

Original Article

Assessment of the Incidence of In-Stent Restenosis and Its Associated Risk Factors Following Percutaneous Coronary Angioplasty: A Cross-Sectional Study

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ABSTRACT

Background: In-stent restenosis remains a significant concern for cardiologists, as it can lead to recurrent angioplasty, coronary artery bypass surgery, myocardial infarction, or death. This study aimed to evaluate the incidence of in-stent restenosis and associated risk factors following percutaneous coronary angioplasty with drug-eluting stents in patients referred to Shahid Mohammadi Hospital between 2020 and 2022.

Methods: This cross-sectional study examined 586 patients with coronary syndrome who underwent coronary angioplasty with stent implantation at Shahid Mohammadi Hospital, Bandar Abbas, Iran, between 2020 and 2022. A researcher-developed checklist was used to collect data on demographic characteristics, clinical findings, and stent-related information from clinical records. Additional data was obtained through telephone interviews with patients as needed. IBM SPSS Statistics software (Version 26) was employed for data analysis, with a significance level below 0.05. The association between coronary restenosis incidence and related factors was evaluated using multivariate logistic regression analysis.

Results: Of the 586 patients included in this study, 335 (57.2%) were male, with a mean age of 56.86 ± 14.61 years. The incidence of in-stent restenosis was 20.8%. Multivariate logistic regression analysis identified several independent risk factors associated with coronary artery restenosis, including hyperlipidemia, diabetes, opium use, a higher number of stents implanted, smaller stent diameter, and increased stent length of intracoronary stents.

Conclusions: Recognizing the risk factors for in-stent restenosis can substantially aid healthcare providers in making informed decisions, ultimately leading to improved prevention strategies and overall management for patients with coronary artery disease. A multidisciplinary approach, including addressing modifiable risk factors such as hyperlipidemia, diabetes, and opium use, as well as optimizing stent selection and placement techniques, may contribute to better long-term outcomes for these patients. (*Iranian Heart Journal 2024; 25(4): 31-42*)

KEYWORDS: Acute coronary syndrome, Angioplasty, Stent placement, In-stent restenosis, medical stenosis

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Coronary artery disease, also referred to as coronary heart disease or ischemic heart disease,¹ is among the most common cardiovascular conditions worldwide. This disease poses a significant global health concern, being a major cause of mortality and disability.^{2, 3} Cardiovascular disease currently ranks as the leading cause of death globally.⁴ In developed countries, this disease accounts for approximately 50% of deaths, amounting to 5 million out of 12 million deaths annually.⁵ Research indicates a 20% to 25% increase in the prevalence of heart disease in Iran in recent years.⁶ In 2005, the World Health Organization reported that 41.3% of all deaths in Iran were attributed to coronary artery disease, with a projected increase to 44.8% by 2030.⁷ The economic burden associated with coronary artery disease is significant, both for individual patients and society as a whole, with an annual cost of care and treatment in the United States estimated at 12.9 billion dollars.⁸ In Iran, the direct costs of hospitalization and treatment, as well as indirect costs from absence from work and unemployment, resulting from coronary artery disease are estimated at 26.77 billion Iranian rials. Considering the substantial economic burden associated with coronary artery disease, adopting a research-oriented and scientific approach to their management and treatment could potentially lead to significant savings in healthcare expenditures.⁹ Efficient strategies aimed at reducing the prevalence and consequences of these diseases would not only alleviate the financial strain on both patients and healthcare systems but also improve the overall quality of life for those affected. The underlying cause of coronary artery disease is the accumulation of plaques within the coronary arteries, which are responsible for supplying blood to the heart for its normal functioning.¹⁰ The buildup of

plaques leads to the narrowing of coronary arteries, ultimately reducing blood flow to the heart muscles and causing impaired heart function. This process, known as atherosclerosis, can result in various clinical manifestations, including angina pectoris, myocardial infarction, and heart failure. The increasing prevalence of cardiovascular disease, particularly coronary artery disease, has driven numerous researchers to concentrate on identifying factors that influence the incidence and mortality of these conditions. As a result of these investigations, certain factors have been recognized as cardiovascular risk factors,¹¹ which play a critical role in the development and progression of heart-related illnesses. These risk factors can be categorized into modifiable and non-modifiable factors, allowing for targeted preventive and therapeutic interventions to mitigate the overall burden of cardiovascular disease. Among the non-modifiable risk factors, age and sex are significant contributors to cardiovascular disease. On the other hand, modifiable risk factors, including hypertension, diabetes, dyslipidemia, obesity, social isolation, physical inactivity, poor nutrition, alcohol misuse, substance abuse, smoking,¹² and stress,¹³ play crucial roles in the development and progression of coronary artery disease.

