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Article

Impact of Combined Exercise Rehabilitation and Continuous Health Education on the Quality of Life and Mental Health of Patients Post-Coronary Stent Implantation

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Abstract

Objective: To evaluate the impact of patient-centered exercise rehabilitation combined with continuous health education on the quality of life and mental health of patients after coronary stent implantation to provide effective rehabilitation intervention strategies and scientific evidence for clinical practice. **Methods**: This retrospective cohort investigation involved patients who underwent coronary stent implantation at our hospital between January 2021 to December 2022. The control group (n = 81) received routine post-operative follow-up and health education, while the observation group (n = 68) additionally received personalized exercise rehabilitation and continuous health education. The short form-36 (SF-36) scale was used to assess quality of life, while the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) were used to evaluate mental health. The Exercise of Self-Care Agency Scale (ESCA) was used to assess self-care ability. **Results**: At 6 months post-operation, the observation group showed significantly higher scores than the control group across all dimensions of the SF-36 scale, SAS, SDS, and ESCA ($p < 0.05$). The observation group exhibited significantly improved quality of life, mental health, and enhanced self-care ability. **Conclusion**: Patient-centered exercise rehabilitation combined with continuous health education significantly positively impacts the quality of life and mental health of patients after coronary stent implantation. This comprehensive rehabilitation intervention strategy should be adopted in clinical practice to improve patient prognosis and quality of life.

Keywords

coronary artery stent implantation; exercise rehabilitation; continuous health education; quality of life; mental health

Background

Coronary artery disease (CAD) ranks among the primary contributors to mortality and disability worldwide. Percutaneous coronary intervention (PCI), a key treatment for CAD, effectively improves myocardial blood supply, alleviates angina symptoms, and reduces the incidence of acute myocardial infarction and mortality [1]. Despite the significant short-term efficacy of PCI, long-term prognosis is influenced by various factors. Patients with PCI often face challenges, such as restenosis and cardiovascular events. Although drug-eluting stents significantly reduce the incidence of restenosis, some patients still face the risk of in-stent restenosis or new coronary lesions after operation [2–5]. Post-operative patients commonly experience psychological stress, anxiety, and depression, particularly during the rehabilitation phase [6–8]. Psychological issues not only affect the quality of life but may also increase the risk of cardiovascular events.

Traditional rehabilitation care focuses mainly on medication and regular follow-ups and often neglect the importance of exercise rehabilitation and psychological support. Recent studies emphasize the role of comprehensive rehabilitation in improving postoperative outcomes, particularly patient-centered individualized intervention models [9,10]. This model includes personalized exercise rehabilitation plans combined with continuous health education to enhance patients' disease management capabilities and psychological adaptability [11,12]. Patient-centered exercise rehabilitation involves creating personalized exercise plans based on each patient's specific conditions and needs, including aerobic exercise, strength training, and flexibility training to improve cardiovascular function and overall physical fitness. Continuous health education provides regular health guidance and psychological support to help patients establish healthy lifestyle, improve disease knowledge, and self-management ability.

Although existing research indicates the positive effects of comprehensive rehabilitation interventions on post-operative outcomes, systematic assessment has not been conducted on the specific impact of patient-centered exer-

cise rehabilitation combined with continuous health education on the quality of life and mental health of patients post-coronary stent implantation. Therefore, this work aims to evaluate the effect of this comprehensive intervention strategy on the quality of life and mental health of patients after coronary stent implantation through a retrospective cohort study and provide effective rehabilitation intervention strategies and scientific evidence for clinical practice.

Materials and Methods

Study Design

This cohort study retrospectively analyzed clinical data from patients who underwent myocardial infarction coronary stent implantation to evaluate the impact of patient-centered exercise rehabilitation combined with continuous health education on their quality of life and mental health.

Study Subjects

The inclusion criteria included the following: patients who underwent coronary stent implantation for the first time; postoperative period between 1 and 6 months; no severe motor impairment or other diseases affecting exercise; complete follow-up data and clinical information; normal cognitive and communication abilities; good compliance and adherence to exercise requirements; age $<$75 years; and New York Heart Association (NYHA) functional class I–II.

The exclusion criteria were as follows: patients with severe postoperative complications combined with other major diseases or mental illnesses; incomplete follow-up data; large area myocardial infarction, cardiogenic shock, *etc*.

Data Source

Clinical data were collected from the cardiology department's medical records system of patients who underwent coronary stent implantation at our hospital between January 2021 and December 2022.

