

Article

# Clinical Application of Cardiac Rehabilitation Program Based on Self-efficacy Theory in Patients with Acute Myocardial Infarction Undergoing Percutaneous Transluminal Coronary Intervention

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## Abstract

**Objective:** This study aimed to evaluate the effectiveness of a cardiac rehabilitation program based on self-efficacy theory in patients with acute myocardial infarction (AMI) undergoing percutaneous transluminal coronary intervention (PCI). **Methods:** A retrospective analysis was conducted on the medical records of 417 patients with AMI who underwent PCI at our hospital from May 2020 to May 2022. Patients were categorized into a control group (210 patients following a cardiac rehabilitation program) and an observation group (207 patients following a cardiac rehabilitation scheme based on self-efficacy theory). Data on demographics, diseases, and 1-year follow-up information were collected from the participants. Comparisons between the groups were made in terms of left ventricular ejection fraction (LVEF), six-minute walk distance test (6MWD), hospitalization duration, the 36-item short-form health survey (SF-36) score, and the incidence of angina pectoris and AMI recurrence within one-year post-management. **Results:** Initially, the groups had no significant difference in LVEF and 6MWD ( $p > 0.05$ ). However, after 1 and 3 months of management, the observation group exhibited higher LVEF and 6MWD than the control group ( $p < 0.001$ ). The observation group had a significantly shorter hospitalization duration ( $p < 0.001$ ) and higher SF-36 scores post-management ( $p < 0.001$ ). Furthermore, the incidence of angina pectoris and AMI recurrence within a year post-management was lower in the observation group ( $p < 0.05$ ). **Conclusion:** The cardiac rehabilitation program grounded in self-efficacy theory significantly improves cardiac function in patients with AMI, accelerates their post-PCI rehabilitation, improves quality of life, and reduces the recurrence of angina pectoris and AMI. This approach offers new directions for cardiac rehabilitation management of AMI.

## Keywords

self-efficacy theory; acute myocardial infarction; percutaneous transluminal coronary intervention; cardiac rehabilitation program

## Introduction

China currently faces the dual challenges of an aging population and a steady increase in metabolic risk factors, leading to an increasing burden of cardiovascular disease. As of 2019, cardiovascular disease deaths in rural and urban areas constituted 46.74% and 44.26% of the total deaths, respectively [1,2]. Acute myocardial infarction (AMI), a critical cardiovascular condition, results from sustained ischemic myocardial necrosis due to a significant reduction or cessation of coronary blood supply. Percutaneous transluminal coronary intervention (PCI), a prevalent clinical revascularization method, swiftly restores coronary circulation and myocardial blood supply, significantly lowering AMI mortality [3]. However, PCI does not halt atherosclerosis progression, and patients frequently face postoperative complications such as coronary artery restenosis and stent thrombosis, along with reduced exercise endurance, impacting their quality of life [4]. Furthermore, the acute onset and rapid progress of AMI have led to a focus on acute-phase rescue and treatment, with long-term prognosis and improvement of quality of life frequently overlooked [5].

Cardiac rehabilitation is an extensive management program encompassing dietary adjustments, exercise, medication adherence, smoking cessation, alcohol limitation, and mood regulation [6]. Research by Yu *et al.* [7] indicates that early cardiac rehabilitation post-PCI can enhance cardiac function, reduce postoperative complication risks, and improve the heart's antioxidant capacity and exercise endurance. Consequently, our hospital has increasingly focused on cardiac rehabilitation programs, particularly emphasizing the enhancement of patients' self-efficacy in clinical practice. In June 2021, a cardiac rehabilitation program

was initiated based on self-efficacy theory for patients undergoing PCI. Self-efficacy, an individual's belief in their capability to achieve specific behavioral goals, is identified by Bandura's social cognitive theory as a critical determinant of self-care behavior participation [8]. This theory has shown promising results in managing gestational diabetes mellitus [9], chronic obstructive pulmonary disease [10], and other conditions. However, reports on cardiac rehabilitation programs grounded in self-efficacy theory are scarce. This study, involving 417 patients with AMI who underwent PCI at our hospital, was conducted retrospectively to evaluate the effectiveness of this approach, aiming to provide insights for clinical practice enhancement.

## Materials and Methods

### General Data

#### Inclusion and Exclusion Criteria

Inclusion criteria: (1) Age between 18–75 years. (2) Postoperative stability. (3) New York Heart Association classification  $\leq$  Grade III. (4) Complete clinical data availability.

