Resistance Training in Home-Based Cardiac Rehabilitation for Patients with Coronary Heart Disease: Postprint

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Abstract

Objective To investigate the application effect of resistance training in home-based cardiac rehabilitation for patients with coronary heart disease. Methods A total of 122 home-based coronary heart disease patients undergoing cardiac rehabilitation, admitted to the cardiology department from April 2020 to March 2021, were selected as study subjects and divided into a control group and an observation group according to admission order, with 61 cases in each group. The control group received community nursing and telephone follow-up, while the observation group additionally received cardiac rehabilitation education and resistance training guidance. Physical function, exercise capacity, and quality of life were evaluated between the two groups, and changes in cardiac function indices were measured. Results After intervention, the observation group exhibited higher scores on the Chinese version of the Simple Physical Performance Test (CM-PPT) and the Chinese Questionnaire of Quality of Life in Cardiovascular Disease Patients (CQQC) than the control group, with statistically significant differences ($P<0.01$). After intervention, the observation group demonstrated higher 30-second Arm Curl Test (30-ACT) and 6-minute Walk Test distance (6MWT), and lower 10-time Sit-to-Stand Test (STS10) than the control group, with statistically significant differences ($P<0.01$). After intervention, the observation group showed higher cardiac output (C0) and left ventricular ejection fraction (LVEF), and lower left ventricular end-diastolic volume (LVEDV) and left ventricular end-systolic volume (LVESV) than the control group, with statistically significant differences ($P<0.05$). Conclusion Implementing cardiac rehabilitation education and resistance training guidance for home-based coronary heart disease patients can further improve physical function, enhance exercise capacity and cardiopulmonary function, restore cardiac function, and improve quality of life.

Full Text

Application of Home-Based Resistance Training in Cardiac Rehabilitation for Patients with Coronary Heart Disease

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Abstract

Objective: To investigate the effect of home-based resistance training in cardiac rehabilitation for patients with coronary heart disease (CHD). **Methods:** A total of CHD patients requiring home-based cardiac rehabilitation were selected as study subjects and divided into a control group (n=) and an observation group according to admission sequence. The control group received community nursing and telephone follow-up, while the observation group additionally received cardiac rehabilitation education and resistance training guidance. Physical function, exercise capacity, and quality of life were evaluated, and changes in cardiac function parameters were measured. **Results:** After intervention, the observation group showed higher scores on the Chinese Mini Physical Performance Test (CM-PPT) and Chinese Questionnaire of Quality of Life in Patients with Cardiovascular Diseases (CQQC) compared with the control group, with statistically significant differences (P<). After intervention, the observation group demonstrated lower 30-second Arm Curl Test (-ACT) scores and shorter times on the 30-second Sit-To-Stand Test (STS) compared with the control group, with statistically significant differences (P<). The observation group also showed higher 6-Minute Walking Test (MWT) distances, cardiac output (C), and left ventricular ejection fraction (LVEF), and lower left ventricular end-diastolic volume (LVEDV) and left ventricular end-systolic volume (LVESV) compared with the control group, with statistically significant differences (P<). **Conclusion:** Implementation of cardiac rehabilitation education and resistance training guidance for home-based CHD patients can further improve physical function, enhance exercise capacity and cardiopulmonary function, restore cardiac function, and improve quality of life.

Keywords: coronary heart disease; cardiac rehabilitation; resistance training; quality of life; physical function; cardiac function

Introduction

Coronary heart disease is primarily a cardiac condition caused by myocardial ischemia, hypoxia, or necrosis due to coronary atherosclerosis, which triggers symptoms such as chest pain and tightness and is characterized by high morbidity and mortality rates. Cardiac rehabilitation is a long-term process; however, patients lack professional supervision after discharge, making them prone to unhealthy behaviors that affect recovery. Therefore, enhanced guidance for home-based cardiac rehabilitation nursing is essential. Conventional cardiac rehabilitation education involves regular centralized lectures instructing patients on medication compliance, diet, and exercise, as well as knowledge seminars, free consultation clinics, and periodic telephone follow-ups to inquire about patients' recovery status and daily living conditions and answer their questions.

