. Notably, newly diagnosed diabetes mellitus exhibited the strongest association with reduced ejection fraction among all variables included in the model (Figure 2).

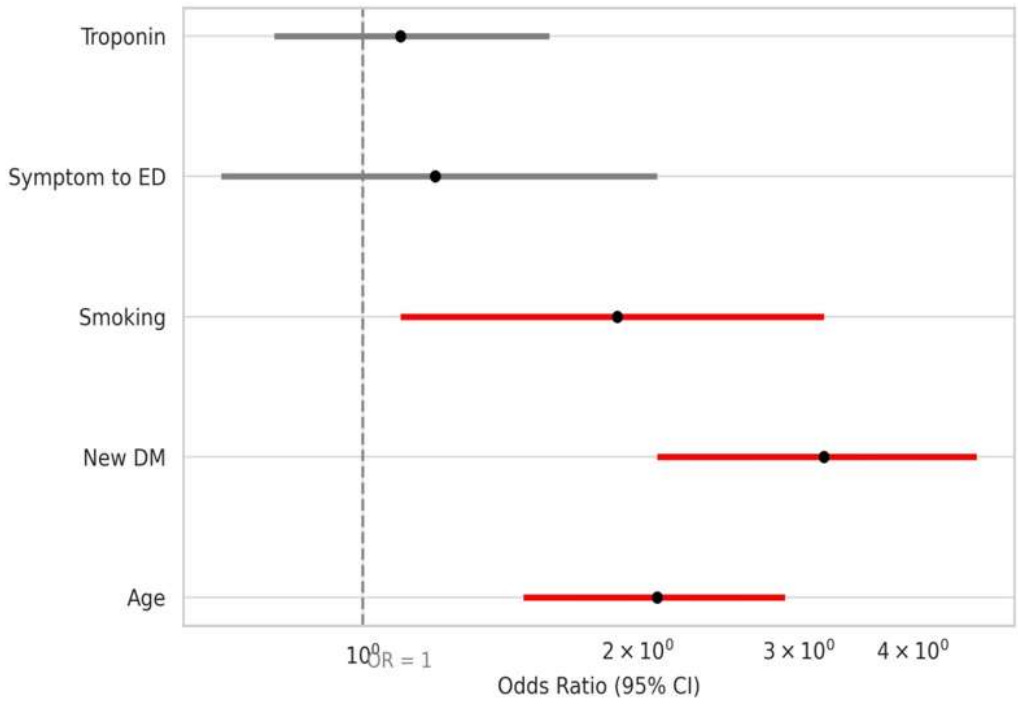


Figure 2. Odds ratio plot for multivariate adjusted variables. **(Prepared by Authors, 2026)**.

3.3 Coronary Angiography and Lesion Characteristics

Coronary angiography confirmed significant atherosclerotic coronary artery disease in 283 of 285 patients (99.3%). Single-vessel disease (SVD) was the most prevalent angiographic pattern, observed in 51.6% of the cohort, followed by two-vessel disease (29.7%) and three-vessel disease (18.7%). The left anterior descending artery (LAD) was the most frequent culprit vessel (46.3%), while the right coronary artery (RCA) and left circumflex artery (LCX) accounted for 30.7% and 23.0% of culprit lesions, respectively. Regarding infarct topography, anterior STEMI (comprising anterior, anteroseptal, and anterolateral infarctions) was the most frequent presentation (45.9%), followed by inferior/inferolateral infarction with right ventricular involvement (43.8%) and lateral/posterior infarction (10.2%). Notably, no statistically significant differences were observed between patients with and without newly diagnosed diabetes regarding the severity of coronary artery disease, the distribution of culprit vessels, or the infarct territory (Table 2).

Table 2. Severity of CAD, Culprit Lesion, and MI Territory by New DM Status.

Category	Variable	Total (n=283)	New DM (n=54)	Non-new DM (n=229)	p-value
Severity of CAD	SVD	146 (51.6%)	26 (48.1%)	120 (52.4%)	0.57
	2VD	84 (29.7%)	16 (29.6%)	68 (29.7%)	0.99
	3VD	53 (18.7%)	12 (22.2%)	41 (17.9%)	0.43
Culprit Lesion	LAD	131 (46.3%)	24 (44.4%)	107 (46.7%)	0.76
	RCA	87 (30.7%)	18 (33.3%)	69 (30.1%)	0.65
	LCX	65 (23.0%)	12 (22.2%)	53 (23.1%)	0.89
Territory of STEMI	Anterior, Anteroseptal, Anterolateral	130 (45.9%)	25 (46.3%)	105 (45.9%)	0.96
	Inferior, Inferolateral, RV	124 (43.8%)	23 (42.6%)	101 (44.1%)	0.84
	Lateral, Posterior	29 (10.2%)	6 (11.1%)	23 (10.0%)	0.78