Exclusion criteria: (1) History of mental illness. (2) Severe life-threatening conditions, such as significant liver or kidney damage and malignant tumors. (3) Physical disabilities or other reasons impeding mobility. (4) Incomplete clinical data.

#### Research Participants

From May 2020 to May 2022, data from 425 patients with AMI who underwent PCI were collected. Exclusions included four patients with incomplete data, two with mental illness, and two with physical disabilities, resulting in 417 eligible patients.

### Methods

#### Management Methods

The control group underwent a routine cardiac rehabilitation program, which included (1) Health education and guidance on diseases, surgeries, diet, and exercise. (2) Bed rest, increased fluid intake, and contrast agent elimination on the first postoperative day, monitoring alongside for complications such as local or retroperitoneal hemorrhage, hematoma, pseudoaneurysm, and arteriovenous fistula, with timely intervention. (3) Assisted rehabilitation training for 7 postoperative days (Fig. 1), monitoring vital signs and stopping training if symptoms such as chest tightness or shortness of breath occurred. Post 7 days, the training intensity was gradually increased based on individual recovery, with patients engaging in activities such as yoga, running, and cycling for at least 3–5 times weekly, for >30

minutes each session. (4) Dietary guidance tailored to individual conditions, including limiting high-calorie foods such as fried foods and candy, increasing high-protein and high-vitamin intake, such as fish, fresh fruits, and vegetables, avoiding gas-producing foods to prevent constipation, sufficient hydration, and alcohol avoidance. (5) Clinical medication guidance, emphasizing the importance of life-long medication adherence, and instructing on timely and accurate dosage. Continuous management for 3 months was followed by appointments for rehabilitation training at the hospital's clinic for 2–3 hours weekly.

The observation group participated in a cardiac rehabilitation program founded on self-efficacy theory. In addition to the standard cardiac rehabilitation regimen, this program focused on enhancing patient self-efficacy through three approaches: increasing personal success experiences, vicarious experiences, and verbal persuasion. (1) Medical staff monitored patients' adherence to medication, diet, and postoperative behaviors, providing positive reinforcement to those maintaining healthy dietary habits, adhering to medical advice, and actively engaging in postoperative rehabilitation. (2) Utilizing examples of patients with favorable health behaviors and successful rehabilitation outcomes, the medical team promoted the program in hospital wards and organized forums for sharing rehabilitation experiences. This promotion activity helped patients recognize the significance of improved self-management and self-efficacy in postoperative physical and mental recovery. (3) Verbal guidance, advice, and encouragement were used to boost self-efficacy. Medical staff maintained a supportive and friendly demeanor during interactions, patiently addressing questions in simple terms and using positive language to foster confidence, such as assurances of completing tasks. Continuous encouragement motivated patients to strive for improvement. Post-discharge, the observation group continued with rehabilitation training identical in location and frequency to the control group.

#### Research Methods

Given the retrospective nature of this study, the patients' informed consent was not required. This study conformed to the principles of the Declaration of Helsinki (2013) [11]. A total of 417 patients who met the inclusion criteria were divided based on the type of management program they received post-PCI. The control group, comprising 210 patients, followed a routine cardiac rehabilitation program, while the observation group of 207 patients participated in a cardiac rehabilitation program based on self-efficacy theory. Medical records and ultrasound electrocardiogram data were collected from all patients. The postoperative measurements of left ventricular ejection fraction (LVEF) and six-minute walk distance (6MWD) were recorded, and repeated 1 month and 3 months post-management.

