ORIGINAL RESEARCH

Study on the Application Effect of Nursing Intervention Based on the Transtheoretical Model in the Rehabilitation Treatment of Patients with Chronic Heart Failure

Guichun Chen, BD; Yumei Zhang, BD; Peizhen Wu, AD

ABSTRACT

Objective • To analyze the application effect of nursing intervention based on the Transtheoretical Model in rehabilitating patients with chronic heart failure (CHF).

Methods • A retrospective analysis of clinical data was conducted for 156 CHF patients admitted to our hospital from May 2019 to September 2022. All patients met the complete inclusion criteria. They were divided into two groups based on the different nursing interventions provided during their treatment. The control group (n=78) received the routine nursing intervention, while the observation group (n=78) received nursing intervention based on the Transtheoretical Model and the care provided to the control group. The treatment compliance (MMAS-8 scale), quality of life (MLHFQ questionnaire), self-care ability (ESCA scale), cardiopulmonary function [anaerobic threshold oxygen consumption (VO_2AT), carbon dioxide ventilation equivalent slope (VE/VCO_2), peak VO_2], and rehospitalization rates were compared between the two groups.

Results • Before the intervention, the two groups had no significant difference in MMAS-8 and MLHFQ scores ($P > .05$). After the intervention, the MMAS-8 scores in the observation group were significantly higher than those in the control group (7.25±0.64 vs. 6.32±0.98), indicating improved treatment compliance. Additionally, the MLHFQ scores were significantly lower in the observation group compared to the control group (48.61±10.42 vs. 57.43±12.15, $P < .05$), indicating an enhanced quality of life. Before the intervention, the two groups had no significant differences in self-care skills, self-concept, health knowledge level, and self-care responsibility level ($P > .05$). However, after the intervention, the observation group showed significantly higher self-care skills (33.89±6.16 vs. 28.56±5.84), self-concept (24.79±3.96 vs. 21.34±4.15), health knowledge level (57.43±6.84 vs. 49.23±7.26), and self-care responsibility level (19.67±3.83 vs. 16.47±3.72) than the control group ($P < .05$). Before the intervention, the two groups had no significant differences in VO2AT, VE/VCO_2, and peak VO_2 levels ($P > .05$). However, after the intervention, the observation group exhibited significantly higher VO2AT (12.79±2.42 vs. 11.68±2.43) and peak VO2 levels (19.58±2.72 vs. 18.15±2.36) compared to the control group. VE/VCO2 levels were significantly lower in the observation group compared to the control group (28.32±3.16 vs. 30.47±3.42, $P < .05$). The rehospitalization rate in the control group was 35.90%, while it was 10.26% in the observation group. The rehospitalization rate in the observation group was significantly lower than that in the control group ($P < .05$).

Conclusion • The integration of nursing intervention based on the Transtheoretical Model into the rehabilitation treatment of CHF patients exhibited significantly improved treatment compliance, enhanced self-care abilities, and favorable changes in cardiopulmonary function and quality of life. These outcomes carry important implications for CHF patients' overall health and well-being, including improved medication adherence, increased exercise tolerance, and reduced rehospitalization rates. The positive outcomes suggest that integrating nursing interventions based on the Transtheoretical Model into standard care for chronic heart failure patients holds promise, with potential applications in other chronic conditions, paving the way for personalized and effective healthcare strategies. (*Altern Ther Health Med.* [E-pub ahead of print.])

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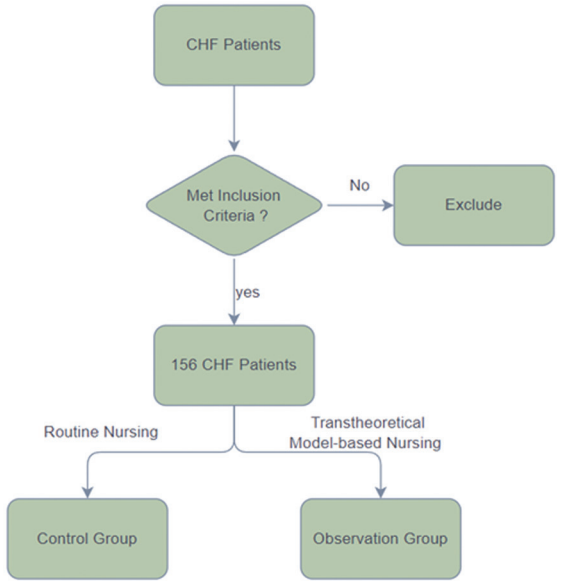
INTRODUCTION

