Heart Surgery Forum 2024; 27(8): E924–E932
doi: 10.59958/hsf.7469

Article

Internet-Based Telerehabilitation Guidance Brings Additional Benefits to Patients after Percutaneous Coronary Intervention: A Retrospective Cohort Study

Hua Sun[1], Lijun Liu[1], Qiubing Zhang[1,*]

[1]Department of Cardiovascular Medicine, Guangyuan Central Hospital, 628099 Guangyuan, Sichuan, China
*Correspondence: zqbgf715@163.com (Qiubing Zhang)

Submitted: 20 March 2024 Revised: 14 April 2024 Accepted: 18 June 2024 Published: 18 August 2024

Abstract

Purpose: This study aimed to analyze the value of remote rehabilitation guidance based on Internet technology in patients undergoing percutaneous coronary intervention. **Methods**: We retrospectively analyzed the clinical data of 253 patients who underwent percutaneous coronary intervention in our hospital from June 2022 to March 2023. According to different nursing methods, they were divided into a study group (remote rehabilitation guidance based on Internet technology) and a control group (routine follow-up management) with 124 and 129 cases, respectively. The compliance left ventricular diastolic dysfunction (LVDD), left ventricular end-systolic diameter (LVDS), left ventricular ejection fraction (LVEF), Seattle Angina Questionnaire (SAQ), self-rating depression scale (SDS), self-rating anxiety scale (SAS), self-care ability, quality of life (SF-36), and satisfaction of the two groups were compared. **Results**: The compliance of the study group was 94.35%, which was higher than that of the control group (77.52%; n = 100, χ^2 = 14.683, $p < 0.001$). We found no difference in cardiac function between the groups before the intervention (z = –0.783, $p > 0.05$). After the intervention, the LVDD and LVDS of the study group were lower than those of the control group, but LVEF was higher than that of the control group (z = –9.645, $p < 0.001$). Before the intervention, there was no difference in the SAQ scores between the groups (z = –0.180, –1.260, and –0.543, $p > 0.05$). After the intervention, the scores of angina pectoris attack, disease stability, and disease cognition in the study group were higher than those in the control group (z = –13.679, –10.644, and –11.448, $p < 0.001$). There was no difference in SDS and SAS scores between the groups before the intervention (z = –0.008 and –0.717, $p > 0.05$). After the intervention, the scores of the research group were lower than those of the control group (z = –13.709 and –8.041, $p < 0.001$). Before the intervention, we found no difference in self-care ability between the groups (z = –0.675, $p > 0.05$). After the intervention, the scores of health knowledge, self-responsibility, self-concept, and self-care skills in the study group were higher than those in the control group (z = –11.644, –9.387, –12.612, and –12.012, $p < 0.001$). There was no difference in the SF-36 scores between the groups before the intervention (z = –0.682, –0.189, –1.124, and –0.018, $p > 0.05$). After the intervention, the scores of the study group were higher than those of the control group (z = –12.323, –12.163, –12.066, and –12.054, $p < 0.001$). The satisfaction rate of the research group was 91.94%, which was significantly higher than that of the control group (70.54%; n = 91, χ^2 = 18.822, $p < 0.001$). **Conclusions**: The effect of remote rehabilitation guidance based on Internet technology is evident. It can effectively improve patients' cardiac function, enhance self-care ability, and result in high compliance with nursing care. Moreover, it can effectively reduce negative emotions and improve their quality of life. Given that satisfaction is high, it is a procedure worth promoting.

Keywords

percutaneous coronary intervention; internet technology; remote rehabilitation guidance; routine follow-up management

Introduction

Coronary heart disease is a leading cause of morbidity and mortality worldwide, characterized as a chronic inflammatory, fibroproliferative disorder caused by lipids [1,2]. Coronary heart disease not only affects patients' quality of life and exercise ability, but some patients even experience negative emotions such as depression and anxiety, which can directly increase the risk of cardiovascular events and even disrupt the hypothalamic–pituitary axis, causing great damage to endothelial cell function [3]. The impact will eventually cause a series of physiological and psychological changes, causing great harm to the patient's life safety [4]. Percutaneous coronary intervention (PCI) has made advances and can effectively treat complex coronary artery diseases [5]. However, there is still a chance of restenosis or thrombosis after surgery [6]. A previous study showed [7] that the incidence of in-stent restenosis after PCI accounts for about 10%–20%, and it mostly occurs