Rehabilitation Measures

The control (non-exposed) group received routine postoperative follow-up and health education, including: ① medication guidance: detailed explanation of commonly used postoperative medications, their mechanisms, administration methods, and precautions to ensure compliance; ② all patients took dual antiplatelet drugs, and appropriate oral medications, including lipid-lowering drugs, β-blockers, and angiotensin converting enzyme (ACE) inhibitors, based on individual conditions; ③ regular check-ups: monthly outpatient follow-ups, including physical examination, electrocardiogram (ECG), blood pressure monitoring, lipid and glucose testing, *etc*.; ④ general health advice: provide advice on healthy diet, smoking cessation, alcohol moderation, and weight management and guide patients in moderate daily activities and avoiding overexertion. This was our standard practice in 2021.

The observation (exposed) group received the same routine follow-up and health education as the control group, with the addition of patient-centered exercise rehabilitation and continuous health education, including the following: exercise rehabilitation: ① evaluation and planning: professional rehabilitation therapists conducted detailed assessments, including cardiovascular function, physical condition, exercise tolerance, *etc*., to create personalized exercise rehabilitation plans; ② aerobic exercise: activities, such as walking, jogging, cycling, three times a week, each session lasting 30–45 minutes. Intensity: Gradually increase intensity and duration based on 50% to 70% of an individual's maximum heart rate (220 minus age); ③ strength training: strength training for major muscle groups, twice a week, each session lasting 20–30 minutes, using light weights and high repetitions, gradually increasing weight; ④ flexibility training: including stretching exercises and flexibility practice, 10–15 minutes of stretching exercises after each session to restore muscle elasticity and prevent injury; ⑤ rehabilitation guidance: weekly meetings or phone/video consultations with rehabilitation therapists to adjust exercise plans, answer questions, and ensure the effectiveness and safety of exercise rehabilitation. Continuous Health Education included the following: ① disease knowledge education: weekly dissemination of coronary artery disease-related knowledge via phone, WeChat, or video conferencing, including etiology, disease course, postoperative rehabilitation essentials, *etc*., to enhance patient understanding; ② psychological counseling: monthly psychological health assessments and targeted counseling to help patients cope with postoperative anxiety, depression, and other emotional issues, with recommendations for professional psychological treatment if necessary; ③ exercise feedback: patients recorded their exercise activities weekly via WeChat, with rehabilitation therapists analyzing feedback, providing encouragement and guidance, and adjusting exercise plans based on patient progress and changes; ④ health monitoring: use of wearable devices (e.g., heart rate monitors) for real-time health monitoring, with data regularly uploaded and analyzed by rehabilitation therapists to identify and address potential issues promptly. This was our standard practice in 2022 for 6 months.

Data Collection

Demographic and Baseline Data

Data including age, gender, body mass index, educational level, comorbidities, *etc*. were collected from the participants.

Table 1. Comparison of baseline data between the two groups ($\bar{x} \pm$ s/n (%)).

Indicator	Observation group (n = 68)	Control group (n = 81)	χ^2/t	p
Gender			0.055	0.814
Male	39 (57.35%)	48 (59.26%)		
Female	29 (42.65%)	33 (40.74%)		
Age (years)	63.35 ± 4.25	63.48 ± 4.36	0.183	0.855
Body mass index (kg/m^2)	23.81 ± 2.95	23.95 ± 3.42		
Education level			0.192	0.662
Junior high school or below	43 (63.24%)	54 (66.67%)		
High school or above	25 (36.76%)	27 (33.33%)		
Marital Status			0.764	0.382
Married	59 (86.76%)	66 (81.48%)		
Single/Divorced/Widowed	9 (13.24%)	15 (18.52%)		
Hypertension	30 (44.12%)	39 (48.15%)	0.242	0.623
Hyperlipidemia	32 (47.06%)	44 (54.32%)	0.780	0.377
Diabetes	15 (22.06%)	19 (23.46%)	0.041	0.840
Smoking history	25 (36.76%)	33 (40.74%)	0.246	0.620
Family history	2 (2.94%)	2 (2.47%)	0.032	0.859
Previous MI location			0.049	0.826
Anterior wall	39 (57.35%)	45 (55.56%)		
Non-anterior wall	29 (42.65%)	36 (44.44%)		
Number of stents	1.26 ± 0.35	1.17 ± 0.32	1.638	0.104
Stent diameter (mm)	2.96 ± 0.52	2.89 ± 0.47	0.863	0.390
Affected vessels			1.526	0.466
Left anterior descending	40 (58.82%)	52 (64.20%)		
Left circumflex	3 (4.42%)	6 (7.40%)		
Right coronary artery	25 (36.76%)	23 (28.40%)		
LVEF (%)	52.53 ± 4.74	53.11 ± 4.01	0.809	0.420

Note: LVEF, left ventricle ejection fraction; MI, myocardial infarction.