Chronic heart failure (CHF) is a severe cardiovascular disease that affects the lives and survival of millions of patients.[1] The primary characteristic of CHF is the heart's inability to pump blood effectively, leading to inadequate blood supply to organs and tissues throughout the body, resulting in a range of serious symptoms, such as shortness of breath, edema, fatigue, palpitations, and more. Researchers predict a 46% increase in heart failure prevalence by 2030, reaching more than 8 million people in the US.[2] In recent years, with the escalating global aging population trend, the incidence of CHF has steadily increased each year, making it a significant public health concern.[3] Apart from causing physical discomfort to patients, CHF also profoundly impacts their daily lives, increases the burden on healthcare resources, particularly with the frequent occurrence of rehospitalization, and imposes substantial economic and emotional burdens on patients' families and

society.[4] CHF imposes a considerable strain on healthcare systems, contributing to elevated costs, increased demand for specialized care, and frequent hospitalizations. Beyond its clinical implications, CHF's broader societal impact encompasses economic consequences, diminished quality of life for patients and caregivers, and a growing public health challenge. Therefore, rehabilitation treatment for CHF is of paramount importance. Rehabilitation treatment aims to improve the quality of life, restore cardiopulmonary function, reduce rehospitalization rates, and extend patient survival. However, CHF rehabilitation is not a one-size-fits-all approach; it requires comprehensive nursing interventions to meet the diverse needs of patients and adapt to their changing conditions throughout the treatment process.[5]

In the rehabilitation treatment of CHF patients, nursing interventions play a pivotal role. Nursing teams are tasked with providing conventional nursing measures and integrating the latest clinical practices and research findings to create personalized treatment plans for each patient.[6] In this process, applying theoretical models becomes particularly crucial as they provide theoretical guidance for nursing interventions, helping nursing teams better understand and address patient needs. The Transtheoretical Model is a stage-based approach to behavior change, which posits that individual behavior change is not a singular event but a dynamic cyclical process characterized by stages.[7] The Transtheoretical Model, chosen for its unique attributes, offers a dynamic framework for behavior change. By recognizing behavior change as a cyclical process across distinct stages, the model aligns seamlessly with the dynamic nature of CHF management. Its emphasis on individualized progress through stages like pre-contemplation, contemplation, preparation, action, and maintenance makes it an ideal guide for tailoring nursing interventions to the ever-changing conditions and motivations of CHF patients. The Transtheoretical Model identifies five key stages of change. In the initial pre-contemplation phase, individuals find themselves oblivious to the necessity for change, not yet contemplating any alterations to their behavior. Moving into the Contemplation stage, a shift occurs as individuals begin acknowledging the need for change and entertain thoughts of taking action in the upcoming six months. Progressing further, the Preparation stage sees individuals actively planning for immediate changes, typically within the next month. The subsequent stage, Action, is characterized by active behavior modification, where tangible efforts are directed toward bringing about behavioral change. Finally, individuals entering the Maintenance stage have successfully altered their behavior and are committed to sustaining these changes over an extended period, signifying a lasting transformation. The rationale behind selecting the Transtheoretical Model lies in its unique approach to behavior change, acknowledging it as a dynamic and multifaceted process occurring across distinct stages. This study aspires to enhance treatment compliance, self-care abilities, cardiopulmonary function, and overall quality of life among CHF patients by employing the Transtheoretical Model as a guiding framework for nursing interventions. The potential impact of this research extends to optimizing clinical practices, and providing a tailored and effective approach to meet the diverse needs of CHF patients throughout their rehabilitation. Therefore, this study selected nursing intervention based on the Transtheoretical Model as the research focus to explore its application effect in the rehabilitation treatment of CHF patients. We will analyze the data before and after treatment in detail for both groups, with the expectation of providing robust clinical evidence for the practical application of CHF rehabilitation treatment. This study aims to enhance the effectiveness of CHF rehabilitation treatment further by comparing the differences in the effects of nursing interventions based on the Transtheoretical Model and traditional nursing interventions.

Figure 1. Flow Diagram of Patient Selection and Assignment



OBJECTIVES AND METHODS

Study Subjects

A retrospective analysis was conducted on the clinical data of 156 CHF patients admitted to our hospital from May 2019 to September 2022. All patients met the complete inclusion criteria. They were divided into two groups based on the different nursing interventions provided during their treatment. The control group (n=78) received the routine nursing intervention, while the observation group (n=78) received nursing intervention based on the Transtheoretical Model in addition to the care provided to the control group. This study was conducted in accordance with the Helsinki Declaration.[8] Ethical approval for this study was obtained from the ethical committee of our hospital prior to the commencement of the research, with an approval number of IRBA-2019-014. The assignment was not randomized but followed specific criteria, including complete clinical data, diagnosis of CHF, age 18 years or older, and the ability to understand and comply with the nursing protocol, among other inclusion and exclusion criteria. The flow diagram of patient selection and assignment is presented in Figure 1.

