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The Impact of Metabolic Equivalent-Based Exercise Rehabilitation Nursing Combined with Exercise-Psychological-Sleep Nursing on Mental Health and Cardiac Rehabilitation in Elderly Patients with Coronary Heart Disease and Heart Failure

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Abstract: *Objective*: To explore the effects of integrating metabolic equivalent-based exercise rehabilitation with exercise-psychological-sleep nursing in elderly patients with coronary heart disease complicated by heart failure. *Methods*: A total of 70 patients meeting the inclusion criteria were selected and randomly divided into a control group (n = 35, receiving conventional cardiac rehabilitation nursing) and an observation group (n = 35, receiving metabolic equivalent-based exercise rehabilitation nursing combined with exercise-psychological-sleep integrated intervention) using a random number table method. Mental health indicators, cardiac rehabilitation indicators, and sleep quality indicators were observed and compared between the two groups before and after nursing. *Results*: After nursing, the observation group had significantly lower SAS scores, SDS scores, and PSQI scores, as well as higher 6MWT and METs levels compared to the control group ($p < 0.05$). *Conclusion*: Metabolic equivalent-based exercise rehabilitation nursing combined with exercise-psychological-sleep integrated intervention can effectively alleviate anxiety and depression in patients, promote cardiac function recovery, optimize sleep status, and demonstrate clear long-term effects, indicating significant value for clinical promotion.

Keywords: Metabolic equivalent; Exercise rehabilitation nursing; Exercise-psychological-sleep nursing; Elderly coronary heart disease with heart failure; Mental health; Cardiac rehabilitation

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1.Introduction

Elderly patients with coronary heart disease and heart failure are in a severe stage of coronary heart

disease progression, characterized by a long and recurrent course, decreased cardiac function, and reduced exercise tolerance. Patients often experience anxiety and depression due to physical suffering and concerns about prognosis, and most suffer from sleep disorders, significantly impacting their quality of life and rehabilitation progress [1]. Conventional cardiac rehabilitation primarily focuses on disease nursing and basic exercise guidance, lacking systematic interventions in psychological and sleep aspects, and lacks scientific quantification standards for exercise intensity, making it difficult to meet individual needs and resulting in unsatisfactory long-term outcomes [2]. Metabolic equivalents (METs) can be used to develop individualized exercise plans based on age and cardiac function classification, avoiding cardiac injury caused by inappropriate intensity. Exercise-psychological-sleep integrated nursing breaks the vicious cycle of "disease-negative emotions-sleep disorders" through multidimensional collaborative interventions. The combination of the two holds promise for compensating for the deficiencies of conventional nursing, although relevant research is limited and lacks evidence from long-term follow-up [3]. This study selected 70 elderly patients with coronary heart disease and heart failure to explore the impact of METs-based exercise rehabilitation nursing combined with integrated nursing on mental health and cardiac rehabilitation. The details are as follows.

2. Materials and methods

2.1. General information

Inclusion period: January 2024 to December 2025; Inclusion criteria: 70 elderly patients with coronary heart disease and heart failure; Research method: Patients were randomly divided into two groups (control group and observation group) using a random number table method, with 35 cases in each group. The male-to-female ratio in the control group was 20/15, with a median age of (71.23 ± 5.18) years and a median disease duration of (4.92 ± 1.17) years; the male-to-female ratio in the observation group was 21/14, with a median age of (71.43 ± 5.22) years and a median disease duration of (4.78 ± 1.13) years. There were no statistically significant differences in baseline data between the groups ($p > 0.05$), indicating comparability.

2.1.1. Inclusion criteria

(1) Clinically diagnosed with coronary heart disease complicated by heart failure [4];
(2) Aged ≥ 60 years;
(3) Cardiac function classification of II–III; clear consciousness and able to cooperate with interventions and follow-up; signed informed consent by patients and their families.

2.1.2. Exclusion criteria

Severe liver and kidney damage; malignant tumors; severe arrhythmias; acute myocardial infarction; cognitive dysfunction; mental illness or inability to cooperate with exercise rehabilitation.

2.2. Methods

2.2.1. Control group

The control group received conventional cardiac rehabilitation nursing:

(1) Exercise guidance

Recommended low-intensity exercises such as walking and Tai Chi for 30–40 minutes daily, 5 times a week, without quantifying intensity based on metabolic equivalents, only adjusting according to

subjective feelings;

(2) Psychological nursing

Daily communication and brief explanation of disease knowledge to alleviate concerns, without systematic intervention;

(3) Sleep nursing

Guidance on regular sleep schedules and creating a quiet environment, without targeted treatment for sleep disorders.