A major concern associated with cardiovascular diseases is the development of stenosis and occlusion in the coronary arteries.¹⁴ These conditions can result in severe consequences, such as the need for percutaneous coronary angioplasty, coronary artery bypass graft surgery, myocardial infarction, or even death for affected patients.¹⁵ Coronary artery disease involves a wide range of arterial pathologies, varying from mild to severe involvement in different patients. In some cases, only a single vessel is affected, while in others, multiple vessels are involved. Observations suggest a

correlation between the severity of coronary artery involvement and specific cardiovascular risk factors, such as diabetes.¹⁶ This association has been confirmed in most studies investigating hyperlipidemia as well.¹⁷ Nonetheless, findings regarding tobacco use and its correlation with coronary artery disease have been inconsistent across various studies.¹⁰ Despite these discrepancies, evidence suggests that smoking is directly associated with approximately 40% of deaths resulting from coronary artery disease.¹⁸ A 2018 study conducted in Khorramabad, titled "Prediction of Restenosis in Patients Undergoing Angioplasty," identified several key predictors of restenosis, including the type of stent used, a history of diabetes, the number of stents implanted, a history of hyperlipidemia, and substance abuse.¹⁹ Restenosis following angioplasty presents another significant concern for cardiologists in the context of cardiovascular disease. The prevalence of restenosis has been reported to range from 12% to 40% within the first 6 months post-angioplasty, according to various studies.¹⁴ In a 2022 study by Mingrui Li et al,²⁰ a total of 341 acute coronary syndrome patients with at least 1 stent placement were included, with a follow-up period of 2.17 ± 2.34 months. During this period, 62 patients (18.2%) experienced restenosis, with a mean time to in-stent restenosis (ISR) occurrence of 32.8 months. The incidence of ISR for the left main coronary artery, left anterior descending coronary artery, left circumflex coronary artery, and right coronary artery was 7.6%, 9.2%, 4.19%, and 4.14%, respectively. Significant differences in left ventricular ejection fraction, the number and type of stents, statin therapy, and antiplatelet therapy were observed between patients in the ISR (+) and ISR (-) groups. Multivariable logistic regression analysis revealed a statistically significant

association between left ventricular ejection fraction and the number of stents with ISR. Interventional cardiology specialists have made efforts to tackle the issue of restenosis following coronary angioplasty through the introduction of intracoronary stents. The development of coronary stents has been a significant breakthrough in the treatment of coronary artery disease, achieving a reduction in restenosis rates by approximately 50%.²¹ Stent implantation has proven effective in diminishing the risk of restenosis in cases of complete coronary artery occlusion.²² Despite the significant advancements in interventional cardiology with the introduction of intracoronary stents, restenosis following stent implantation continues to pose a substantial clinical challenge. The prevalence of restenosis post-stenting has been reported to range from 20% to 46% across various studies.¹⁵

Motivated by the inconsistencies in previous research regarding the prevalence of restenosis and its associated factors, the present study aimed to investigate the incidence of restenosis and its related risk factors after percutaneous coronary intervention (PCI) in patients with restenosis who have stents. The study focused on patients referred to Shahid Mohammadi Hospital between 2019 and 2022. By conducting this study, we sought to address the conflicting findings in previous research and potentially identify new associated risk factors, ultimately contributing to the understanding of restenosis post-PCI and the development of more effective preventive and management strategies.