Inclusion and Exclusion Criteria

Inclusion Criteria: (1) Complete clinical data information. (2) All patients were diagnosed with chronic heart failure (CHF) according to internationally recognized criteria, including clinical symptoms (such as dyspnea, edema, fatigue) and evidence of cardiac structural or functional abnormalities (e.g., cardiac ultrasound, nuclear myocardial perfusion imaging, cardiac magnetic resonance imaging, etc.). (3) All patients were aged 18 years or older. (4) Inclusion criteria also included the ability to understand and comply with the nursing protocol with no intellectual disabilities or cognitive impairments.

Rationale for the criteria: Complete Clinical Data Information: Comprehensive clinical data are crucial for a thorough retrospective analysis, allowing for a comprehensive assessment of patient conditions, treatment responses, and outcomes. Diagnosis of Chronic Heart Failure: Focusing on patients diagnosed with CHF ensures homogeneity in the study population, allowing specific insights into interventions tailored for this condition. Age 18 Years or Older: Restricting the study to individuals 18 years and older ensures that the results apply to the adult population, as CHF predominantly affects adults. Ability to Understand and Comply with Nursing Protocol: Including patients with the ability to comprehend and comply with the nursing protocol ensures active participation and adherence to the prescribed interventions, minimizing confounding factors.

Exclusion Criteria: (1) Patients with acute heart failure were excluded. (2) Patients with severe physical limitations or those unable to complete rehabilitation treatment were excluded. (3) Patients with other severe illnesses (such as advanced cancer, intellectual disabilities, severe renal insufficiency, etc.) were excluded. (4) Patients who had undergone cardiac surgery were also excluded.

Rationale for the criteria: Exclusion of Acute Heart Failure Patients: Excluding acute cases ensures a focus on chronic conditions, providing a more targeted examination of the application of nursing interventions in the context of long-term CHF management. Exclusion of Severe Physical Limitations: Removing patients with severe physical limitations ensures that the selected interventions are feasible and adaptable for individuals with varying physical capabilities. Exclusion of Other Severe Illnesses: Eliminating patients with other severe illnesses reduces potential confounders, allowing the study to attribute observed effects more accurately to the applied nursing interventions. Exclusion of Patients Who Underwent Cardiac Surgery: Excluding patients who underwent cardiac surgery helps maintain a homogenous sample by focusing on those undergoing rehabilitation rather than post-surgical recovery.

Methods

Control Group. Patients in the control group received routine nursing intervention. Patients and their families were educated on medication usage, dosage, and precautions according to the admission and discharge procedures and the CHF knowledge guide. Patients were instructed to follow medical advice for medication, develop good medication habits, and avoid medication errors or omissions. Patients were also guided to consume a light and easily digestible diet, with attention to nutrient intake. They were advised on proper rest and physical activity, ensuring adequate sleep, and avoiding factors that could exacerbate cardiac stress, such as infections, excessive fatigue, or emotional excitement.

Observation Group. Patients in the observation group received nursing intervention based on the Transtheoretical Model in addition to the care provided to the control group. The Transtheoretical Model divides behavior change into five stages: pre-contemplation stage, contemplation stage, preparation stage, action stage, and maintenance stage. Specific measures for each of these stages were as follows:

Precontemplation Stage: Patients do not intend to take action within the next six months. Behavior change methods in this stage include awareness raising, dramatic relief, and self-efficacy. Content: (1) Awareness Raising and Dramatic Relief: Patients were guided to recall scenarios of their illness symptoms and were educated about the harm and risks of the disease. This aimed to make patients aware of the damage CHF can cause to themselves and their families. Nurses engaged in positive conversations with patients to identify reasons for their resistance to nursing interventions and rehabilitation treatments and modify patient intentions accordingly. Patients were provided with disease manuals and multimedia presentations on CHF health knowledge and medication guidance, with the head nurse participating in teaching. After the teaching sessions, patients' questions were actively addressed to assess their understanding of correct medication knowledge and lifestyle. This was conducted weekly, each session lasting approximately 30 minutes. Multimedia presentations and individual discussions with the head nurse ensured a personalized approach. (2) Self-Efficacy: Patients were informed about the consequences of non-adherence to prescribed medications and self-care. This helped subtly identify potential motivations for behavior change in patients and gradually changed their intentions. This was integrated into regular patient-nurse interactions, reinforcing the consequences of non-adherence and promoting gradual behavioral changes.

Contemplation Stage: In this stage, patients have the intention to take action within the next six months. Behavior change methods in this stage include self-reevaluation and environmental reevaluation strategies. Content: (1) Self-Reevaluation: Weekly sessions of self-reevaluation last 40 minutes, focusing on patient self-evaluation, identifying reasons for poor control, and lifestyle impact discussions. Patients evaluated their maladaptive behaviors and medication compliance, reviewing their own behaviors and identifying reasons for poor control of CHF symptoms and low medication compliance. Patients also described how the disease affected their lifestyles. (2) Environmental Reevaluation: Environmental reevaluation involved family discussions scheduled bi-weekly, emphasizing the positive impact of healthy behaviors and

assessing social support attributes. Patients recognized the negative effects of maladaptive behaviors and poor medication compliance and understood the positive impact of healthy behaviors. Patients' social support attributes were fully activated, and family members were invited to participate in discussions. Family members were asked to express their true feelings about the patient's illness, worsening condition, or rehospitalization. Patients were asked about the impact of the disease on their lives and work. Family members expressed their support for the patient's active participation in treatment and changing unhealthy behaviors, alleviating patient concerns, and promoting the patient's continuous transition to healthy behaviors.