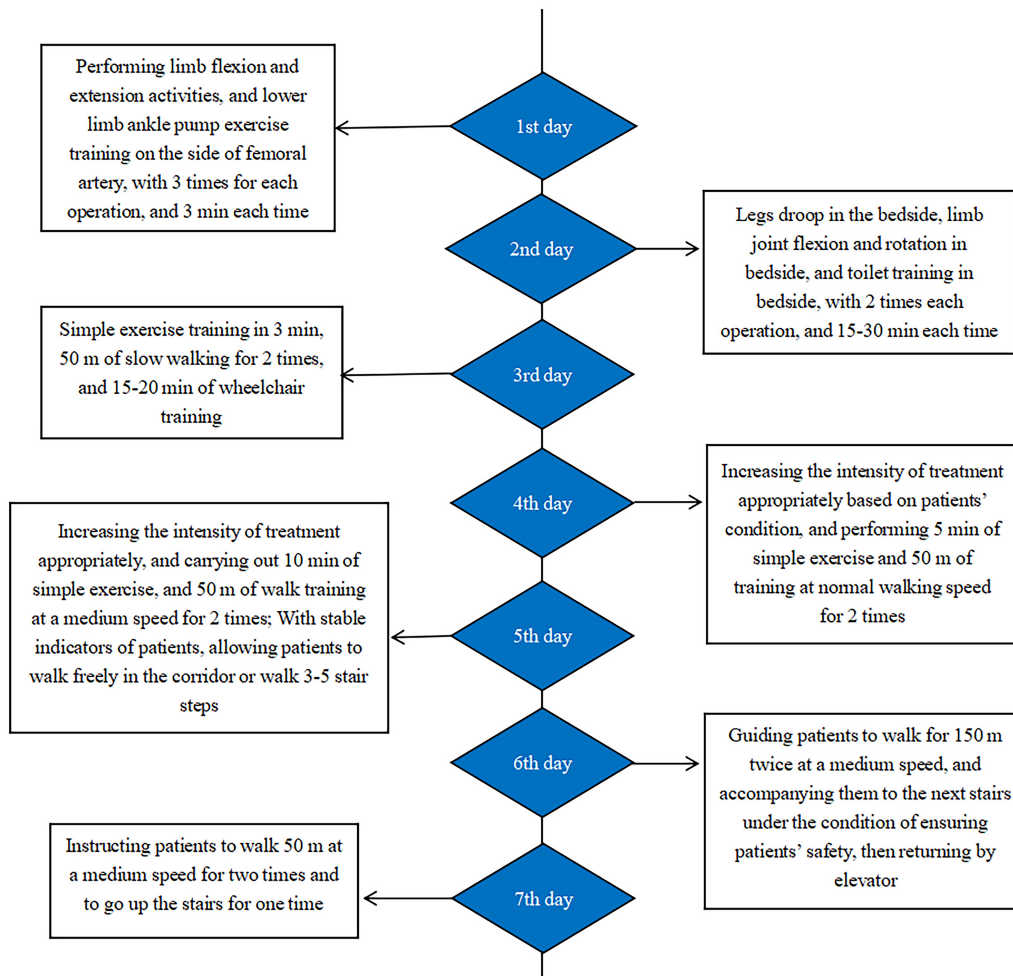


Fig. 1. Seven-day post-percutaneous transluminal coronary intervention (PCI) Rehabilitation training schedule.

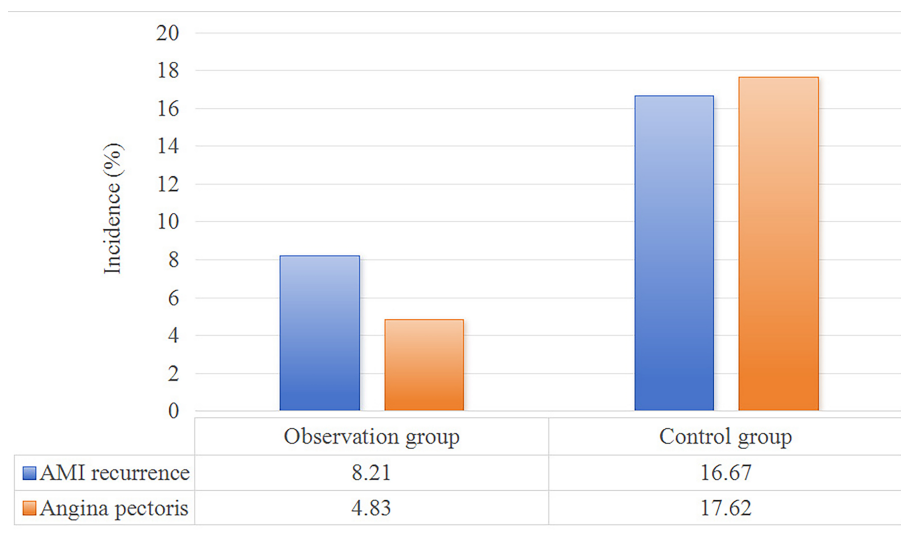


Fig. 2. One-year follow-up comparison of angina pectoris incidence and acute myocardial infarction (AMI) recurrence between the two groups.

Patients completed a comprehensive questionnaire designed by the research team, which gathered demographic and disease-related data, including information on gender,

age, marital status, education level, lifestyle, family's average monthly income, medical payment method, smoking and drinking habits, time of admission for AMI, and pres-

ence of complications (such as diabetes and hypertension), number of stents, number of lesions, and completeness of revascularization.