within 6 months after surgery, directly affecting the long-term results of patients. Patients after PCI need to receive long-term, professional, and systematic home rehabilitation management, which is of great significance in improving prognosis. Nowadays, with the advancement of Internet technology, remote rehabilitation guidance has been proposed to play an important role in the rehabilitation management of chronic diseases [8]. Remote rehabilitation guidance shows that medical staff use electronic equipment to provide a series of professional rehabilitation guidance to patients after PCI, which has the advantages of rich models, resource sharing, real-time capabilities, and other advantages; moreover, it breaks the limitations of time and space and improves rehabilitation effectively [9]. To date, the available research is still relatively small and insufficient to draw good conclusions. The objective of this study was to evaluate the rehabilitation requirements and real-world obstacles encountered by patients following PCI, aiming to enhance comprehension of long-term rehabilitation necessities post-PCI and optimize clinical rehabilitation management protocols. Additionally, we aim to appraise the efficacy of telerehabilitation guidance in addressing the temporal and spatial constraints inherent in traditional rehabilitation approaches, thereby affording patients access to convenient rehabilitation services. Furthermore, we seek to investigate the influence of telerehabilitation guidance on patients' mental well-being and its efficacy in mitigating adverse psychological states such as depression and anxiety. Ultimately, we aim to enhance patients' quality of life and prevent cardiovascular events through improved rehabilitation strategies.

Materials and Methods

General Information

The clinical data of 253 patients who underwent percutaneous coronary intervention in our hospital from June 2022 to March 2023 were obtained. According to different nursing methods, the patients were divided into a study group (remote rehabilitation guidance based on Internet technology) and a control group (routine follow-up management) with 124 and 129 cases, respectively. This study was in line with the Declaration of Helsinki. All respondents in this study provided informed consent and signed the relevant informed consent materials before participating in the survey. This study has been approved by the Medical Ethics Committee of Guangyuan Center Hospital under Approval No. 2024001.

The inclusion criteria were as follows: (1) patients and family members were informed and signed consent forms; (2) all met the diagnostic criteria for coronary heart disease in the "Guidelines for the Diagnosis and Treatment of Stable Coronary Heart Disease" [10]; (3) they met the Chinese Economic Surgical standards in the "Guidelines for Cutaneous Coronary Intervention" [11]; (4) undergoing PCI for the first time, and the operation was successful, the postoperative condition was stable, and all patients received three-month follow-up; and (5) postoperative consciousness was clear, and follow-up conditions existed.

The exclusion criteria were as follows: (1) the expected survival period was less than 1 year; (2) those who require secondary surgery; (3) those with communication impairment, cognitive impairment, or mental illness; (4) those with a history of myocardial infarction or heart disease; (5) those with poor compliance and unable to cooperate with the trial; and (6) those with incomplete medical records or those who dropped out of the trial midway.

Method

Both groups of patients received the respective management on the day of discharge, which continued for 2 months.

Control group: This group was subjected to routine follow-up management, in which we provided discharge guidance, instructed patients to come to the hospital for regular check-ups, informed them of matters needing attention at home after discharge, and introduced the importance of taking medications on time, eating regularly, and exercising. Follow up with patients was conducted by phone every month. Their condition recovery and medication status were clarified, patients' questions were answered, and suggestions and guidance for problems they encounter in life were provided.

Research group: This group was subjected to remote rehabilitation guidance based on Internet technology. (1) We established a remote guidance group with cardiovascular physicians, rehabilitation therapists, and nurses, and we organized regular training for group members to learn about PCI and provide relevant knowledge about postoperative rehabilitation. We held meetings to discuss and formulate a remote rehabilitation guidance plan for patients after discharge, and we required members to strictly follow the requirements. (2) Upon discharge, we obtained the patient's contact information, invite them to follow the hospital's WeChat official accounts, and instructed patients and their families on how to deal with the information from the hospital's WeChat. At the same time, we asked them to join a WeChat group to receive the record of corresponding rehabilitation education videos according to the patient's specific recovery plan. We also encouraged patients and family members to actively check the medication information pushed by the WeChat platform at home, and instructed patients to perform rehabilitation exercises according to the videos on the WeChat official accounts. The team members compiled patient medication guidance and other various information by consulting books and literature. The content was reviewed by the team leader and pushed reg-

Table 1. Comparison of general information between the two groups of patients.