Preparation Stage: In this stage, patients plan to take action within one month. Behavior change methods in this stage include self-liberation and helping relationships. Content: (1) Self-Liberation: Monthly sessions of self-liberation last 45 minutes, guiding patients in creating and committing to treatment plans. Signed agreements were revisited in subsequent sessions. Patients are encouraged to believe in their ability to change and make commitments. They are assisted in creating a treatment and care plan in adherence to medical advice. The plan primarily covers medication adherence, dietary plans, exercise routines, etc. Patients are required to sign a written agreement regarding behavior change and commit to medication adherence and healthy behavior in public settings. They also commit to being supervised by family members and healthcare personnel. (2) Helping Relationships: This encouraged participation in support groups with quarterly meetings, ensuring ongoing social support. Patients receive the necessary social support for their behavior change. They are encouraged to participate in organizations such as support groups and actively engage with these groups. Patients are guided to exhibit correct behavior. Patients are requested to cooperate with regular follow-up appointments during which they can seek advice from their attending physicians or nurses for any questions or concerns.

Action and Maintenance Stages: Patients have already initiated behavior change in these stages. The action stage lasts less than six months, while the maintenance stage continues for six months or more. Behavior change methods in these two stages include counterconditioning, reinforcement management, and stimulus control. Content: (1) Counterconditioning: This was conducted bi-weekly with sessions lasting 50 minutes, focusing on identifying maladaptive behaviors, analyzing reasons, and providing alternative measures. Patients are encouraged to replace unhealthy behaviors with healthy ones. Patients are asked to identify and articulate their maladaptive behaviors, such as medication adherence and poor lifestyle habits. They are assisted in analyzing the reasons behind these behaviors and provided with alternative healthy behavior measures to correct them. (2) Reinforcement Management: Monthly sessions were carried out to motivate positive behavior through recorded habits and personalized reward plans. Patients are motivated to maintain positive behavior through material or psychological rewards. Patients are prompted to record their medication times, dosages, exercise methods, frequency, dietary habits, and personal feelings. This helps patients and their families experience the positive effects of behavior change. Patients and their families are guided to develop specific reward plans, such as arranging recreational activities after completing a course of medication adherence. (3) Stimulus Control: Ongoing guidance was provided to reduce adverse stimuli and promote a conducive treatment environment, with regular reinforcement through visual displays. Patients are advised to reduce or eliminate adverse stimuli and increase effective stimuli. Patients are guided to reduce vigorous exercise, quit smoking and alcohol, reduce the intake of stimulating foods, and change their habit of casual medication. Strict medication and healthy behavior plans are created. Patients are provided with a conducive treatment environment. Posters containing information on healthy behavior and medication knowledge are displayed in places frequently visited by patients, such as the ward, hallway bulletin boards, and the living room at home, to enhance their adherence.

Observational Parameters

Treatment Compliance: Immediately before and after the intervention, treatment compliance of both groups was evaluated using the Morisky Medication Adherence Scale (MMAS-8).[9] MMAS-8 is widely used to assess medication adherence, a critical aspect in chronic conditions like heart failure. It provides insights into patients' compliance with prescribed medications, crucial for effective management. MMAS-8 has demonstrated good reliability and validity in measuring medication adherence. Its psychometric properties make it suitable for capturing variations in adherence levels. This scale consists of 8 items with a total score of 8 points. Higher scores indicate better treatment compliance.

Quality of Life: Immediately before and after the intervention, the quality of life of both groups was assessed using the Minnesota Living with Heart Failure Questionnaire (MLHFQ).[10] MLHFQ is a well-established tool specifically designed to assess the impact of heart failure on a patient's quality of life. It offers a comprehensive evaluation of various dimensions affected by heart failure symptoms. MLHFQ has been extensively validated and shows high reliability. Its use in heart failure studies is supported by its sensitivity to changes in health status and treatment effects. This questionnaire has a total score of 105 points and comprises 21 items. Higher scores indicate a poorer quality of life.

Self-Care Abilities: Immediately before and after the intervention, patients' self-care abilities were assessed using the Exercise of Self-Care Agency Scale (ESCA).[11] ESCA is chosen to evaluate patients' self-care abilities across multiple dimensions. It provides a holistic view of a patient's ability to manage their health and adhere to self-care practices. ESCA has demonstrated good reliability and validity in assessing self-care abilities. Its multidimensional nature captures

nuances in self-care skills, self-concept, health knowledge, and responsibility. This scale measures self-care abilities in four dimensions: self-care skills, self-concept, level of health knowledge, and sense of self-care responsibility, totaling 43 items. The total score on this scale is 172 points, with higher scores indicating stronger self-management abilities.