Trained researchers assisted patients in completing the 36-item short-form health survey (SF-36) scale [12], allowing for comparisons in self-efficacy and quality of life post-management. The SF-36 scale encompasses eight dimensions: physical functioning (PF), role of physiology (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SE), role of emotion (RE), and mental health (MH), each scored from 1 to 100 points. Higher scores indicate a better quality of life in health.

Patients were biannually followed up through telephone, WeChat, or outpatient visits for a year. The incidence of angina pectoris and the recurrence of AMI in both groups were recorded.

### Statistical Methods

All data were analyzed using SPSS 15.0 software (IBM Corp., Armonk, NY, USA) from International Business Machines Corporation. The Shapiro–Wilk method tested for normal distribution in continuous variables, with non-normally distributed variables presented as M ( $P_{25}$ ,  $P_{75}$ ), and analyzed using the Mann–Whitney U test. Categorical data were examined using the  $\chi^2$  test and expressed as [n (%)]. Statistical significance was set at  $p < 0.05$ . Figs. 1,2 were created using Microsoft Office Word (version: 2020; manufacturer: Microsoft Corporation; origin: Redmond, WA, USA) and Microsoft Excel (version: 2019; manufacturer: Microsoft Corporation; origin: Redmond, WA, USA).

## Results

### Demographic and Disease Data

Table 1 indicated no significant differences in clinical data between the two groups ( $p > 0.05$ ), confirming their comparability.

### Cardiac Function Indexes

There were no considerable differences in LVEF and 6MWD between the groups immediately postoperatively ( $p > 0.05$ ). However, after 1 and 3 months of management, the observation group displayed higher LVEF and 6MWD than the control group ( $p < 0.001$ ), as shown in Table 2.

### Hospitalization Duration

The hospitalization period for the observation group was significantly shorter at 7.00 (6.00, 7.00) days, compared to 10.00 (8.00, 11.00) days in the control group ( $Z = -15.152, p < 0.001$ ).

### Quality of Life

Post management, the observation group showed higher SF-36 scores across the PF, RP, BP, GH, VT, SE, RE, and MH dimensions than the control group ( $p < 0.001$ ), as detailed in Table 3.

### Incidence of Angina Pectoris and Recurrence Rate of AMI

Follow-up data revealed that the observation group experienced a lower incidence of angina pectoris and a reduced recurrence rate of AMI compared to the control group ( $p < 0.05$ ), as illustrated in Fig. 2.

## Discussion

AMI, characterized as an acute and critical condition, is frequently associated with complications such as arrhythmia or heart failure, leading to rapid deterioration and high mortality rates [13–15]. PCI is employed to recanalize stenosed or occluded coronary arteries, facilitating reperfusion of the ischemic myocardium and thereby improving cardiac function. It has become a primary clinical treatment for AMI [16]. However, post-PCI, a majority of patients experience psychological stress, leading to varying degrees of negative emotions. Furthermore, factors related to physiology and social interaction contribute to a diminished quality of life, ultimately impacting the prognosis of the disease. Effective postoperative management measures are essential for promoting recovery and enhancing the quality of life in patients with AMI after PCI. Cardiac rehabilitation, a comprehensive approach, has been proven effective and safe for patients with acute coronary syndrome or heart failure with reduced ejection fraction and for those undergoing coronary revascularization [17]. A study confirmed mild to moderate cardiac rehabilitation reduces angina and arrhythmia post-PCI [18].

However, patients with AMI show low participation rates and adherence to cardiac rehabilitation post-PCI, resulting in suboptimal clinical management. Self-efficacy theory, a core concept of Bandura's social cognitive theory, provides a framework for behavioral change, shifting patient involvement from passive to active in cardiac rehabilitation. However, there is a lack of research on the effectiveness of cardiac rehabilitation programs based on self-efficacy theory, with a scarcity of relative clinical data. Therefore, this study conducted a retrospective analysis to enrich the clinical basis for applying and promoting such programs. Standard postoperative evaluation methods in clinics include physical activity assessments, exercise endurance, cardiac function, and autonomic nervous system function. This study evaluated clinical efficacy based on cardiac function and the SF-36 scale, offering a comprehensive assessment of patients' local and overall physiological function, mental health, and social functioning. This study