The observation group implemented cardiac rehabilitation education and resistance training guidance based on routine nursing care. The intervention measures were as follows: Education was delivered through weekly telephone follow-ups, biweekly topic lectures, and monthly home visits. Patients first attended specialized cardiac rehabilitation lectures covering coronary heart disease knowledge and cardiac rehabilitation content, followed by education on cardiovascular risk factors and cardiovascular medications, and finally instruction on exercise training, diet, and nutrition. This sequence helped patients correctly understand the benefits and importance of cardiac rehabilitation while learning about the hazards of unhealthy diets, unscientific medication use, and improper exercise. Personalized dietary plans were developed based on patients' eating habits and dietary restrictions, and healthy cooking methods were taught. Regular telephone follow-ups were conducted to assess patients' weekly self-management behaviors, evaluate their recovery progress, and address their concerns.

Psychological intervention was implemented through communication and psychological scales to help patients understand their psychological status. Knowledge of psychology was explained to help them recognize the relationship between negative emotions and cardiovascular disease, and they were guided to learn methods for managing psychological states, such as meditation, distraction, and exercise, adopting appropriate emotion regulation techniques based on their individual conditions.

Resistance training, as a strength training method, can enhance cardiac pressure load, reduce myocardial oxygen consumption, improve peripheral vascular function, and increase body strength and endurance, thereby improving cardiopulmonary function. However, whether its specific application can achieve satisfactory results requires further research. This study selected CHD patients undergoing cardiac rehabilitation in the cardiology department of our hospital as research subjects to explore the application effect of resistance training in home-based cardiac rehabilitation for CHD patients and its impact on patients' quality of life. The findings are now reported as follows.

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1. Materials and Methods

1.1 Study Subjects CHD patients undergoing home-based cardiac rehabilitation in the cardiology department of our hospital from to were selected as study subjects. Inclusion criteria: Diagnosis confirmed through electrocardiogram and echocardiography examination, meeting the diagnostic criteria of "Nomenclature and Diagnostic Criteria for Ischemic Heart Disease"; complete clinical data; and voluntary signing of informed consent. Exclusion criteria: Patients with cardiogenic shock, ventricular arrhythmia, unstable coronary heart disease, severe pulmonary hypertension, uncontrolled hypertension ($\geq$ mmHg), severe and symptomatic aortic stenosis, or mental illness. This study was approved by the hospital ethics committee.

1.2 Grouping and Intervention Methods Patients were divided into a control group and an observation group according to admission sequence, with cases in each group. The control group comprised males and females, aged - years with a mean of () years; disease duration of - years with a mean of () years; and New York Heart Association (NYHA) classification: class cases and class cases. The observation group comprised males and females, aged - years with a mean of () years; disease duration of - years with a mean of () years; and NYHA classification: class cases and class cases. Comparison of basic data between the two groups showed no statistically significant differences (P>), indicating comparability.

The control group received community nursing and telephone follow-up, with community medical staff providing routine public health services including coronary heart disease knowledge lectures, free consultation clinics, and regular telephone follow-ups to inquire about patients' recovery status and daily living conditions and answer their questions.

The observation group implemented cardiac rehabilitation education and resistance training guidance based on the routine nursing care described above. The intervention measures were as follows: Education was delivered through weekly telephone follow-ups, biweekly topic lectures, and monthly home visits. Patients first attended specialized cardiac rehabilitation lectures covering coronary heart disease knowledge and cardiac rehabilitation content, followed by education on cardiovascular risk factors and cardiovascular medications, and finally instruction on exercise training, diet, and nutrition. This sequence helped patients correctly understand the benefits and importance of cardiac rehabilitation while learning about the hazards of unhealthy diets, unscientific medication use, and improper exercise. Personalized dietary plans were developed based on patients' eating habits and dietary restrictions, and healthy cooking methods were taught. Regular telephone follow-ups were conducted to assess patients' weekly self-management behaviors, evaluate their recovery progress, and address their concerns.