Table 2. Contrast of SAS and SDS scores across both groups ($\bar{x} \pm$ s, points).

Group	n	SAS		SDS	
		T0	T1	T0	T1
Observation group	68	55.76 ± 4.38	42.82 ± 4.16	51.88 ± 4.20	48.32 ± 4.48
Control group	81	56.12 ± 4.45	48.34 ± 4.22	51.42 ± 4.15	50.62 ± 4.55
t		0.495	8.005	0.670	3.095
p		0.621	<0.001	0.504	0.002

Note: SDS, Self-Rating Depression Scale; T0, at 1 month post-operation; T1, 6 months post-operation; SAS, Self-Rating Anxiety Scale.

Quality of Life Assessment

Retrospective assessment of the quality of life scores of patients was conducted using the 36-Item Short Form Survey (SF-36) scale [13] at 1 (T0) and 6 (T1) months after operation. The SF-36 scale covers 8 dimensions, of which 7 were used in this study: physical functioning, role physical, bodily pain, general health, vitality, social functioning, and role emotional. Each dimension was scored from 0 to 100, with higher scores indicating better health status.

Mental Health Assessment

Retrospective assessment of patients' mental health scores at T0 and T1 was conducted using the Self-Rating Anxiety Scale (SAS) [14] and Self-Rating Depression Scale (SDS) [15]. The SAS includes 20 items with a total score range of 25–100 (scores <50 no anxiety, 50–59 mild anxiety, 60–69 moderate anxiety, and >70 severe anxiety). The SDS also includes 20 items with a total score range of 25–100 (scores <53 no depression, 53–62 mild depression, 63–72 moderate depression, and >73 severe depression).

Self-Care Ability

Retrospective assessment of patients' self-care ability data at T0 and T1 was performed using The Exercise of Self-Care Agency Scale (ESCA) [16]. The ESCA includes 4 dimensions: self-concept (8 items), health knowledge level (17 items), self-care skills (12 items) and self-

Table 3. Contrast of ESCA scores across both groups ($\bar{x} \pm s$, points).

Groups		Observation group (n = 68)	Control group (n = 81)	t	*p*
Self-concept	T0	18.58 ± 3.54	18.76 ± 3.60	0.306	0.760
	T1	23.24 ± 4.01	21.55 ± 4.12	2.525	0.013
Self-care skills	T0	26.90 ± 5.36	25.56 ± 5.45	1.506	0.134
	T1	36.36 ± 5.14	32.54 ± 7.05	3.715	<0.001
Self-responsibility	T0	14.82 ± 3.10	14.90 ± 3.12	0.156	0.876
	T1	16.78 ± 3.56	15.32 ± 4.06	2.312	0.022
Health knowledge	T0	42.76 ± 4.32	41.90 ± 5.26	1.077	0.283
	T1	55.32 ± 6.20	48.78 ± 7.90	5.542	<0.001

ESCA, Exercise of Self-Care Agency Scale.

Table 4. Contrast of SF-36 scores across both groups ($\bar{x} \pm s$, points).

Groups		Observation group (n = 68)	Control group (n = 81)	t	*p*
Physical functioning	T0	67.85 ± 7.20	65.98 ± 6.54	1.660	0.099
	T1	88.58 ± 6.14	81.32 ± 7.46	6.407	<0.001
Physical role functioning	T0	47.45 ± 6.22	48.90 ± 6.42	1.393	0.166
	T1	88.28 ± 10.96	73.31 ± 6.80	10.182	<0.001
Bodily pain	T0	68.14 ± 6.80	66.45 ± 6.98	1.490	0.139
	T1	91.30 ± 6.80	84.12 ± 7.96	5.857	<0.001
General health	T0	56.42 ± 6.96	58.10 ± 7.02	1.461	0.146
	T1	78.82 ± 7.62	73.46 ± 7.50	4.314	<0.001
Vitality	T0	59.45 ± 8.40	62.20 ± 8.62	1.962	0.052
	T1	90.10 ± 7.25	78.42 ± 6.46	10.395	<0.001
Social functioning	T0	64.25 ± 7.08	65.06 ± 7.75	0.661	0.510
	T1	87.76 ± 6.30	82.85 ± 12.85	2.873	0.005
Emotional role functioning	T0	64.25 ± 5.40	65.52 ± 5.56	1.407	0.162
	T1	83.90 ± 8.54	76.91 ± 6.59	5.635	<0.001

SF-36, short form-36.

responsibility (6 items), with a total of 43 items. The total score ranges from 43 to 172, with higher scores indicating stronger self-care ability.