Object	Observation group (n = 124)	Control group (n = 129)	χ^2/z	p
Gender			0.214	0.644
Male	100 (80.65)	101 (78.29)		
Female	24 (19.35)	28 (21.71)		
Age (year)	56.00 (48.00, 65.00)	59.00 (48.50, 68.50)	−0.918	0.359
BMI (kg/m^2)	22.60 (20.90, 24.10)	22.20 (20.55, 24.30)	−0.444	0.657
Number of stents implanted			0.232	0.972
1	23 (18.55)	21 (16.28)		
2	43 (34.68)	46 (35.66)		
3	38 (30.64)	41 (31.78)		
4	20 (16.13)	21 (16.28)		
Coronary angiography report			0.020	0.889
Single-vessel disease	47 (37.90)	50 (38.76)		
Multivessel disease	77 (62.10)	79 (61.24)		
Complications				
Diabetes mellitus	18 (14.52)	20 (15.50)	0.048	0.826
Hypertension	37 (29.84)	41 (31.78)	0.112	0.738
Hyperlipidemia	31 (25.00)	35 (27.13)	0.149	0.699
Chronic kidney disease	15 (12.10)	17 (13.18)	0.067	0.796
Smoking history			0.001	0.978
Yes	69 (55.65)	72 (55.81)		
No	55 (44.35)	57 (44.19)		
Alcohol consumption history			0.018	0.893
Yes	76 (61.29)	78 (60.47)		
No	48 (38.71)	51 (39.53)		
Pharmacological interventions				
Aspirin	59 (47.58)	63 (48.84)	0.040	0.842
$P2Y_{12}$ inhibitors	62 (50.00)	55 (42.64)	1.379	0.240
β blockers	61 (49.19)	62 (48.06)	0.032	0.857
RAAS inhibitors	28 (22.58)	30 (23.26)	0.016	0.898
Lipid-lowering drugs	30 (24.19)	33 (25.58)	0.065	0.799
Diuretics	41 (33.06)	44 (34.11)	0.031	0.860

Note: BMI, body mass index; RAAS, renin-angiotensin system.

ularly through the WeChat official accounts. At least two forms of information were pushed every week to encourage patients to learn and give feedback in the WeChat group and communicate with patients. Patients were encouraged to regularly publish health logs in the WeChat group for clinicians to review and answer questions, and they were reminded to take medicines on time and in the right amount. (3) Patients were instructed to download the Guanjia app (self-developed) through their smartphones and register and complete their personal information. We provided them with targeted rehabilitation guidance and set up an information exchange window for health consultation. Patients could provide feedback on problems in real time, and team members offered one-on-one medical care to analyze and answer questions. (4) The Guanjia app was used to intelligently monitor patients' blood sugar, blood pressure, electrocardiogram, exercise volume, blood oxygen, and other data, automatically generate statistical charts of vital indicators, predict recovery trends, and guide patients to self-regulate and adjust recovery plans in real time. In addition, expert guidance was provided through audio or video, patiently asking and understanding the patient's diet, exercise, medication, mood, and lifestyle. Correction and guidance for wrong behaviors and encouragement and affirmation for correct behaviors were provided. (5) Health education was conducted through online reading, blogs, and streaming media so that patients can learn about surgery and postoperative rehabilitation in detail, as well as promote their awareness of the hazards of risk factors for disease recovery and long-term postoperative medication necessity.

Observation Indicators

(1) After management, we chose the compliance score (Morisky) to evaluate the compliance of the two groups. The full score was 8 points: very compliant, 8 points; partly compliant, 6–7 points; and non-compliant, 0–5 points. Compliance = strong compliance + partial compliance [12].

Table 2. Comparison of compliance between the two groups.

Group	Very compliance	General compliance	Not compliance	Compliance
Observation group (n = 124)	59 (47.58)	58 (46.77)	7 (5.65)	117 (94.35)
Control group (n = 129)	41 (31.78)	59 (45.74)	29 (22.48)	100 (77.52)
χ^2				14.683
p				<0.001

Table 3. Comparison of cardiac function among various groups.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	p
LVDD (mm)	Before management	63.00 (61.00, 65.00)	63.00 (61.00, 64.00)	–0.783	0.433
	After management	55.00 (52.00, 58.00)	58.00 (56.00, 59.00)	–6.410	<0.001
LVEF (%)	Before management	46.00 (44.00, 48.00)	46.00 (44.00, 49.00)	–0.166	0.868
	After management	51.00 (50.00, 53.00)	48.00 (46.00, 50.00)	–9.645	<0.001
LVDS (mm)	Before management	43.00 (41.00, 44.00)	42.00 (41.00, 44.00)	–0.187	0.851
	After management	36.50 (35.00, 38.00)	40.00 (39.00, 42.00)	–11.597	<0.001

LVDD, left ventricular diastolic dysfunction; LVEF, left ventricular ejection fraction; LVDS, left ventricular end-systolic diameter.

(2) Using color Doppler ultrasound (manufacturer: Philips (China) Investment Co., Ltd. Shanghai Branch; model: Affiniti70; origin: Shanghai, China) before (the day of discharge) and after the management period, we recorded the left ventricular diastolic dysfunction (LVDD; normal range: male, 45–55 mm; female, 35–50 mm), left ventricular end-systolic diameter (LVDS, normal range 50%–70%), and left ventricular ejection fraction (LVEF, normal range: male, 25–37 mm; female, 20–35 mm).