**Table 1. Comparative analysis of demographic and disease data across both groups.**

Variables	Observation group (n = 207)	Control group (n = 210)	$\chi^2/Z$	<i>p</i>
Gender [Male, n (%)]	128 (61.84)	125 (59.52)	0.298	0.585
Age [years, M (P <sub>25</sub> , P <sub>75</sub> )]	63.00 (57.00, 69.00)	63.00 (58.00, 69.00)	-0.598	0.550
Marital status [married, n (%)]	194 (93.72)	191 (90.95)	1.127	0.288
Education level [senior high school and above, n (%)]	101 (48.79)	110 (52.38)	0.537	0.464
Living style [living alone, n (%)]	136 (65.70)	149 (70.95)	1.329	0.249
Family per capita monthly income [ $\geq$ 3000 CNY, n (%)]	89 (43.00)	95 (45.24)	0.213	0.645
Medical payment form [medical insurance, n (%)]	118 (57.00)	113 (53.81)	0.431	0.512
Smoking [n (%)]	79 (38.16)	85 (40.48)	0.234	0.629
Drinking [n (%)]	97 (46.86)	104 (49.52)	0.296	0.586
Admission time [h, M (P <sub>25</sub> , P <sub>75</sub> )]	7.00 (5.00, 9.00)	7.00 (6.00, 9.00)	-0.981	0.327
Diabetes [n (%)]	56 (27.05)	61 (29.05)	0.205	0.650
Hypertension [n (%)]	128 (61.84)	147 (70.00)	3.094	0.079
Number of stents [ $\geq$ 2, n (%)]	166 (80.19)	165 (78.57)	0.167	0.682
Number of lesions [single lesion, n (%)]	94 (45.41)	99 (47.14)	0.126	0.723
Revascularization [complete revascularization, n (%)]	95 (45.89)	97 (46.19)	0.004	0.952
Types of implanted stent			1.150	0.563
Mesh stent [n (%)]	73 (35.27)	81 (38.57)		
Tubular stent [n (%)]	66 (31.88)	70 (33.33)		
Other types [n (%)]	68 (32.85)	59 (28.10)		
Surgical types			1.738	0.187
Emergency PCI [n (%)]	139 (67.15)	128 (60.95)		
Staged PCI [n (%)]	68 (32.85)	82 (39.05)		

Notes: 1 CNY  $\approx$  0.1393 USD.

**Table 2. Comparison of cardiac function parameters in both groups [M (P<sub>25</sub>, P<sub>75</sub>)].**

Indexes	Time	Observation group (n = 207)	Control group (n = 210)	Z	<i>p</i>
LVEF (%)	After surgery	44.00 (40.00, 47.00)	44.00 (41.00, 48.00)	-1.423	0.155
	After 1 month of management	56.00 (52.00, 60.00)	53.00 (50.00, 56.00)	-7.847	<0.001
	After 3 months of management	61.00 (57.00, 65.00)	57.00 (54.00, 61.00)	-4.127	<0.001
6MWD (m)	After surgery	308.00 (290.00, 324.00)	308.00 (290.00, 323.00)	-0.384	0.701
	After 1 month of management	471.00 (445.00, 491.00)	454.50 (435.00, 479.00)	-6.424	<0.001
	After 3 months of management	510.00 (472.00, 551.00)	475.00 (449.75, 500.25)	-7.640	<0.001

Notes: LVEF, left ventricular ejection fraction; 6MWD, 6-minute walk distance.

approach provides a more holistic understanding of the effects of cardiac rehabilitation compared to studies focusing solely on cardiac function or exercise endurance [19,20].

The results indicated that the observation group had improved LVEF and 6MWD post-management compared to the control group ( $p < 0.001$ ), demonstrating that cardiac rehabilitation based on self-efficacy theory effectively enhances cardiac function in patients with AMI. Literature suggests that such rehabilitation improves the cardiovascular reserve capacity by strengthening the exercise capacity of patients, enhancing myocardial contractility, inhibiting myocardial fibrosis, and preventing pathological remodeling [21,22]. Implementing self-efficacy theory supports patient initiative in cardiac rehabilitation, maintaining healthy behavior, delaying atherosclerosis progression, and improving myocardial blood supply, thereby enhancing cardiac function.