Psychological intervention was implemented through communication and psy-

chological scales to help patients understand their psychological status. Knowledge of psychology was explained to help them recognize the relationship between negative emotions and cardiovascular disease, and they were guided to learn methods for managing psychological states, such as meditation, distraction, and exercise, adopting appropriate emotion regulation techniques based on their individual conditions.

Resistance training began with upper limb muscle group strength training: shoulder external rotation to exercise rotator cuff muscles with palms facing up, elbows close to sides, and forearms rotating outward; shoulder raises to exercise deltoid muscles with palms facing forward and arms extended upward; straight arm abduction and press to exercise rotator cuff and back muscles with palms facing each other and arms abducting; and single-arm curls to exercise biceps with one hand holding the elastic band end, elbow close to the body, performing single-arm curls. Lower limb muscle group strength training followed: standing leg abduction to exercise outer thigh muscles with one hand holding the folded elastic band end close to the body, the other hand on hip, legs apart, with one foot pressing the center of the folded elastic band and the other foot inserted into the fold to abduct and tighten the elastic band; knee-leg extension to exercise thigh muscles and calf gastrocnemius muscles with the folded elastic band held close to the upper body while seated, feet pressing the band center; and seated foot rowing to exercise quadriceps and gluteus maximus with both hands holding the elastic band ends close to the upper body while seated, feet pushing the band forward. Finally, abdominal core muscle group training was performed in supine position with the elastic band placed above the abdomen, both hands holding the ends at the sides of the body, and hips lifting upward. Each movement lasted seconds, with repetitions per set, at least days between sessions, times per week, with each exercise session lasting minutes.

1.3 Evaluation Indicators Physical Function and Quality of Life: Before and after intervention, physical function and quality of life were evaluated in both groups using the Chinese Mini Physical Performance Test (CM-PPT), which includes four items: standing static balance, sit-to-stand timing, m walking timing, and squat timing, with each item scored - points (higher scores indicating better physical function). Quality of life was assessed using the Chinese Questionnaire of Quality of Life in Patients with Cardiovascular Diseases (CQQC), which contains items scored - points (higher scores indicating better quality of life).

Exercise Capacity: Exercise capacity was evaluated using the 30-second Arm Curl Test (-ACT) to assess upper limb muscle strength, with men using -pound dumbbells and women using -pound dumbbells, recording the number of forearm flexions within seconds. The 30-second Sit-To-Stand Test (STS) measured lower limb strength, with hands crossed on the chest, recording the time to complete standard-height chair stands. The 6-Minute Walking Test (MWT) evaluated exercise tolerance, recording the walking distance in minutes (higher

values indicating stronger exercise capacity).

Cardiac Function Parameters: Changes in cardiac function parameters were measured using ultrasound to determine cardiac output (C), left ventricular ejection fraction (LVEF), left ventricular end-diastolic volume (LVEDV), and left ventricular end-systolic volume (LVESV).

1.4 Statistical Methods SPSS software was used for statistical analysis. Measurement data were expressed as mean ± standard deviation (x ± s) and compared between groups using t-tests. Count data were expressed as percentages (%) and analyzed using ^{2} tests. The significance level was set at $\alpha=$, with P< considered statistically significant.

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2. Results

2.1 Comparison of Physical Function and Quality of Life Between Groups Before intervention, no statistically significant differences were observed in CM-PPT and CQQC scores between the two groups (P>). After intervention, both groups showed improved CM-PPT and CQQC scores compared with pre-intervention levels, and the observation group's scores were significantly higher than those of the control group (P<) .

2.2 Comparison of Exercise Capacity Between Groups Before intervention, no statistically significant differences were found in -ACT, STS, or MWT between the two groups (P>). After intervention, both groups showed improvements in -ACT, STS, and MWT compared with pre-intervention levels. The observation group demonstrated higher MWT and lower STS than the control group, with statistically significant differences (P<) .