METHODS

This cross-sectional study involved patients with coronary stents admitted to Shahid Mohammadi Hospital between 2019 and 2022. The inclusion and exclusion criteria for the study were as follows:

Inclusion Criteria:

1. Completion of the patient's medical record
2. Presence of at least 1 coronary stent in the previous angioplasty

Exclusion Criteria:

1. Incomplete clinical records
2. Patients treated with drugs and without stent placement in previous angiography

For the selection of patients with cardiac stents referred to Shahid Mohammadi Hospital (in the Iranian city of Bandar Abbas), a simple random sampling method

was utilized in this study. The patient list was obtained from the angiographic center registry, which functions as an extensive database encompassing all patients who have undergone angiography procedures. A total of 600 patients were initially identified through the angiographic center registry. However, 14 cases were subsequently excluded due to incomplete demographic information. Following the application of the inclusion criteria, the final sample comprised 586 patients. The schematic representation of the patient selection process is depicted in Figure 1.

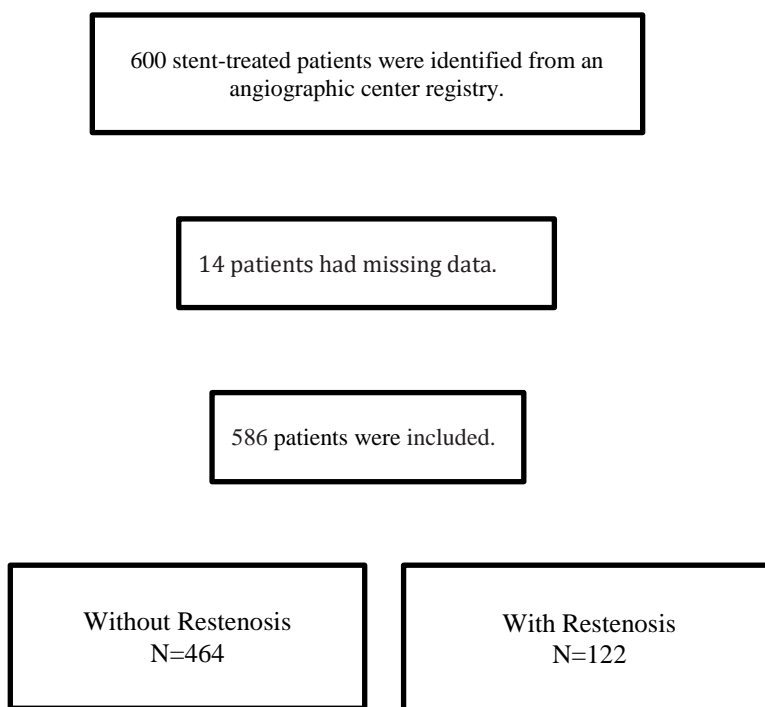


Figure 1: The flowchart of screening the eligible patients in the study is presented here.

In determining the appropriate sample size for this study, we took into account the sample sizes from previous research conducted by Mingrui Li et al,²⁰ Hasani et al,¹⁴ and Ghariani et al.²¹ We assumed a population proportion (P) of 0.30, with a confidence level of 95% and a maximum error of 0.04. Based on these parameters, the minimum sample size was calculated to be

504. To account for potential sample loss, an additional 10% was added to the sample size, resulting in a total of 586 patients. Continuous sampling was employed for participant recruitment.

Data Collection

Data collection in this study was performed using a researcher-made checklist. The

required data were primarily extracted from clinical records and the Hospital Information System (HIS). In cases where specific information, such as the occurrence of restenosis in stented arteries, was missing or incomplete in the clinical records, contact was made via telephone calls with patients or their families using the available contact information provided in the clinical records. The researcher-made checklist incorporated various essential data points, such as demographic information (age, sex, occupation), underlying diseases (diabetes, hypertension, chronic kidney disease, history of myocardial infarction, unstable angina), and stent-related information (number and length of stents, affected vessels [right coronary, left circumflex, and left anterior descending arteries]). Environmental factors like a history of drug abuse, smoking, and hyperlipidemia were also included. The definition of restenosis utilized in this study was a minimum 50% reduction in the luminal diameter of the artery at the site of previous angioplasty.