Cardiopulmonary Function: Immediately before and after the intervention, the cardiopulmonary function of both groups was measured using the SCHILLER-CS200 cardiopulmonary exercise testing system. The measured indicators included anaerobic threshold oxygen consumption (VO_2AT), slope of carbon dioxide ventilation equivalent (VE/VCO_2), and peak oxygen consumption (peak VO_2). These measures are essential in assessing the cardiopulmonary function of heart failure patients. They offer objective indicators of aerobic capacity, ventilatory efficiency, and overall cardiorespiratory performance. Cardiopulmonary function measures, when obtained through standardized methods and equipment like the SCHILLER-CS200 system, are reliable and valid indicators of cardiovascular health. They are commonly used in clinical research and practice.

Rehospitalization: Criteria for determination: A patient readmitted within 3 months after discharge due to worsening of CHF for various reasons. The rehospitalization status of both groups was uniformly recorded by relevant healthcare personnel in our hospital.

Rehospitalization decisions are determined by vigilant monitoring of specific clinical indicators in patients with chronic heart failure. Worsening symptoms, such as increased dyspnea, persistent fatigue, or fluid retention, serve as critical cues for intervention. Signs of fluid overload, decreased exercise tolerance, abnormal vital signs, and alterations in mental status contribute to the clinical assessment. Additionally, laboratory findings, including electrolyte imbalances and renal dysfunction, along with an inadequate response to outpatient management, may prompt the decision for rehospitalization. These criteria ensure a comprehensive evaluation, enabling healthcare providers to respond promptly to deteriorating conditions and optimize patient care.

Statistical Analysis

GraphPad Prism 8 was used for graphing, and SPSS 22.0 was used for data analysis. For quantitative data, mean and standard deviation were used to describe the distribution, and statistical analysis was performed using methods such as *t* tests or analysis of variance. For count data, distribution was described using frequency and percentage, and statistical analysis was performed using methods such as the chi-square test or Fisher's exact test. A significance level of $P < .05$ was considered statistically significant.

RESULTS

Baseline Data Comparison

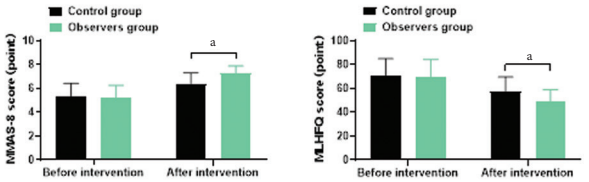
The baseline data of the two groups of patients were comparable, and there were no significant differences in the comparison ($P > .05$). Please refer to Table 1 for details.

Table 1. Baseline Data Comparison

	Control (n = 78)	Observation (n = 78)	t/χ^2	*P* value
Gender			1.883	.170
Male	65	58		
Female	13	20		
Age (years)	68.74±6.37	69.07±6.52	0.319	.749
Height (cm)	165.71±5.87	166.27±5.61	0.609	.543
Weight (kg)	64.62±4.15	65.03±4.22	0.611	.541
Blood Pressure				
Systolic (mmHg)	128.23±10.75	128.64±10.69	0.238	.811
Diastolic (mmHg)	78.76±7.43	79.07±7.51	0.259	.795
Mean Pulse (bpm)	81.72±4.07	80.56±4.39	1.711	.089
Mean EF (%)	39.37±5.64	40.15±5.34	0.886	.376
NYHA[a] Functional Classification			0.660	.416
Class II	2	1		
Class III	61	65		
Class IV	15	12		
Underlying Cause of Heart Failure			0.106	.744
Coronary Heart Disease	31	33		
Hypertension	9	10		
Cardiomyopathy	15	16		
Valve Disease	14	12		
Other	9	7		

[a]The NYHA Functional Classification, established by the New York Heart Association, is a widely embraced system evaluating the functional capacity of individuals with heart failure. It classifies patients into four categories based on their activity-related limitations: In Class I (Mild), patients experience heart failure without significant activity restrictions. Routine physical activities don't induce excessive fatigue, palpitation, or shortness of breath. Class II (Mild to Moderate) comprises patients comfortable at rest but facing limitations during ordinary activities, leading to fatigue, palpitation, or dyspnea. Class III (Moderate) involves patients at ease during rest but with marked limitations during less-than-ordinary activities, causing fatigue, palpitation, or dyspnea. Class IV (Severe) includes patients unable to engage in any physical activity without discomfort. Heart failure symptoms persist even at rest, intensifying with any level of physical exertion.