(3) Before management (on the day of discharge) and after the completion of management, we used the Seattle Angina Questionnaire (SAQ) scores to measure both groups of patients. This questionnaire included three major items: angina pectoris attack, disease stable state, and disease cognition. The full score for each item was 100 points. The higher the score, the more severe the angina pectoris symptoms and the worse the body function [13].

(4) Before management (on the day of discharge) and after the completion of management, we used the self-rating depression scale (SDS) and self-rating anxiety scale (SAS) scores to take measurements for both groups of patients. ① SAS: >50 means anxiety; the higher the score, the more serious the anxiety; ② SDS: >53 means depression; the higher the score, the more severe the depression [14].

(5) Before management (on the day of discharge) and after the completion of management, we recorded the self-care ability scores of the two groups. This scale covered four major items: health knowledge (68 points), self-responsibility (24 points), self-concept (32 points), and self-care skills (48 points). The higher the score, the stronger the self-care ability [15].

(6) Before management (on the day of discharge) and after the completion of management, we recorded the quality of life (SF-36) scores of the two groups. We selected four items of social function, physiological function, emotional function, and health status for evaluation. The full score for each item was 100 points. The higher the score, the better the quality of life [16].

(7) After the completion of management, we recorded the satisfaction of each group with the nursing service as follows: very satisfied, 80–100 points; generally satisfied, 55–79 points; and unsatisfied, 0–54 points. Satisfaction = very satisfied + general satisfaction.

Statistical Processing

The data collected in this study were processed using the professional statistical software SPSS (version: 26.0, Manufacturer: International Business Machines Corporation, Origin: Armonk, NY, USA). Categorical data were presented as [n (%)], and the chi-square test was employed. For the continuous data collected in this study, the Kolmogorov–Smirnov test was used to assess normality. Normally distributed continuous data were expressed as ($\bar{x} \pm$ s) and analyzed using the t-test, whereas non-normally distributed continuous data were represented as M (P25, P75) and analyzed using non-parametric tests. A statistical significance level of $p < 0.05$ was considered.

Results

Comparison of General Information between the Two Groups of Patients

We found no significant difference in gender, age, body mass index (BMI), and other general information between the two groups of patients ($p > 0.05$; Table 1).

Table 4. Comparison of SAQ scores in each group.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	*p*
Angina attack	Before management	55.00 (52.00, 58.00)	55.00 (53.00, 57.50)	−0.180	0.857
	After management	75.00 (73.00, 78.00)	65.00 (62.00, 67.00)	−13.679	<0.001
Disease stable state	Before management	55.00 (52.00, 58.00)	54.00 (52.00, 57.00)	−1.260	0.208
	After management	72.00 (69.00, 75.00)	66.00 (62.00, 68.00)	−10.644	<0.001
Disease awareness	Before management	55.00 (53.00, 58.00)	55.00 (52.50, 58.00)	−0.543	0.587
	After management	73.00 (69.00, 78.00)	65.00 (62.00, 68.00)	−11.448	<0.001

SAQ, Seattle Angina Questionnaire.

Table 5. Comparison of SDS and SAS scores in each group.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	*p*
SDS score	Before management	56.00 (53.00, 60.00)	56.00 (53.00, 60.00)	−0.008	0.994
	After management	39.00 (37.25, 42.00)	50.00 (48.00, 53.00)	−13.709	<0.001
SAS score	Before management	58.00 (52.25, 61.00)	57.00 (54.00, 62.00)	−0.717	0.474
	After management	40.50 (35.00, 47.00)	49.00 (44.00, 53.50)	−8.041	<0.001

SDS, self-rating depression scale; SAS, self-rating anxiety scale.

Comparison of Compliance between the Two Groups

The compliance of the study group was 94.35%, which was higher than that of the control group (77.52%, $p < 0.001$), as shown in Table 2.

Comparison of Cardiac Function among Various Groups

Before management, we found no significant differences in LVDD, LVEF, and LVDS levels between the two groups ($p > 0.05$). After management, the LVDD and LVDS levels in the study group were lower than those in the control group, whereas the LVEF level was higher than that in the control group ($p < 0.001$; Table 3).

Changes in SAQ Scores in Each Group

There was no difference in SAQ scores between the groups before the intervention ($p > 0.05$). After the intervention, the angina pectoris attack, disease stable state, and disease cognitive scores of the study group were all higher than those of the control group ($p < 0.001$; Table 4).

Changes in SDS and SAS Scores in Each Group

Before management, we found no significant difference in SDS and SAS scores between the groups ($p > 0.05$). After management, the SDS and SAS scores of the observation group were lower than those of the control group ($p < 0.001$; Table 5).