Data Analysis

Various statistical tests were employed to analyze the collected data. For quantitative data, descriptive tests, such as mean, variance, and standard deviation, were performed. When the data showed normal distribution, inferential tests including χ^2 , independent T-test, Pearson's correlation coefficient, and one-way analysis of variance were utilized. In instances where the data were non-normally distributed, non-parametric equivalents like Mann-Whitney, Spearman, and Kruskal-Wallis analyses were conducted. In presenting the results for quantitative data, the format "mean \pm standard deviation" or "(third quartile - first quartile) median" was utilized, while qualitative data were reported as numbers

(percentages). To assess the normality of the frequency distribution for quantitative variables, the non-parametric Kolmogorov-Smirnov test was employed. Additionally, the equality of variance across groups was evaluated using the Levene test.

To examine the relationship between the occurrence of coronary restenosis and related factors, both univariate and multivariate logistic regression statistical tests were utilized. IBM SPSS Statistics software (version 26) was employed for the data analysis, and a significance level below 0.05 was established for determining statistical significance.

RESULTS

Among the 586 participants in the study, 464 did not have ISR, while 122 (20.81%) experienced restenosis. The demographic characteristics of the studied patients showed that out of the 586 patients, 353 were male, and 233 were female, with an average age of 56.86 years (standard deviation of 14.61). The majority of the participants were self-employed (40.4%). In terms of the medical history of underlying diseases among the studied patients, the most prevalent conditions were unstable angina, hyperlipidemia, hypertension, diabetes, and chronic kidney disease, in descending order. Additionally, drug abuse had a prevalence rate of 24.7%, while 42.2% of the patients reported smoking. The analysis of the involved arteries and placed stents in the studied patients demonstrated that the left anterior descending artery was the most frequently affected vessel. The majority of patients had 1 stent implanted, with an average length of 24.2 mm (standard deviation of 2.84). ISR occurred in 122 individuals, representing 20.8% of the study population.

Table 1: Distribution of the Demographic Characteristics of the Patients Studied According to Stent Restenosis

Variables	Categories	Without Restenosis N (%)	With Restenosis N (%)	P value
Age, y	Mean ± SD	56.53± 14.55	58.11± 14.83	0.289**
Sex	Male	279 (79)	74 (21)	0.916*
	Female	185 (79.4)	48 (20.6)	
Occupation	Employee	31 (83.8)	6 (16.2)	0.825*
	Freelance	187 (78.9)	50 (22.1)	
	Housekeeper	173 (77.9)	49 (22.1)	
	Retired	73 (81.1)	17 (18.9)	
Stent Type (Brand)	Wilma	113 (79)	30 (21)	0.869*
	Supraflex	73 (77.7)	21 (22.3)	
	BioMime	76 (80)	19 (20)	
	XIENCE	30 (81.1)	7 (18.9)	
	Artemis	32 (76.2)	10 (23.8)	
	Firehawk	35 (77.8)	10 (22.2)	
	NC TREK	38 (79.2)	10 (20.8)	
	Foxtrot NC	19 (82.6)	4 (17.4)	
	Other	48 (81.4)	11 (18.6)	

* χ^2 ** independent T-test**Table 2:** Distribution of the Frequency of Underlying Diseases and Drug Abuse in the Patients Studied According to Stent Restenosis

Variables	Categories	Without Restenosis N (%)	With Restenosis N (%)	P value
Kidney disease	No	289 (78.9)	104 (21.1)	*0.705
	Yes	75 (80.6)	18 (19.4)	
Hyperlipidemia	No	309 (82.2)	67 (17.8)	*0.017
	Yes	155 (73.8)	55 (26.2)	
Hypertension	No	317 (83)	65 (17)	*0.002
	Yes	147 (72.1)	57 (27.9)	
Diabetes mellitus	No	350 (82)	77 (18)	*0.006
	Yes	114 (71.7)	45 (28.3)	
Unstable angina	No	274 (83.5)	54 (16.5)	*0.003
	Yes	190 (73.6)	68 (26.4)	
Drug abuse	No	363 (82.3)	78 (17.7)	*0.001
	Yes	101 (69.7)	44 (30.3)	
Smoking	No	275 (81.1)	64 (18.9)	*0.175
	Yes	189 (76.5)	58 (23.5)	

* χ^2 **Table 3:** Distribution of the Frequency of the Characteristics of Involved Vessels and Stents Implanted in the Studied Patients According to Stent Restenosis