Ethics

This retrospective study has been approved by the Medical Ethics Committee of Shaoxing People's Hospital (Approval No.: 2021-K-Y-375-01). As the study involved retrospective analysis of clinical data, patient consent was not required. Data protection and privacy policies were strictly followed to ensure the anonymity of patient information. All data were used solely for academic research, with access restricted to the research team. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki to ensure scientific methods and transparent data processing.

Statistical Methods

Data analysis was performed using SPSS software (Version 15.0, SPSS Inc., Chicago, IL, USA). We performed the normality test for continuous data by using the Shapiro-Wilk test. Continuous data following normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$). Normally distributed continuous variables were assessed using *t*-tests for comparison. Qualitative variables were presented as counts with corresponding percentages, and χ^2 test was used for comparison. $p < 0.05$ was deemed to indicate statistical significance.

Results

Baseline Data Contrast

The study enrolled 149 patients, which were divided into the combined group (n = 81) and the control group (n = 68). Baseline characteristics were similar between the two groups, showing no statistically significant differences ($p > 0.05$, Table 1).

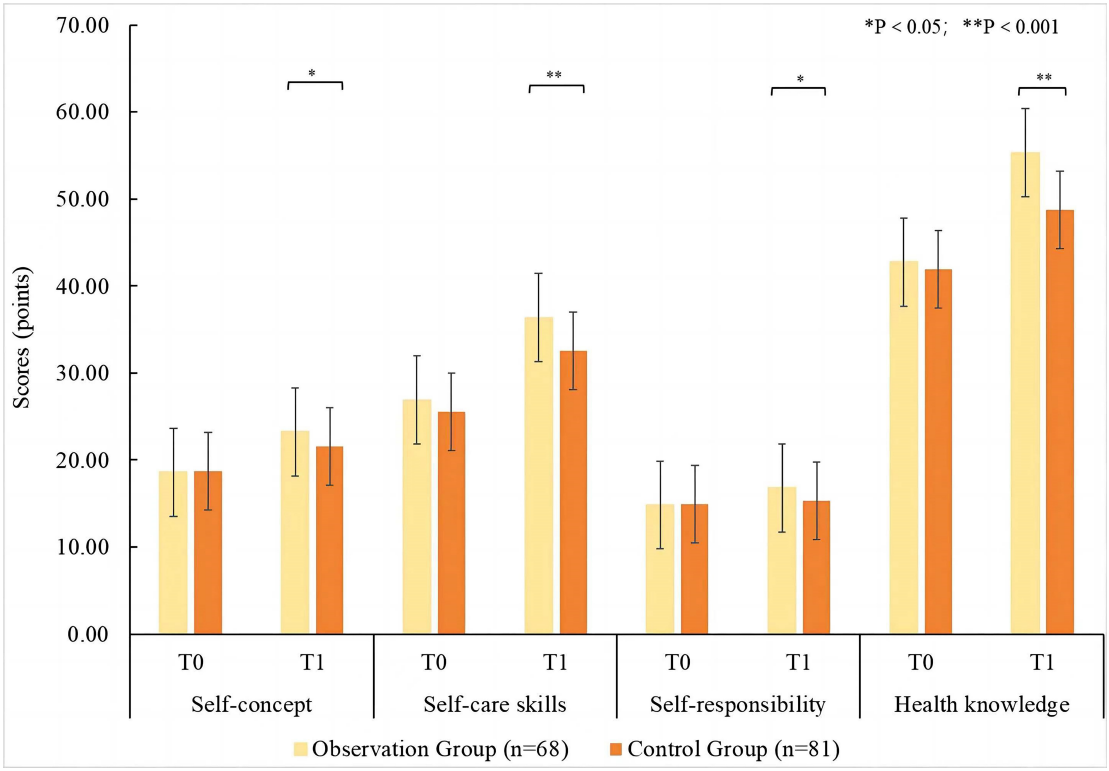

Fig. 1. Contrast of Exercise of Self-Care Agency Scale (ESCA) scores. *$p < 0.05$, **$p < 0.001$.