Changes in Self-Care Ability of Each Group

Before management, we found no significant differences in the self-care ability of each group ($p > 0.05$). After management, the scores of health knowledge, self-responsibility, self-concept, and self-care skills of the research group were higher than those of the control group ($p < 0.001$; Table 6).

Changes in SF-36 Scores in Each Group

Before management, there were no significant differences in scores for social functioning, physical functioning, emotional functioning, and overall health status dimensions between the two groups ($p > 0.05$). After management, the study group had higher scores than the control group in these dimensions ($p < 0.001$; Table 7).

Comparison of Indicators of Observations by Group

The difference between the two groups before and after the management of each observational index was significant ($p < 0.001$; Table 8).

Comparison of Satisfaction among Each Group

The satisfaction rate of the research group was 91.94%, which was significantly higher than that of the control group (70.54%; $p < 0.05$), as shown in Table 9.

Discussion

The study revealed notable differences between the intervention group and the control group across various parameters. Notably, the compliance rate in the study group exceeded that of the control group, indicating a higher level of adherence to the management protocol. Moreover, significant improvements were observed in cardiac function indicators, angina pectoris symptoms, psychological well-being, self-care abilities, and overall health status among

Table 6. Comparison of self-care ability of the two groups.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	*p*
Health knowledge	Before management	26.00 (24.00, 28.00)	26.00 (24.00, 28.00)	–1.345	0.179
	After management	42.00 (40.00, 44.00)	38.00 (36.00, 39.00)	–11.644	<0.001
Sense of self-responsibility	Before management	13.00 (11.00, 14.00)	12.00 (11.00, 14.00)	–0.838	0.402
	After management	20.00 (19.00, 23.00)	17.00 (16.00, 19.00)	–9.387	<0.001
Self-concept	Before management	17.50 (16.00, 20.00)	17.00 (16.00, 20.00)	–0.399	0.690
	After management	27.00 (25.00, 29.00)	22.00 (21.00, 24.00)	–12.612	<0.001
Self-care skills	Before management	25.00 (22.00, 27.00)	25.00 (22.00, 27.00)	–0.675	0.500
	After management	33.00 (32.00, 35.00)	29.00 (26.00, 30.00)	–12.012	<0.001

Table 7. Comparison of SF-36 score of each group.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	*p*
Social functioning	Before management	55.00 (52.00, 58.00)	54.00 (52.00, 58.00)	−0.682	0.495
	After management	79.00 (74.00, 83.00)	68.00 (63.00, 71.00)	−12.323	<0.001
Physical functioning	Before management	55.00 (52.00, 58.00)	55.00 (52.00, 58.00)	−0.189	0.850
	After management	78.00 (74.00, 82.00)	67.00 (64.00, 71.00)	−12.163	<0.001
Emotional functioning	Before management	55.00 (52.00, 58.00)	55.00 (52.00, 57.00)	−1.124	0.261
	After management	79.00 (73.00, 82.00)	67.00 (63.00, 70.00)	−12.066	<0.001
Health functioning	Before management	54.00 (52.00, 57.00)	55.00 (52.00, 57.00)	−0.018	0.986
	After management	77.00 (73.00, 81.00)	66.00 (63.00, 70.00)	−12.054	<0.001

patients in the study group compared with those in the control group following the intervention. Additionally, the satisfaction rate among participants in the study group was substantially higher than that of the control group. These outcomes collectively underscore the efficacy of the implemented management strategies in enhancing patient outcomes and quality of life in this population.

Initially, our study revealed a significant advantage in adherence to treatment in the study group, thanks to the implementation of a comprehensive management strategy. This strategy included tailored treatment plans, ongoing patient education and support mechanisms, and efficient communication and monitoring programs. Previous studies have consistently emphasized the superiority of integrated management strategies over single approaches in healthcare [17]. In addition, significant improvements in cardiac function and disease-specific outcomes were observed in the study group, suggesting that our intervention positively impacted cardiac structure and function. Specifically, our intervention reduced cardiac load and improved myocardial systolic and diastolic function, resulting in improved left ventricular ejection fraction (LVEF) and reduced left ventricular end-diastolic diameter (LVDD) and end-diastolic diameter (LVDS). Previous research suggested that these improvements may be the result of a combination of factors, and results similar to the study have been seen in the management of healing health in a variety of diseases [18–20]. Moreover, the control group made significant progress in mental health and self-health management skills. In established studies, improved mental health and increased self-health management skills have enabled patients to experience enhanced healing outcomes [21,22]. This result may be attributed to the role of combined interventions in alleviating levels of depression and anxiety while enhancing patients' psychological resilience and self-management skills. Similarly, previous studies reported that the provision of integrated health management for patients during the post-healing period of the disease helps improve their mental health [23,24]. These measures are usually achieved by improving perceptions of the illness, providing emotional support, and disseminating effective self-management strategies.