Variables	Categories	Without Restenosis N (%)	With Restenosis N (%)	P value
Stent length, mm	Mean ± SD	23.93±2.88	25.22±2.47	>**0.001
Type of involved vessel	RCA	104 (78.8)	28 (21.2)	*0.055
	LAD	211 (75.6)	68 (24.4)	
	LCX	92 (82.1)	20 (17.9)	
	Other	57 (90.5)	6 (9.5)	
Number of stents	1 stent	329 (81.4)	75 (18.6)	*0.045
	2 and more	135 (74.2)	47 (25.8)	

* χ^2 ** independent T-test

According to the results presented in Table 1, the χ^2 and independent T-tests demonstrated that none of the demographic characteristics of the patients, concerning coronary artery restenosis, exhibited a statistically significant difference ($P > 0.05$). According to the results presented in Table 2, the χ^2 statistical test indicated that the frequency distribution of underlying diseases such as kidney disease and smoking did not demonstrate a statistically significant difference in terms of restenosis among the studied patients ($P > 0.05$). Nonetheless, for diabetes, hypertension, hyperlipidemia, unstable angina, and drug abuse, the difference in restenosis was found to be statistically

significant ($P < 0.05$). As indicated in Table 3, the results of the χ^2 statistical test demonstrated that the frequency distribution of the type of involved vessels did not exhibit a statistically significant difference in terms of restenosis ($P > 0.05$). Nevertheless, the number of implanted stents showed a significant difference in relation to restenosis ($P < 0.05$). The results of the independent T-test revealed a statistically significant difference in the mean stent length between the 2 groups with and without coronary restenosis ($P < 0.05$). Specifically, the stent length in the patient group with restenosis was significantly greater than that in the group without restenosis.

Table 4: Investigation of the Relationship Between Coronary Restenosis and Its Predictive Factors According to the Univariate Logistic Regression Statistical Test

Variables		Restenosis		OR (95% CI)	P value
		Yes N (%)	No N (%)		
Hyperlipidemia	No	309 (82.2)	18. (19.4)	1.63 (1.09-2.45)	*0.017
	Yes	155 (73.8)	55 (26.2)		
Hypertension	No	317 (83)	65 (17)	1.89 (1.26-2.83)	*0.002
	Yes	147 (72.1)	57 (27.9)		
Diabetes mellitus	No	350 (82)	77 (18)	1.79 (1.17-2.74)	*0.007
	Yes	114 (71.7)	45 (28.3)		
Unstable angina	No	274 (83.5)	54 (16.5)	1.81 (1.21-2.71)	*0.004
	Yes	190 (73.6)	68. (26.4)		
Drug abuse	No	363 (82.3)	78 (17.7)	2.02 (1.31-3.11)	*0.001
	Yes	101 (69.7)	44 (30.3)		
Number of stents	1	329 (81.4)	75 (18.6)	1.52 (1.007-2.31)	*0.046
	2 and more	135 (74.2)	47 (25.8)		
Stent length, mm		23.93	25.22	1.19 (1.10-1.29)	0.001<
Stent diameter, mm		2.60	2.48	0.33 (0.22-0.50)	0.001<

OR: odds ratio, CI: confidence interval *Binary logistic regression (univariate)

Table 5: Investigation of the Relationship Between Coronary Restenosis and Its Independent Predictive Factors According to the Multivariate Logistic Regression Statistical Test

Variables	OR (95% CI)	P value
Hyperlipidemia	1.96 (1.20-3.20)	*0.007
Hypertension	1.83 (0.99-3.37)	*0.051
Diabetes mellitus	5.24 (2.61-10.51)	*<0.001
Unstable angina	1.29 (0.70-2.38)	*0.402
Drug abuse	9.96 (4.84-20.48)	*<0.001
Number of stents	4.91 (2.42-9.93)	*<0.001
Stent length, mm	1.21 (1.11-1.32)	*<0.001
Stent diameter, mm	0.3 (0.47-0.47)	*<0.001

OR: odds ratio, CI: confidence interval *binary logistic regression (multivariate)