Comparison of SAS and SDS Scores between the Two Groups

At T0, SAS and SDS were not significantly different between the two groups ($p > 0.05$). At T1, the SAS and SDS had significantly lower levels in the observation group than in the control group (Table 2).

Comparison of ESCA Scores between the Two Groups

At T0, all dimensions of ESCA were not significantly different between the two groups ($p > 0.05$). At T1, the observation group had significantly higher scores in all ESCA dimensions than the control group ($p < 0.05$, Table 3 and Fig. 1).

Comparison of SF-36 Scores between the Two Groups

At T0, all dimensions of SF-36 were not significantly different the two groups ($p > 0.05$). At T1, the observation group had significantly higher scores in all SF-36 dimensions than the control group ($p < 0.05$, Table 4 and Fig. 2).

Discussion

This study demonstrates that post-coronary stent implantation patients can significantly improve their quality of life and mental health through combined patient-centered exercise rehabilitation and continuous health education. Specifically, the intervention group showed superior scores in the SF-36, SAS, SDS, and ESCA scales compared with the control group. These findings support the critical role of comprehensive rehabilitation interventions in the long-term prognosis of patients after coronary stent implantation.

First, the study found that the intervention group had significantly higher scores across all dimensions of the SF-36 scale than the control group. Previous research reported that exercise rehabilitation can effectively improve the quality of life of patients with cardiovascular diseases [17,18], particularly by enhancing cardiopulmonary function and improving exercise tolerance, thereby significantly alleviating physical discomfort and pain [19,20]. Laustsen *et al.* [21] stated that self-selected physical exercise in cardiac rehabilitation can improve peak oxygen uptake, muscle endurance, muscle strength, and muscle power. Health-related quality of life is significantly improved in physical and psychological aspects [21]. McGregor *et al.* [22] reported that for patients with CAD undergoing cardiac rehabilitation (CR), low-volume high-intensity interval training (HIIT) is a safe, well-tolerated, and clinically effective intervention that can improve cardiopulmonary health in the short term. However, this study further emphasizes the importance of continuous health education. Through regular health guidance and psychological support, patients in the intervention group were better able to understand and manage their health, leading to significant improvements in all aspects of quality of life.