Figure 2. Comparison of Treatment Adherence and Quality of Life



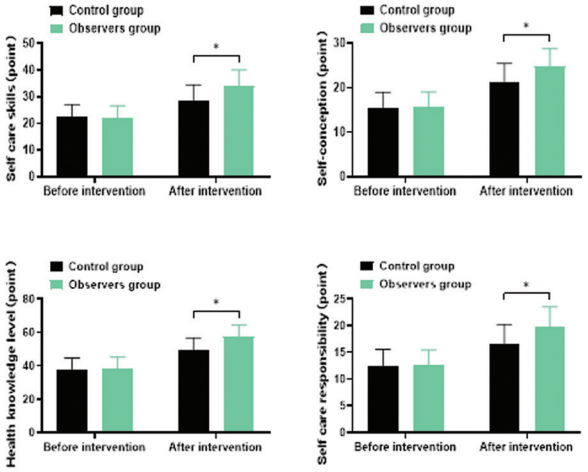
[a]Indicates intergroup comparison with $P < .05$.

Comparison of Treatment Adherence and Quality of Life

As shown in Figure 2, the MMAS-8 scores for the control group before and after intervention were (5.27±1.15, 95% CI: 4.12 - 6.42 and 6.32±0.98, 95% CI: 5.34 - 7.30), and the MLHFQ scores were (70.39±14.52, 95% CI: 55.87 - 84.91 and 57.43±12.15, 95% CI: 45.28 - 69.58) respectively. For the observation group, the MMAS-8 scores before and after intervention were (5.19±1.06, 95% CI: 4.13 - 6.25 and 7.25±0.64, 95% CI: 6.61 - 7.89), and the MLHFQ scores were (69.57±14.74, 95% CI: 54.83 - 84.31 and 48.61±10.42, 95% CI: 38.63 - 58.59) respectively. Before the intervention, there were no significant differences in MMAS-8 and MLHFQ scores between the two groups ($P > .05$). However, after intervention, the MMAS-8 scores in the observation group were significantly higher than those in the control group. In comparison, the MLHFQ scores were significantly lower than those in the control group ($P < .05$).

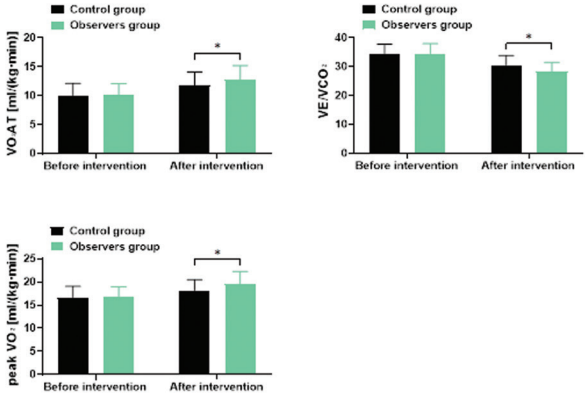
The observed increase in MMAS-8 scores and decrease in MLHFQ scores post-intervention suggest a clinically

Figure 3. Comparison of Self-Care Abilities



[a]Indicates intergroup comparison with $P < .05$.

Figure 4. Comparison of Cardiopulmonary Function



[a]Indicates intergroup comparison with $P < .05$.

meaningful improvement in treatment adherence and quality of life for chronic heart failure patients, emphasizing the positive impact of Transtheoretical Model-based nursing interventions.

Comparison of Self-Care Abilities

As shown in Figure 3, the self-care skills for the control group before and after the intervention were (22.47 ± 4.53 and 28.56 ± 5.84, 95% CI: 17.94 - 27.00 and 22.72 - 34.40, respectively). The self-concept scores were (15.32 ± 3.67 and 21.34 ± 4.15, 95% CI: 12.65 - 17.99 and 17.19 - 25.49, respectively). Health knowledge levels were (37.45 ± 7.12 and 49.23 ± 7.26, 95% CI: 29.53 - 45.37 and 40.97 - 57.49, respectively). Self-care responsibility levels were (12.38 ± 3.15 and 16.47 ± 3.72, 95% CI: 9.43 - 15.33 and 12.91 - 20.03, respectively). For the observation group, the self-care skills before and after the intervention were (21.92 ± 4.63 and 33.89 ± 6.16, 95% CI: 17.49 - 26.35 and 27.73 - 40.05, respectively). Self-concept scores were (15.61 ± 3.44 and 24.79 ± 3.96, 95% CI: 12.94 - 18.28 and 20.89 - 28.69, respectively). Health knowledge levels were (38.21 ± 6.95 and 57.43 ± 6.84, 95% CI: 30.60 - 45.82 and 50.17 - 64.69, respectively). Self-care responsibility levels were (12.56 ± 2.89 and 19.67 ± 3.83, 95% CI: 10.14 - 15.98 and 16.84 - 22.50, respectively). Before the intervention, the two groups had no significant differences in self-care skills, self-concept, health knowledge levels, and self-care responsibility levels ($P > .05$). However, after the intervention, the observation group showed significantly higher self-care skills, self-concept, health knowledge levels, and self-care responsibility levels than the control group ($P < .05$).