According to the results presented in Table 4, the binary logistic regression analysis identified statistically significant associations between restenosis and several underlying conditions, including hyperlipidemia, hypertension, diabetes, unstable angina, the number, diameter, and length of stents, as well as drug abuse ($P < 0.05$). These findings suggest that the presence of each of these underlying conditions and drug abuse may increase the likelihood of developing restenosis and stent restenosis. The results indicate that specific risk factors are associated with increased odds of developing restenosis. Hyperlipidemia is associated with a 1.63-fold increase in odds, hypertension with a 1.89-fold increase, diabetes with a 1.79-fold increase, stable angina with a 1.81-fold increase, and drug abuse with a 2.02-fold increase. Moreover, having more than 1 stent increases the odds by 1.52-fold, and for each millimeter increase in stent length, the odds of restenosis post-stent placement increase by 1.19. Conversely, stent diameter serves as a protective factor, as an increase in stent diameter is associated with a decreased risk of restenosis.

The multivariable logistic regression analysis (Table 5) highlights the factors significantly associated with restenosis. Hyperlipidemia is associated with 1.83-fold increased odds, diabetes with 5.43-fold increased odds, drug abuse with 9.12-fold increased odds, having more than 1 stent with 4.98-fold increased odds, and for each millimeter increase in stent length, the odds increase by 1.20. Interestingly, stent diameter continues to be a protective factor, as a higher stent diameter is associated with a decreased risk of restenosis. These factors have been identified as independent predictors of restenosis.

DISCUSSION

Coronary artery stenosis is a complex process that begins in childhood and gradually exhibits

its symptoms during middle or old age. Epidemiological studies indicate that this condition may emerge as the leading cause of morbidity and mortality worldwide.²³ As a result, this disorder has become a focus of researchers, unveiling itself as a multifactorial process stemming from the interaction of biological, cellular, and metabolic factors.²⁴ Numerous studies have shown that restenosis can contribute to significant, unintended cardiac events, leading to additional interventions like repeat angioplasty via cutaneous approaches or open-heart surgery, potentially causing myocardial infarction or even death related to cardiovascular disease.²⁵ The primary objective of this study was to ascertain the incidence and identify the risk factors associated with restenosis following stent placement in patients with coronary artery disease.

The findings demonstrated that the incidence of restenosis in these patients was 20.8%. Previous studies have reported varying rates of restenosis. For instance, a study examining a population of 2159 patients undergoing angioplasty in the western region of the country reported a restenosis rate of 12.9%.¹⁴ Naseriyan et al³² found a 43% incidence of restenosis during a 4-year follow-up after angiography in their study conducted in the Iranian city of Zanjan. In a separate study involving the American population, Alraies et al²⁶ reported that the incidence of restenosis ranged from 3% to 20%. The discrepancies in restenosis incidence rates across various studies may be attributed to variations in demographic characteristics, individual and social factors, and multiple associated risk factors within different populations and geographical locations. Furthermore, research has revealed that hyperlipidemia, diabetes, drug abuse, a higher number of stents, and longer stents within coronary arteries are independent risk factors that can predict the occurrence of restenosis. Prior studies have also identified multiple factors associated with

restenosis. In their investigation of predictive risk factors for restenosis, Ebrahimzadeh et al¹⁹ determined that diabetes, the number of stents, a history of high blood fat, and drug abuse were the most common predictive risk factors. Hassani et al²⁰ recognized older age, a higher number of stents, diabetes, and the use of aspirin and β -blockers as predictive risk factors for restenosis. In the current study, however, age did not exhibit a significant correlation with restenosis. Nonetheless, a higher number of stents and the presence of diabetes were identified as predictive factors. The correlation between stent length, a higher number of stents, and larger stent sizes with restenosis has been corroborated by multiple studies. Similarly, Hou et al²⁰ identified a higher number of stents as factors associated with restenosis within arteries. Hasani et al¹⁴ determined a higher number of stents as a predictive risk factor for restenosis. This finding has been corroborated by Jukema et al²⁷ and other studies. Still, it should be noted that some studies, such as the one conducted by Latif et al,²⁸ have not found a significant correlation between a higher number of stents and restenosis. Zhang et al²⁹ established that the number of implanted stents, stent length, stent diameter, and the presence of consecutive stents were predictive factors for restenosis. In a similar vein, Zbinden et al³⁰ determined that a larger stent diameter plays a role in preventing restenosis. While stents are known to be associated with restenosis, the relationship between stent diameter and restenosis appears to be multifaceted and potentially influenced by various factors, including stent type, lesion length, and patient characteristics. To gain a more comprehensive understanding of the connection between stent diameter and restenosis, additional research is warranted. The discrepancy observed in the relationship between stent diameter and restenosis may be attributed to the impact of other confounding variables, including stent

type, length, size, and the location of stent placement.