4. Discussion

The present study showed that newly diagnosed diabetes mellitus was independently associated with reduced left ventricular ejection fraction in patients presenting with ST-segment elevation myocardial infarction. Furthermore, older age and cigarette smoking were identified as independent predictors of impaired systolic function. These findings suggest that abnormalities in glucose metabolism may adversely affect myocardial performance even in the absence of a prior clinical diagnosis of diabetes. Left ventricular ejection fraction is a cornerstone of risk stratification following STEMI, as it quantifies the extent of myocardial damage and independently predicts the subsequent risk of heart failure, ventricular arrhythmias, and cardiovascular mortality. Notably, our research demonstrated that patients with newly diagnosed diabetes were more likely to have reduced systolic function despite having no previous history of diabetes. This observation implies that subclinical metabolic abnormalities may already be present at the time of myocardial infarction and may contribute to impaired ventricular performance during the acute phase of the STEMI. The adverse effects of diabetes on the myocardium have been widely reported. Persistent hyperglycemia, insulin resistance, oxidative stress, endothelial dysfunction, and chronic inflammation contribute to structural and functional myocardial alterations that ultimately result in diabetic cardiomyopathy [9-12]. Critically, these pathological processes often begin years before diabetes is diagnosed clinically. Consequently, patients with newly diagnosed diabetes may already have myocardial injury that becomes clinically evident when exposed to the stress of an acute myocardial infarction. Our findings align with previous studies evaluating the relationship between abnormal glucose metabolism and cardiac function after myocardial infarction. Kowalczyk and colleagues reported that elevated HbA1c levels in patients without previously known diabetes were associated with less favorable ventricular remodeling and poorer left ventricular function following acute myocardial infarction [13]. Similarly, Liu et al. demonstrated that stress hyperglycemia was associated with increased mortality and worse clinical outcomes in patients with acute myocardial infarction [14].

Whereas the aforementioned investigations focused primarily on prognosis, our results specifically demonstrate an independent association between newly diagnosed diabetes and reduced left ventricular ejection fraction in patients with STEMI. Notably, in contrast to diabetes, several conventional cardiovascular risk factors, including hypertension, dyslipidemia, and body mass index, were not significantly associated with reduced ejection fraction in our cohort. In contrast, cigarette smoking remained an independent predictor of impaired ventricular function. Smoking accelerates endothelial dysfunction, enhances oxidative stress and inflammation, and promotes thrombus formation, all of which may aggravate myocardial injury and delay functional recovery after infarction [15].

These findings indicate that both metabolic disturbances and modifiable lifestyle factors contribute to ventricular dysfunction following STEMI. A notable observation in the present study was that patients with newly diagnosed diabetes did not exhibit more extensive coronary artery disease or a different distribution of culprit lesions than those without diabetes. This suggests that the reduction in left ventricular function is unlikely to be explained solely by the anatomical severity of coronary artery disease. Rather, impaired microvascular perfusion, metabolic abnormalities within cardiomyocytes, diffuse myocardial fibrosis, and chronic low-grade inflammation may have a greater influence on ventricular contractility in these patients [16, 17]. Several mechanisms may account for the association between newly diagnosed diabetes and impaired systolic function. Chronic exposure to elevated glucose concentrations promotes the accumulation of advanced glycation end-products, amplifies oxidative stress, and activates inflammatory signaling pathways, culminating in myocardial fibrosis and adverse ventricular remodeling [18-20]. In addition, insulin resistance alters myocardial energy metabolism, reducing cardiac efficiency and increasing susceptibility to ischemic injury. Experimental studies have also shown that abnormalities in intracellular calcium handling, particularly involving SERCA2a and phospholamban, contribute to impaired myocardial contraction in diabetes [1, 21]. Together, these mechanisms provide a biological basis for the association observed in our study.

These findings carry tangible implications for clinical practice. Routine HbA1c measurement in patients admitted with STEMI may facilitate the identification of previously undiagnosed diabetes, thereby enabling earlier recognition of patients at heightened risk of ventricular dysfunction. Early diagnosis may facilitate individualized follow-up, optimization of cardiovascular risk factors, and timely initiation of evidence-based therapies that may reduce adverse ventricular remodeling and improving long-term outcomes (22, 23). This study has several strengths. First, all patients underwent systematic HbA1c screening, allowing identification of previously unrecognized diabetes rather than relying solely on medical history. Second, detailed clinical, echocardiographic, and angiographic data were available for all enrolled patients, providing a comprehensive evaluation of factors associated with left ventricular systolic function. Finally, multivariable regression analysis was performed to account for potential confounding variables, strengthening the reliability of the observed associations. Nevertheless, several limitations warrant acknowledgment. The cross-sectional design does not allow causal conclusions. Furthermore, this was a single-center study, and the relatively small number of patients with newly diagnosed diabetes may limit the generalizability of the findings. Left ventricular ejection fraction was measured only during the index hospitalization, and changes in ventricular function during long-term follow-up were not assessed. Future multicenter prospective studies with larger sample sizes

are needed to determine whether early diagnosis and treatment of newly recognized diabetes can improve ventricular recovery and reduce adverse cardiovascular events after STEMI.

5. Conclusion

New DM is a risk factor for reduced EF in patients with STEMI. Also, older age and smoking are significantly associated with reduced EF following STEMI.

Routine screening for previously undiagnosed diabetes using HbA1c in STEMI patients may facilitate early risk stratification and closer follow-up to prevent adverse ventricular remodeling.

6. Declarations

6.1 Acknowledgments

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6.2 Ethical Considerations

The study protocol was approved by the Ethics Committee of Zanjan University of Medical Sciences (Approval No. IR.ZUMS.REC.1403.249).

6.3 Authors' Contributions

The first author contributed to the supervision of the work and provided access to the necessary resources. The second author served as the corresponding author and was responsible for coordinating the manuscript submission. The third, fourth, and fifth authors contributed to writing and editing the manuscript.

6.4 Conflict of Interest

The authors declare that they have no competing interests.

6.5 Fund or Financial Support

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

6.6 Using Artificial Intelligence Tools (AI Tools)

The authors did not utilize AI Tools.

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