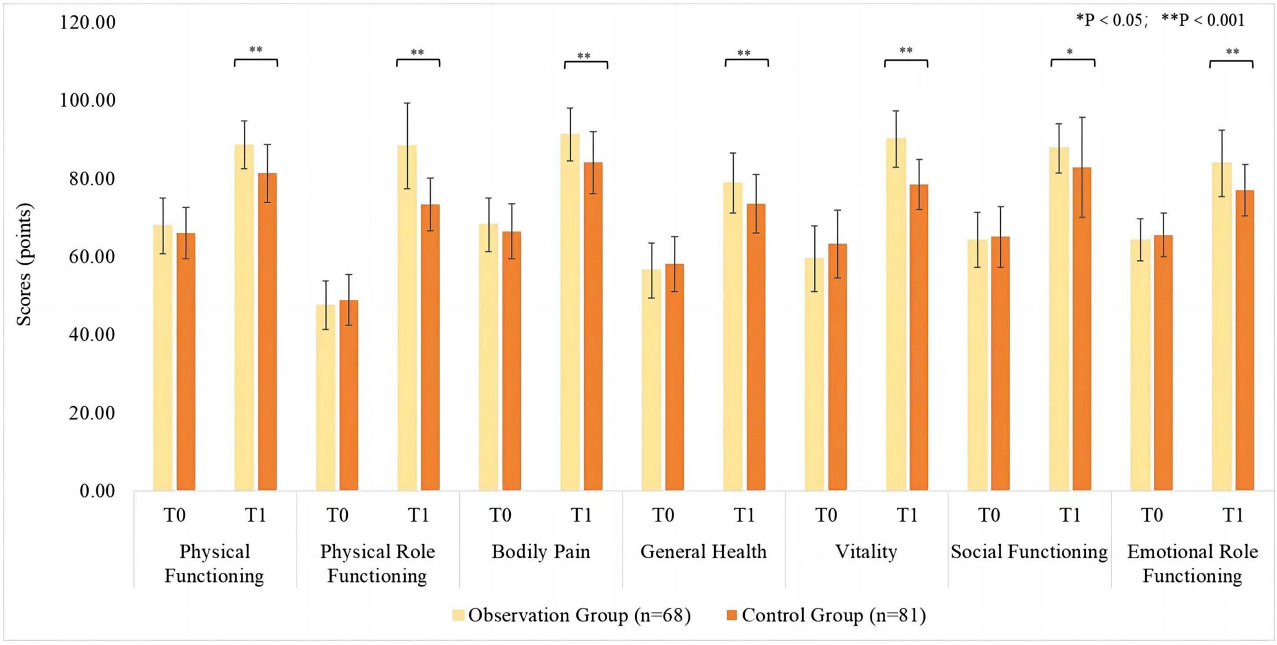

Fig. 2. Contrast of SF-36 scores. *$p < 0.05$, **$p < 0.001$.

Second, the results showed that the mental health of patients in the intervention group was significantly better than that of the control group, as evident by the significantly lower anxiety and depression scores at 6 months post-operation. In literature, patients with coronary heart disease often face high psychological stress after surgery, and mental health issues can further affect disease prognosis [23,24]. Gostoli *et al.* [25] indicated that cardiac rehabilitation is related to maintaining physical activity, improving behavior associated with food consumption, stress management, and sleep quality. By contrast, cardiac rehabilitation is not related to weight loss, healthy eating, or medication adherence. Exercise rehabilitation by increasing physical activity and social interaction can effectively alleviate the symptoms of anxiety and depression. Psychological counseling and continuous support within the continuous health education framework help patients feel cared for and supported during their rehabilitation, thereby regulating emotions and reducing psychological stress. Exercise rehabilitation enhances patients' cardiopulmonary function through systematic aerobic exercise, strength training, and flexibility training, which also improve muscle strength and body flexibility and reduce physical pain and discomfort. These physiological improvements directly enhance patients' quality of life.

Continuous health education played an important role in this study. First, systematic disease knowledge education can significantly improve patients' understanding and awareness of coronary heart disease, enhance self-management abilities, and reduce psychological stress associated with disease uncertainty and worry [26,27]. Second, psychological counseling and continuous health monitoring provide patients with ongoing support and encouragement during rehabilitation, enabling timely adjustment of rehabilitation plans and boosting patient confidence and treatment adherence [28–30]. The study also found that the intervention group had higher scores across all dimensions of the ESCA compared with the control group. Improved self-care ability indicates significant progress in self-management and disease coping, a result of exercise rehabilitation and continuous health education. Health education equips patients with disease knowledge and health skills, enable proactive participation in the rehabilitation process, and promote overall health improvement.

This study is a retrospective cohort study that provides evidence support. However, compared with prospective randomized controlled trials, retrospective studies have certain biases. Despite efforts to control confounding factors, unidentified confounding variables may still influence the results. This study was conducted in a single center, which may present regional differences, thereby limiting the generalizability of the results. The strict inclusion and exclusion criteria set to reduce confounding factors may limit the study's representativeness. In practice, patients' acceptance and adherence to exercise rehabilitation and health education may vary and affect the evaluation of intervention effects. The subjective data on psychological health and self-care abilities primarily relied on patient self-reporting, which posed a risk of self-reporting bias. Future research should consider integrating objective measures, such as physiological assessments or third-party evaluations, to provide comprehensive and objective data support. The sample size should be increased, and further multi-center randomized controlled trials should be conducted to enhance the reliability and generalizability of the results. Further refining and standardizing interven-

tion measures and exploring the specific effects of different types and intensities of exercise rehabilitation programs are necessary. Combining individualized health education content and tailored interventions based on different patient needs should be considered.

Conclusion

This study confirms that patient-centered exercise rehabilitation combined with continuous health education has a significant positive impact on the quality of life and mental health of patients after coronary stent implantation. This comprehensive rehabilitation intervention strategy can be adopted in clinical practice to improve patient prognosis and quality of life.

Availability of Data and Materials

The datasets used and/or analyzed during the current study were available from the corresponding author on reasonable request.

Author Contributions

JX and CY designed the study; all authors conducted the study; FP and HL collected and analyzed the data; WT and CX participated in drafting the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content. All authors contributed to editorial changes in the manuscript. All authors gave final approval of the version to be published. All authors participated fully in the work, take public responsibility for appropriate portions of the content, and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study has been approved by the Medical Ethics Committee of Shaoxing People's Hospital. Approval No.: 2021-K-Y-375-01. This study is retrospective cohort investment, so there is no need for a written informed consent form from the patient.

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Conflict of Interest

The authors declare no conflict of interest.

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