Furthermore, post-management SF-36 scores in each dimension were higher in the observation group than in the control group ( $p < 0.001$ ), indicating that cardiac rehabilitation post-PCI based on self-efficacy theory significantly improves physical and mental health, enhancing the quality of life of patients with AMI. This program improves the physiological mechanisms such as cardiac function, endothelial function, and inflammatory response post-coronary revascularization, promoting physical recovery and exercise endurance [23,24]. Long-term positive exercise training addresses systemic disorders related to depression, balancing autonomic nerves, reducing cortisol levels, alleviating negative emotions, and reducing the patients' autonomic nervous system reaction to disease, treatment, and psychosocial stress, consequently promoting psychological and mental health [25,26].

Various cardiac rehabilitation modes exist, such as hospital-oriented [27], family-based [28], or exercise-based

**Table 3. Comparative evaluation of SF-36 scores between both groups [points, M (P<sub>25</sub>, P<sub>75</sub>)].**

Dimensions	Observation group (n = 207)	Control group (n = 210)	Z	p
PF	79.00 (74.00, 84.00)	71.00 (67.00, 75.00)	-12.749	<0.001
RP	80.00 (74.00, 85.00)	70.00 (65.75, 74.00)	-13.126	<0.001
BP	79.00 (73.00, 83.00)	70.00 (65.00, 74.00)	-12.332	<0.001
GH	78.00 (73.00, 83.00)	66.00 (63.00, 69.00)	-158.999	<0.001
VT	77.00 (73.00, 82.00)	65.00 (61.75, 69.00)	-15.820	<0.001
SE	79.00 (74.00, 84.00)	70.00 (66.00, 75.00)	-12.762	<0.001
RE	76.00 (72.00, 82.00)	69.00 (64.00, 73.00)	-11.598	<0.001
MH	78.00 (74.00, 83.00)	71.00 (66.00, 75.00)	-12.238	<0.001

Notes: SF-36, the 36-item short-form health survey; PF, physical functioning; RP, role of physiology; BP, body pain; GH, general health; VT, vitality; SE, social functioning; RE, role of emotion; MH, mental health.

modes [29]. While each has its merits, they recognize the importance of patient participation. Cardiac rehabilitation is a lengthy process, and patient initiative and self-care ability are vital. By encouraging patient participation and enhancing self-care skills, rehabilitation programs can be implemented at a minimal medical cost. This implementation is achieved by fully engaging patients in cardiac rehabilitation and progressively developing their self-care competencies. This study's self-efficacy theory-based cardiac rehabilitation program integrates patients' intrinsic motivational resources and outcome expectations with cardiac rehabilitation and health behaviors. This integration aims to bolster patients' self-efficacy, motivating them to actively and constantly engage in cardiac rehabilitation post-discharge. Concurrently, the program aids in cultivating healthy lifestyle habits and continuously improving their physical and mental well-being, thereby facilitating a swift return to everyday social life following surgery. However, successfully implementing a cardiac rehabilitation program that focuses on self-efficacy theory necessitates quickly earning the trust of patients and their families to enhance patient compliance. To address this issue, hospitals should emphasize developing medical staff's communication skills and encourage them to devote more time to discussing conditions with patients and their families, answering questions patiently, and providing reassurance. These actions can help patients perceive the professionalism and respectfulness of medical staff. This study provides data to support the implementation of self-efficacy theory-based cardiac rehabilitation following PCI.

This research specifically targeted patients with AMI who underwent PCI and may not apply to patients with other diseases undergoing pharmacotherapy or surgical revascularization. The follow-up period for patients is limited to three months, and it does not involve long-term impact assessments, which is a limitation. Moreover, being a single-center study with all samples drawn from one hospital, there is a potential for biased results. Future studies should broaden the sample inclusion criteria and conduct multi-center prospective studies based on these findings to

provide more comprehensive insights for enhancing and applying postoperative cardiac rehabilitation programs in patients with AMI.

## Conclusion

In summary, adopting a cardiac rehabilitation program grounded in self-efficacy theory post-PCI significantly enhances cardiac function significantly in patients with AMI, improves their overall health and quality of life, reduces the incidence of angina pectoris and AMI recurrence, and improves the patient prognosis.

## Availability of Data and Materials

Data to support the findings of this study are available on reasonable request from the corresponding author.

## Author Contributions

ZY and QZ performed the research. QZ provided help and advice on the experiments. ZY contributed to the analysis and interpretation of the data. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

## Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University [Approval No: 2021(2022-467)]. Since this study adopted a retrospective research method, the patients' informed consent was unnecessary.

## Acknowledgment

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## Conflict of Interest

The authors have no conflicts of interest to declare.

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