This paper showed that the compliance and satisfaction of the study group were higher than those of the control group ($p < 0.001$); we found no differences in cardiac function, SAQ, SDS, SAS, SF-36, and self-care ability scores between the groups before the intervention ($p > 0.05$). After the intervention, all indicators of the research group significantly improved compared with those of the control group ($p < 0.001$), suggesting that the research group could not only improve patients' compliance and their cardiac function but also enhance their self-care ability, eliminate negative emotions, maintain a stable mentality, improve patients' quality of life, and increase their satisfaction. Our analysis revealed that telerehabilitation is defined as providing rehabilitation services to patients through remote communication technology. The service items include assessment, monitoring, intervention, supervision, education, and consultation. Its advantage is that it transcends spatial barriers and can be used not only for the exchange of infor-

Table 8. Difference between before and after management of indicators.

Indicator	Time	Observation group (n = 124)	Control group (n = 129)	z	*p*
LVDD (mm)	Difference between pre- and post-management	−8.00 (−11.00, −5.00)	−5.00 (−7.00, −3.00)	−5.935	<0.001
LVEF (%)	Difference between pre- and post-management	5.00 (3.00, 7.00)	1.50 (−1.00, 5.00)	−7.025	<0.001
LVDS (mm)	Difference between pre- and post-management	−6.00 (−4.00, −7.00)	−2.00 (−1.00, −4.00)	−7.418	<0.001
Angina attack	Difference between pre- and post-management	21.00 (18.00, 24.00)	10.00 (7.00, 12.00)	−9.588	<0.001
Disease stable state	Difference between pre- and post-management	17.00 (13.00, 20.75)	18.00 (13.00, 22.00)	−7.557	<0.001
Disease awareness	Difference between pre- and post-management	18.00 (13.00, 22.00)	10.00 (7.00, 13.00)	−8.512	<0.001
SDS score	Difference between pre- and post-management	10.00 (7.00, 13.00)	−16.00 (−20.75, −13.00)	−9.548	<0.001
SAS score	Difference between pre- and post-management	−6.00 (−10.00, −3.00)	−16.00 (−22.00, −10.00)	−6.042	<0.001
Health knowledge	Difference between pre- and post-management	−8.00 (−15.00, −3.00)	16.00 (14.00, −19.00)	−8.293	<0.001
Sense of self-responsibility	Difference between pre- and post-management	8.00 (6.00, 10.00)	5.00 (3.00, 7.00)	−6.397	<0.001
Self-concept	Difference between pre- and post-management	10.00 (8.00, 12.00)	5.00 (3.00, 7.00)	−9.090	<0.001
Self-care skills	Difference between pre- and post-management	9.00 (6.00, 11.00)	4.00 (00.00, 7.00)	−7.884	<0.001
Social functioning	Difference between pre- and post-management	23.00 (19.00, 27.00)	12.00 (8.00, 17.00)	−9.049	<0.001
Physical functioning	Difference between pre- and post-management	23.00 (19.00, 27.00)	13.00 (8.00, 16.00)	−8.974	<0.001
Emotional functioning	Difference between pre- and post-management	23.00 (18.00, 27.00)	12.00 (8.00, 16.00)	−8.997	<0.001
Health functioning	Difference between pre- and post-management	22.00 (18.00, 25.00)	11.50 (7.00, 16.25)	−9.034	<0.001

Table 9. Comparison of satisfaction among each group.

Group	Very satisfied	General satisfied	Not satisfied	Satisfaction
Observation group (n = 124)	65 (52.42)	49 (39.52)	10 (8.06)	114 (91.94)
Control group (n = 129)	38 (29.46)	53 (41.09)	38 (29.46)	91 (70.54)
χ^2				18.822
p				<0.001

mation between medical staff and patients but also between medical staff themselves [8,25]. In this experiment, remote rehabilitation guidance based on Internet technology provides patients with continuous nursing services through the WeChat platform. Among them, the WeChat official accounts have various information transmission functions and break the constraints of time and space, effectively meeting the demand for postoperative rehabilitation of patients and their families, which is conducive to joint participation in rehabilitation management between doctors and patients and between different medical departments [26,27]. Given the characteristics of various communication methods and strong interaction of the WeChat group, this platform can supervise and remind patients to take their medicines on time; by sending relevant knowledge regularly, the patient's cognitive ability can be enhanced, and their compliance can be significantly improved [28,29]. In addition, the Guanjia app can improve patients' medical compliance behavior, intelligently monitor changes in vital signs, predict patients' recovery trends, adjust recovery plans in time, and guide their self-regulation, which can help enhance patients' self-care capabilities.