2.2.2. Observation group

The observation group received metabolic equivalent-oriented exercise rehabilitation combined with exercise-psychological-sleep integrated intervention, with the following specific measures:

(1) Metabolic equivalent-based exercise rehabilitation nursing

① Pre-exercise assessment: Before the intervention, the 6-minute walk test (6MWT) was used to comprehensively assess the patient's exercise tolerance, and metabolic equivalent thresholds were calculated based on age, cardiac function classification, and physical condition to select appropriate exercise intensity. ② Exercise plan formulation: A stepwise plan was developed based on metabolic equivalent thresholds. a. Phase 1 (1–3 months): Low-intensity aerobic exercises, including slow walking and sit-to-stand alternating training, for 20–30 minutes daily, 5 times a week; b. Phase 2 (4–12 months): Moderate-intensity exercises, including Tai Chi and dumbbell exercises, for 30–40 minutes daily, 5–6 times a week; c. Phase 3 (13–24 months): Maintain appropriate intensity and increase exercise diversity, such as square dancing and jogging, for 40–50 minutes daily, 6 times a week. ③ Exercise monitoring: Vital signs were closely monitored during exercise, and exercise was immediately stopped if discomfort such as chest tightness, shortness of breath, or palpitations occurred. Exercise tolerance and metabolic equivalent levels were assessed weekly to dynamically adjust the plan.

(2) Exercise-psychological-sleep integrated nursing

① Psychological nursing: Individualized psychological profiles were established based on psychological assessments (SAS, SDS scales). For anxious and depressed patients, cognitive-behavioral therapy, relaxation training, and music therapy were implemented twice a week for 30 minutes each session; meanwhile, strengthened doctor-patient communication was provided to offer sufficient emotional support and share rehabilitation cases to enhance confidence. For solitary and less educated patients, communication frequency was increased, and disease knowledge was explained in simple terms to alleviate psychological concerns. ② Sleep nursing: The PSQI scale was used to assess sleep quality and analyze inducing factors for sleep disorders, followed by targeted interventions: creating a quiet, comfortable, and appropriately humid and temperature-controlled rest environment; guiding patients to avoid high-intensity exercise and intense emotional fluctuations within 1 hour before bedtime; relaxing the body and mind through soothing music and warm foot baths; adjusting medication times to avoid nighttime use of diuretics to reduce nocturia; and providing auxiliary measures under physician guidance for severe sleep disorders. ③ Collaborative intervention: Attention was paid to psychological states during exercise and timely guidance was provided; patients were guided to release stress through exercise during psychological interventions; sleep nursing was combined with exercise routines to adjust exercise times and avoid exercise affecting sleep, achieving synergistic promotion of physical and mental rehabilitation among the three aspects.

2.3. Observation indicators

The following indicators were assessed before nursing and 3 months after nursing:

(1) Mental health indicators

Quantitatively assessed using the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS), with total scores ranging from 0 to 100, and scores positively correlated with the severity of negative emotions.

(2) Cardiac rehabilitation indicators

Exercise tolerance was measured using the 6-minute walk test (6MWT), recording the maximum walking distance within 6 minutes, with distance positively correlated with exercise tolerance; cardiac function and exercise capacity were detected using a cardiopulmonary exercise testing instrument to measure metabolic equivalents (METs), with increased values indicating improved cardiac function.

(3) Sleep quality indicators

Evaluated using the Pittsburgh Sleep Quality Index (PSQI), with total scores ranging from 0 to 21, and scores positively correlated with the severity of sleep disorders.

2.4. Statistical methods

Comparisons were made using SPSS 23.0 software. Count data were expressed as percentages (%) and tested using the χ^2 test. Measurement data conforming to a normal distribution were expressed as $\bar{x} \pm s$ and tested using the *t*-test. A *p*-value < 0.05 indicated a statistically significant difference.

3. Results

3.1. Comparison of mental health indicators

As shown in **Table 1**, after nursing, the observation group had significantly lower SAS scores and SDS scores, with $p < 0.05$ indicating a significant difference.

Table 1. Comparison of SAS scores and SDS scores between groups before and after nursing [$\bar{x} \pm s$, points]

Group name	Number of cases (n)	SAS score		SDS score	
		Before care	After care	Before care	After care
Observation group	35	61.82 ± 5.16	25.81 ± 3.23a	58.34 ± 4.33	23.32 ± 3.31a
Control group	35	61.92 ± 5.21	30.56 ± 3.28a	58.29 ± 4.29	29.45 ± 3.22a
t value	-	0.081	6.104	0.049	7.853
p value	-	0.936	0.001	0.961	0.001

Note: For comparisons within each group before and after nursing, $p^a < 0.05$.