2.3 Comparison of Cardiac Function Parameters Between Groups Before intervention, no statistically significant differences were observed in C, LVEF, LVEDV, or LVESV between the two groups (P>). After intervention, the observation group showed higher C and LVEF and lower LVEDV and LVESV compared with the control group, with statistically significant differences (P<) .

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3. Discussion

Coronary heart disease is an ischemic heart disease. Current clinical treatments such as percutaneous coronary intervention and thrombolytic therapy can correct myocardial ischemia symptoms and delay disease progression, but long-term systematic cardiac rehabilitation—including rehabilitation assessment, exercise

training, and dietary management—is still required; otherwise, disease progression cannot be controlled. Traditional community nursing and telephone follow-up provide certain guidance but have limitations, lacking standardization and scientific rigor, making it difficult for patients to control appropriate rehabilitation methods and affecting prognosis.

A cardiac rehabilitation nursing team composed of cardiac rehabilitation experts, community physicians, and nurses was established to provide care for home-based CHD patients. Cardiac rehabilitation experts formulated rehabilitation plans, community physicians were responsible for implementation and quality control, and community nurses provided guidance and education while adjusting nursing plans according to patients' individual characteristics to ensure nursing quality. Patients were also guided to perform resistance training to exercise muscular fitness and cardiopulmonary fitness. The training began with aerobic warm-up exercises and muscle relaxation, followed by elastic band resistance training exercises. Initial low-intensity exercise was controlled at % of maximum load for upper limbs and % for lower limbs, with gradual intensity increases to improve functional fitness.

The study results showed that after intervention, the observation group's physical function and quality of life scores were higher than those of the control group, confirming that cardiac rehabilitation education and resistance training guidance can help patients improve physical function, enhance upper and lower limb strength, and improve physical, psychological, and medical conditions, thereby increasing quality of life. Resistance training specifically exercises upper limb muscle strength, lower limb muscle strength, and abdominal core muscle strength, combined with regular cardiac rehabilitation education to stimulate patients' health awareness, help them recognize cardiovascular disease risk factors, and understand the impact of diet, exercise, and psychology on cardiac function, thereby improving motivation.

In terms of exercise capacity, the observation group showed higher MWT and lower STS and -ACT compared with the control group, confirming that cardiac rehabilitation education and resistance training guidance can improve patients' exercise tolerance. Different movement training exercises strengthen muscles at different locations and promote improvements in myocardial contractility and cardiopulmonary function. Strict adherence to resistance training according to medical advice can increase left ventricular diastolic pressure, improve subendocardial blood perfusion, enhance peak oxygen uptake capacity, and improve anti-atherosclerotic effects, thereby improving cardiopulmonary endurance fitness. Moreover, cardiac rehabilitation education and resistance training guidance can enhance patients' awareness of medical compliance, driving compliance in other aspects through exercise, which benefits prognosis.

After intervention, the observation group showed higher C and LVEF and lower LVEDV and LVESV compared with the control group, confirming that cardiac rehabilitation education and resistance training guidance can enhance patients' cardiac function, improve ventricular remodeling, and help reverse atheroscle-

rosis, thereby improving rehabilitation outcomes. These findings are similar to those of Luan Chunhong et al., who reported that "the LVEF of patients in the brisk walking group and combined training group was higher than that of the control group, and the LVEF of patients in the combined training group was higher than that of the brisk walking group," both confirming that resistance training can improve cardiac function and quality of life in CHD patients.

In summary, the application of cardiac rehabilitation education and resistance training guidance in home-based CHD patients can improve cardiac function, physical function, enhance upper and lower limb muscle strength and exercise endurance, improve cardiopulmonary function and quality of life, and is worthy of promotion.

Conflict of Interest Statement: The authors declare no conflict of interest in this article.

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Note: Figure translations are in progress. See original paper for figures.