The intervention led to a notable improvement in the observation group's self-care skills, self-concept, health knowledge levels, and self-care responsibility levels compared to the control group, underscoring the clinical significance of these enhancements in CHF patient care. These findings suggest a positive impact on overall well-being and self-management, highlighting the effectiveness of the Transtheoretical Model-based nursing interventions.

Comparison of Cardiopulmonary Function

As shown in Figure 4, the VO_2AT scores for the control group before and after the intervention were (9.89 ± 2.21 and 11.68 ± 2.43, 95% CI: 8.18 - 11.60 and 10.42 - 12.94, respectively). VE/VCO_2 scores were (34.23 ± 3.56 and 30.47 ± 3.42, 95% CI: 31.11 - 37.35 and 27.93 - 33.01, respectively), and peak VO_2 scores were (16.59 ± 2.47 and 18.15 ± 2.36, 95% CI: 14.15 - 19.03 and 15.79 - 20.50, respectively). For the observation group, the VO_2AT scores before and after the intervention were (10.06 ± 2.03 and 12.79 ± 2.42, 95% CI: 8.64 - 11.48 and 11.21 - 14.37, respectively). VE/VCO_2 scores were (34.51 ± 3.45 and 28.32 ± 3.16, 95% CI: 31.40 - 37.62 and 26.87 - 29.77, respectively), and peak VO_2 scores were (16.84 ± 2.13 and 19.58 ± 2.72, 95% CI: 15.34 - 18.34 and 17.74 - 21.42, respectively). Before the intervention, the two groups had no significant differences in VO_2AT, VE/VCO_2, and peak VO_2 scores ($P > .05$). However, after the intervention, the observation group showed significantly higher VO2AT and peak VO_2 scores compared to the control group, while the VE/VCO_2 score was significantly lower than that of the control group ($P < .05$).

The intervention resulted in noteworthy improvements in the observation group's aerobic threshold (VO_2AT) and peak oxygen consumption (peak VO_2), indicating enhanced cardiopulmonary function. Moreover, the lower ventilation equivalent for carbon dioxide (VE/VCO_2) in the observation group suggests improved efficiency and respiratory dynamics, underscoring the clinical significance of these changes in CHF patients.

Comparison of Rehospitalization Rates

The notable decrease in rehospitalization rates, from 35.90% in the control group to 10.26% in the observation group, underscores the substantial clinical impact of nursing interventions guided by the Transtheoretical Model. This reduction signifies an enhanced quality of care, potentially leading to improved patient outcomes and healthcare resource utilization. Detailed statistics can be found in Table 2.

Table 2. Comparison of Rehospitalization Rates

Group	n	Due to Improper Medication [n(%)]	Due to Improper Lifestyle Management [n(%)]	Rehospitalization Rate [n(%)]
Control	78	12 (15.38%)	16 (20.51%)	28 (35.90%)
Observation	78	3 (3.85%)	5 (6.41%)	8 (10.26%)
χ^2	-	-	-	14.444
P value	-	-	-	<.001

Limitations

While our study contributes valuable insights into the efficacy of nursing interventions based on the Transtheoretical Model for CHF rehabilitation, certain limitations should be acknowledged. The lack of randomization in patient assignment and potential selection bias might influence the generalizability of our findings. Additionally, variations in individual patient characteristics and adherence levels could introduce confounding factors. Furthermore, the retrospective nature of the analysis and reliance on clinical data might limit the depth of information available for a comprehensive evaluation. These considerations should be taken into account when interpreting the results.

DISCUSSION

Chronic heart failure (CHF) is a severe cardiovascular disease, often resulting from the long-term accumulation of heart-related issues and other health factors.[12] Research has shown that the onset of CHF is typically the result of multiple factors working in concert, including hypertension, coronary artery disease, heart valve problems, myocardial disease, diabetes, lung conditions, kidney issues, dietary and lifestyle factors, and factors such as age, family history, and gender can also play a role in the development of CHF.[13] Currently, clinical treatments for CHF primarily revolve around medication maintenance, lifestyle modifications, and dietary management. A common characteristic of these treatment approaches is their long-term and high level of self-discipline.[14] However, many patients cannot actively adhere to treatment and follow-up due to factors such as the prolonged course of the disease, extended recovery times, and disease recurrence. Some patients may even develop resistance and aversion to treatment and recovery efforts, resulting in poor treatment compliance. This can have a serious impact on the disease control and quality of life of CHF patients.[15]

To further improve the prognosis of CHF patients, clinical practice advocates provide high-quality nursing interventions to help patients improve their treatment compliance while receiving effective treatment.[16] In the past, conventional nursing interventions were often provided to CHF patients. However, patients who receive conventional nursing interventions tend to be in a passive receiving state, with poor subjective initiative. This makes it difficult to achieve the expected clinical outcomes.[17] Therefore, clinical practice should seek higher-quality and more easily implementable nursing interventions for CHF patients, which is crucial for their prognosis and recovery.