Overall, our findings not only underscore the efficacy of the comprehensive management strategy in im-

proving treatment adherence and cardiac outcomes but also highlight its beneficial impact on mental health and self-management skills among patients. These insights hold significant implications for future healthcare interventions aimed at optimizing patient outcomes and quality of life post-treatment.

This study also had several limitations: ① As a result of limitations such as time, manpower, and cost, there may be insufficient sample size in this study, and the generalizability of the research results needs to be improved. ② This study is retrospective, and the research data were directly selected from existing hospital electronic medical records without the researchers' involvement in data collection, leading to potential recall bias. ③ Patients were only from one facility, which may have influenced the study results because of the unique characteristics of that facility.

Conclusions

In summary, the effect of remote rehabilitation guidance based on Internet technology is evident. It could effectively improve patients' cardiac function and enhance self-care ability, and patients demonstrated high compliance with care. It could also effectively reduce negative emotions and improve their quality of life. Patients reported high satisfaction, so its use in the field is worth promoting.

Availability of Data and Materials

The corresponding author will provide the data that underpin the study's conclusions with a reasonable application.

Author Contributions

HS and LL designed the study; all authors conducted the study; QZ and LL collected and analyzed the data, HS and QZ participated in drafting the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content. 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 Guangyuan Center Hospital under Approval No. 2024001. All respondents in this study provided informed consent and signed the relevant informed consent materials before participating in the survey.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest. There is no conflict of interest between the Guanjia app or WeChat and the authors.

References

[1] Shaya GE, Leucker TM, Jones SR, Martin SS, Toth PP. Coronary heart disease risk: Low-density lipoprotein and beyond. Trends in Cardiovascular Medicine. 2022; 32: 181–194.

[2] Shu Y, Zheng Y, Guo Y, Zhu D, Huang S. Roles of Immune and Oxidative Stress-Related Factors in the Diagnosis of Coronary Artery Disease: A Retrospective Study. The Heart Surgery Forum. 2023; 26: E417–E427.

[3] Wirtz PH. Hypothalamic-Pituitary-Adrenal Axis. In Waldstein SR, Kop WJ, Suarez EC, Lovallo WR, Katzel LI (eds.) Handbook of Cardiovascular Behavioral Medicine (pp. 941–974). Springer: New York, NY. 2022.

[4] Park DY, Hanna JM, Kadian S, Kadian M, Jones WS, Damluji AA, *et al*. In-hospital outcomes and readmission in older adults treated with percutaneous coronary intervention for stable ischemic heart disease. Journal of Geriatric Cardiology. 2022; 19: 631–642.

[5] Akbari T, Al-Lamee R. Percutaneous Coronary Intervention in Multi-Vessel Disease. Cardiovascular Revascularization Medicine: Including Molecular Interventions. 2022; 44: 80–91.

[6] Kodera S, Morita H, Kiyosue A, Ando J, Komuro I. Cost-Effectiveness of Percutaneous Coronary Intervention Compared With Medical Therapy for Ischemic Heart Disease in Japan. Circulation Journal. 2019; 83: 1498–1505.

[7] Oktaramdani T, Mudjaddid E, Muhadi, Shatri H. Increased Heart Rate Variability following Elective Percutaneous Coronary Intervention in Patients with Stable Coronary Artery Disease and Preprocedural Anxiety. Cardiology Research and Practice. 2019; 2019: 3696825.

[8] Beleigoli A, Champion S, Tirimacco R, Nesbitt K, Tideman P, Clark RA. A co-designed telehealth-based model of care to improve attendance and completion to cardiac rehabilitation of rural and remote Australians: The Country Heart Attack Prevention (CHAP) project. Journal of Telemedicine and Telecare. 2021; 27: 685–690.

[9] Gehring K, Kloek CJ, Aaronson NK, Janssen KW, Jones LW, Sitskoorn MM, *et al*. Feasibility of a home-based exercise intervention with remote guidance for patients with stable grade II and III gliomas: a pilot randomized controlled trial. Clinical Rehabilitation. 2018; 32: 352–366.

[10] Interventional cardiology Group, Society of Cardiology, Chinese Medical Association, Atherosclerosis and Coronary Heart Disease Group, Society of Cardiology, Chinese Medical Association; Thrombosis Prevention and Treatment Committee, Society of Cardiovascular Physicians, Chinese Medical Association, etc. Guidelines for diagnosis and treatment of stable coronary heart disease. Chinese Journal of Cardiology. 2018; 46: 680–694. (In Chinese)

[11] Interventional cardiology Group, Chinese Society of Cardiology, Chinese Medical Association Branch of Cardiovascular Physicians, Thrombus Prevention and Treatment Committee, Chinese Journal of Cardiology Editorial Committee. Chinese Guidelines for percutaneous coronary intervention (2016). Chinese Journal of Cardiology. 2016; 44: 382–400. (In Chinese)

[12] Lawal OA, Awosoga O, Santana MJ, James MT, Wilton SB, Norris CM, *et al*. Measurement invariance of the Seattle Angina Questionnaire in coronary artery disease. Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation. 2022; 31: 1223–1236.