3.2. Comparison of cardiac rehabilitation indicators

As shown in **Table 2**, after nursing, the observation group had significantly higher values for both the 6-Minute Walk Test (6MWT) and Metabolic Equivalents (METs), with $p < 0.05$ indicating a significant difference.

Table 2. Comparison of 6MWT and METs between groups before and after nursing [$\overline{x}$ ± s]

Group	Number of cases (n)	6MWT (m)		METs	
		Before care	After care	Before care	After care
Observation group	35	361.92 ± 10.65	475.34 ± 11.23[b]	2.82 ± 0.16	4.97 ± 0.22[b]
Control group	35	362.16 ± 10.89	403.16 ± 11.28[b]	2.78 ± 0.14	3.66 ± 0.29[b]
t value	-	0.093	26.828	1.113	21.291
p value	-	0.926	0.001	0.270	0.001

Note: Comparison within the group before and after nursing care, $p^b < 0.05$.

3.3. Comparison of sleep quality indicators

As shown in **Table 3**, after nursing care, the PSQI score of the observation group was lower, with $p < 0.05$, indicating a significant difference.

Table 3. Comparison of PSQI scores before and after nursing care between groups [$\overline{x}$ ± s, points]

Group	Number of cases (n)	PSQI score	
		Before care	After care
Observation group	35	15.45 ± 2.16	6.45 ± 1.34c
Control group	35	15.38 ± 2.14	9.65 ± 1.23c
t value	-	0.136	10.408
p value	-	0.892	0.001

Note: Comparison within the group before and after nursing care, $p^c < 0.05$.

4. Discussion

Elderly patients with coronary heart disease (CHD) and heart failure are prone to negative emotions such as anxiety and depression due to impaired cardiac function, reduced exercise tolerance, recurrent episodes of the disease, and long-term symptoms. These negative emotions can stimulate the sympathetic nervous system, increase cardiac load, and further deteriorate cardiac function [5]. Simultaneously, manifestations of cardiac insufficiency such as chest tightness and shortness of breath, along with accompanying negative psychological states, can significantly disrupt patients' sleep rhythms. Sleep disorders, in turn, exacerbate patients' emotional disturbances, forming a vicious cycle of decreased cardiac function, negative emotions, and sleep disorders. This cycle hinders the cardiac rehabilitation process and reduces the quality of life for patients. Therefore, rehabilitation nursing for elderly patients with CHD and heart failure should focus not only on improving cardiac function but also on regulating mental health and sleep quality, achieving comprehensive intervention in multiple aspects [6].

Data analysis in this study indicates that after intervention measures, the SAS and SDS scores of patients in the observation group were significantly lower than those in the control group ($p < 0.05$). The results demonstrate that this nursing model is more effective in alleviating negative emotions, primarily because the observation group received holistic psychological intervention, which differs from the simple communication in the control group. The observation group utilized personalized psychological profiles, conducted regular scale assessments, implemented precise interventions, combined rehabilitation cases with

family support, enhanced patients' rehabilitation confidence, and laid a psychological foundation for cardiac rehabilitation [7]. Regarding cardiac rehabilitation indicators, after intervention, the 6MWT and METs levels in the observation group were higher than those in the control group ($p < 0.05$). The key difference lies in the observation group's use of metabolic equivalents (METs) as a quantitative standard to establish personalized exercise thresholds based on different cardiac function classifications and adopt a stepwise, phased training approach that balances safety and effectiveness [8]. In contrast, the control group's exercise guidance lacked quantification, often resulting in inappropriate intensity levels, further highlighting the significant value of METs. In terms of sleep quality, after intervention, the total PSQI score in the observation group was lower than that in the control group ($p < 0.05$). The observation group conducted regular PSQI assessments, adjusted medication times accordingly, optimized the sleep environment, guided pre-sleep relaxation, and combined these efforts with psychological intervention to form a positive cycle. The control group only provided routine guidance, which failed to fundamentally improve sleep, demonstrating the auxiliary role of sleep intervention. Considering the results of the three core indicators, this model breaks through the limitations of traditional rehabilitation, which emphasizes physiology while neglecting the mind and body. It integrates the scientific nature of METs with the comprehensiveness of holistic intervention, addressing the issues of lacking quantitative standards and insufficient psychological and sleep support in conventional rehabilitation. This approach achieves multidimensional precise intervention and promotes the synergistic improvement of psychological and cardiac rehabilitation [9,10].

5.Conclusion

In summary, combining MET-based exercise rehabilitation nursing with integrated exercise-psychological-sleep nursing can effectively improve anxiety and depression in elderly patients with CHD and heart failure, enhance cardiac rehabilitation levels, and improve sleep quality, demonstrating its value for widespread application.

Disclosure statement

The authors declare no conflict of interest.

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