Furthermore, our study has corroborated the role of a history of hyperlipidemia as a significant risk factor for restenosis.

A study conducted in the Iranian province of Lorestan yielded comparable findings.¹⁹

Additionally, 2 studies in Zanjan further validated this result.³¹ Despite these concordant results, it should be noted that Latif et al²⁸ reported a lack of association between hyperlipidemia and restenosis. Hyperlipidemia and arterial stiffness can be regarded as predictive risk factors for artery stenosis due to their involvement in lipid and fat deposition within the walls of arteries and stents. This deposition can contribute to a narrowing of the arteries and an increased risk of restenosis. In our study, sex and age did not demonstrate a significant association with the incidence of restenosis, a finding that aligns with the results of other previous studies.^{32, 28,}

^{33, 34} The present study determined that drug addiction and substance abuse were predictive factors for restenosis, which is in agreement with studies conducted by Stefanini et al³³ and Naseriyan et al.³² Interestingly, tobacco smoking did not show a significant correlation with the incidence of restenosis in our study, a finding that aligns with the aforementioned investigations. In contrast, Naseriyan et al³⁵ found a nonsignificant association in a separate study. The discrepancies in the relationship between tobacco use and restenosis could be attributed to the diverse patterns of tobacco use across various cultures and its varying prevalence within the studied populations.

A Zanjan-based study focusing on identifying factors affecting the incidence of restenosis over 4 years following angioplasty revealed that a history of diabetes, unstable angina, and chronic kidney disease were predictive risk factors for restenosis.³² Lau et al²² discovered that diabetes was a significant risk factor for coronary restenosis, a finding

supported by Aoyama et al,³⁴ who also established an association between diabetes, renal diseases, and restenosis. In our study, diabetes was identified as a predictive factor; however, no significant association was found between chronic kidney disease and unstable angina with restenosis. This discrepancy with our study stands in contrast to the investigations by Latif et al²⁸ and Stefaniak et al,³³ where the association between diabetes and restenosis was reported as nonsignificant. The contrasting results could be attributed to the lower prevalence of diabetes in the populations examined in these studies compared with the current study. This study, in conjunction with earlier investigations, has revealed some inconsistencies in the findings pertaining to predictive factors for restenosis. One key explanation for these discrepancies could lie in the utilization of distinct statistical populations, diverse definitions of dependent variables, and other heterogeneous characteristics of the studied populations.

It is important to acknowledge some limitations of our study. Firstly, the cross-sectional design allows only for the examination of associations between risk factors and ISR, without the ability to establish causal relationships. Secondly, the study was conducted exclusively on patients from a single facility in southern Iran, which may restrict the generalizability of the findings to larger or more diverse populations. Thirdly, participant selection was based on recurrent symptoms, leading to additional angiography, possibly introducing bias as individuals with more severe symptoms or higher risk profiles might have been more likely to undergo repeat procedures. Lastly, data collection was retrospective, relying on medical records and telephone follow-ups, which could potentially introduce misclassification bias due to incomplete or inaccurate data recording.

CONCLUSIONS

The findings of this study reveal that the incidence of restenosis following stent placement in patients with coronary artery disease is 20.8%. Hyperlipidemia, diabetes, drug abuse, a higher number of stents, and longer stent length within coronary arteries have been identified as independent risk factors associated with restenosis. As such, recognizing the risk factors linked to restenosis and incorporating them into clinical decision-making processes can substantially aid medical professionals in preventing these complications and improving the overall management of patients undergoing PCI. Notably, this study was carried out on a specific population of individuals seeking care at the educational and medical center of Shahid To analyze the collected data, various statistical tests were employed., which may limit the applicability of the findings to the general population. In light of this, future studies should examine the association between restenosis and other predictive factors. Moreover, researching a larger and more diverse participant population, while considering various demographic factors, would yield more comprehensive and generalizable results.

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