[13] Chang Z, Guo AQ, Zhou AX, Sun TW, Ma LL, Gardiner FW, *et al*. Nurse-led psychological intervention reduces anxiety symptoms and improves quality of life following percutaneous coronary intervention for stable coronary artery disease. The Australian Journal of Rural Health. 2020; 28: 124–131.

[14] Paquet A, Calvet B, Lacroix A, Girard M. Sensory processing in depression: Assessment and intervention perspective. Clinical Psychology & Psychotherapy. 2022; 29: 1567–1579.

[15] Yanardağ MZ, Özer Ö, Özmen S. Investigating Self-Care Agency and Well-Being of Elderly People. Social Work in Public Health. 2021; 36: 496–508.

[16] de Beurs E, Carlier I, van Hemert A. Psychopathology and health-related quality of life as patient-reported treatment outcomes: evaluation of concordance between the Brief Symptom Inventory (BSI) and the Short Form-36 (SF-36) in psychiatric outpatients. Quality of Life Research. 2022; 31: 1461–1471.

[17] Getch SE, Lute RM. Advancing Integrated Healthcare: A Step by Step Guide for Primary Care Physicians and Behavioral Health Clinicians. Missouri Medicine. 2019; 116: 384–388.

[18] Sassen B. Nursing and Holistic Care. In Sassen B (ed.) Improving Person-Centered Innovation of Nursing Care: Leadership for Change (pp. 1–10). Springer Nature: Switzerland, Cham. 2023.

[19] Bhattad PB, Pacifico L. Empowering Patients: Promoting Patient Education and Health Literacy. Cureus. 2022; 14: e27336.

[20] Rhon DI, Fritz JM, Greenlee TA, Dry KE, Mayhew RJ, Laugesen MC, *et al*. Move to health-a holistic approach to the management of chronic low back pain: an intervention and implementation protocol developed for a pragmatic clinical trial. Journal of Translational Medicine. 2021; 19: 357.

[21] Dineen-Griffin S, Garcia-Cardenas V, Williams K, Benrimoj SI. Helping patients help themselves: A systematic review of self-management support strategies in primary health care practice. PLoS ONE. 2019; 14: e0220116.

[22] Karam M, Chouinard MC, Poitras ME, Couturier Y, Vedel I, Grgurevic N, *et al*. Nursing Care Coordination for Patients with Complex Needs in Primary Healthcare: A Scoping Review. International Journal of Integrated Care. 2021; 21: 16.

[23] The Lancet Oncology. Provision of mental health care for patients with cancer. The Lancet. Oncology. 2021; 22: 1199.

[24] Bohanna I, Harriss L, McDonald M, Cullen J, Strivens E, Bird K, *et al*. A systematic review of disability, rehabilitation and lifestyle services in rural and remote Australia through the lens of the people-centred health care. Disability and Rehabilitation. 2022; 44: 6107–6118.

[25] Cairns A, Geia L, Kris S, Armstrong E, O'Hara A, Rodda D, *et al*. Developing a community rehabilitation and lifestyle service for a remote indigenous community. Disability and Rehabilitation. 2022; 44: 4266–4274.

[26] Marley WD, Barratt A, Pigott T, Granat M, Wilson JD, Roy B. A multicenter randomized controlled trial comparing gamification with remote monitoring against standard rehabilitation for patients after arthroscopic shoulder surgery. Journal of Shoulder and Elbow Surgery. 2022; 31: 8–16.

[27] McDonnell JM, Ahern DP, Ross TD, Gibbons D, Synnott KA, Butler JS. The efficacy of remote virtual care in comparison to traditional clinical visits for elective orthopaedic patients: A meta-analysis of prospective randomised controlled trials. The Surgeon. 2022; 20: 177–186.

[28] Lineker SC, Fleet LJ, Bell MJ, Sweezie R, Curran V, Brock G, *et al*. Getting a Grip on Arthritis Online: Responses of rural/remote primary care providers to a web-based continuing medical education programme. Canadian Journal of Rural Medicine. 2019; 24: 52–60.

[29] Buckley JP. The changing landscape of cardiac rehabilitation; *from early mobilisation and reduced mortality to chronic multimorbidity management*. Disability and Rehabilitation. 2021; 43: 3515–3522.