The Trans-Theoretical Model is a new theoretical model in clinical practice that focuses on the individual's decision-making ability for behavior change rather than social or biological influences.[18] This model suggests that individual behavior change is not a single event but rather a continuous process, with people's behavior progressing through a series of dynamically changing stages before real change is achieved.[19] In this study, we attempted to incorporate the Trans-Theoretical Model into nursing interventions for CHF. We aimed to adopt different behavior change strategies for individuals at different stages of the model, thereby promoting patients' transition to the action and maintenance stages and ultimately improving their prognosis and recovery.

The results of this study demonstrate that after the intervention, the observation group had significantly higher MMAS-8 scores compared to the control group, while MLHFQ scores were significantly lower in the observation group than in the control group ($P < .05$). Furthermore, after the intervention, the observation group showed significantly higher levels of self-care skills, self-concept, health knowledge, and self-responsibility compared to the control group ($P < .05$). These research findings indicate that nursing interventions based on the Trans-Theoretical Model can effectively enhance treatment compliance and self-care abilities in CHF patients, thereby improving their quality of life. The reason for these improvements is that when nursing interventions based on the Trans-Theoretical Model are employed, nurses provide patients with essential information, then guide patients to reiterate this information and offer feedback and corrections. This two-way information exchange model is patient-centered and helps patients understand their disease and personal condition accurately. Consequently, this approach contributes to improved treatment compliance and self-care abilities, ultimately leading to an effective enhancement in the quality of life for patients.

Previous research[20] has pointed out that the assessment of heart and lung function in CHF patients can effectively predict their prognosis and recovery status. Changes in the levels of heart and lung function indicators indicate the severity of a patient's cardiac dysfunction. The results of this study reveal that after the intervention, the observation group had significantly higher levels of VO_2AT and peak VO_2 compared to the control group, while VE/VCO_2 levels were significantly lower in the observation group than in the control group ($P < .05$). Additionally, the observation group had a significantly lower readmission rate than the control group ($P < .05$). These findings demonstrate that nursing interventions based on the Trans-Theoretical Model can effectively improve the heart and lung function of CHF patients and reduce the risk of readmission. The reason behind these improvements is that the implementation of nursing interventions based on the Trans-Theoretical Model divides health education into various stages to address patients in different phases, such as the intention transition period and the action implementation period. Subsequently, through health education, patients are assisted in understanding disease-related knowledge. The healthcare provider also assesses patients' cognitive levels, and understanding, and corrects any misconceptions. This

continuous reinforcement of patients' understanding of their disease and personal condition leads to improved heart and lung function and a reduced risk of readmission. The reduction in rehospitalization rates observed in CHF patients undergoing Transtheoretical Model-based interventions can be attributed to targeted approaches addressing issues like medication adherence and lifestyle management. The control group experienced higher rehospitalization rates, primarily linked to these factors. This nuanced understanding underscores the clinical significance of the reduced rates and emphasizes the tangible impact on patient outcomes. Future research can explore specific contributors to rehospitalization, refining interventions for enhanced chronic heart failure care.

Nursing interventions based on the Trans-Theoretical Model facilitate nuanced communication and consistent reinforcement, fostering a tailored approach that aligns with individual patient progress. By recognizing the diverse stages of behavior change, the TTM addresses specific challenges, promotes patient autonomy, and provides targeted support. The observed enhancements in treatment compliance, quality of life, self-care abilities, and cardiopulmonary function can be attributed to the TTM's adaptive and personalized framework, empowering CHF patients throughout their rehabilitation journey.

While the study demonstrates promising outcomes with Transtheoretical Model-based interventions in our specific healthcare setting, generalizability to diverse settings and patient populations requires careful consideration. Potential limitations may arise due to variations in healthcare structures, patient demographics, and cultural factors. Adapting the Transtheoretical Model to different contexts demands a nuanced understanding of local dynamics, and its effectiveness may vary. Caution should be exercised in extrapolating results, emphasizing the need for context-specific assessments before widespread implementation.

The observed improvements in treatment compliance, quality of life, self-care abilities, and cardiopulmonary function hold promising clinical significance and practical implications. Enhanced treatment compliance suggests increased adherence to prescribed medications, potentially reducing disease progression and related complications. Improved quality of life indicates a positive impact on patients' overall well-being, potentially minimizing the psychological and emotional burden associated with CHF. Moreover, heightened self-care abilities are indicative of patients' improved skills in managing their health, fostering greater autonomy and reducing reliance on healthcare resources. The positive changes in cardiopulmonary function suggest enhanced physiological capacity, potentially leading to better cardiovascular outcomes and a reduced risk of rehospitalization. These improvements collectively contribute to better patient outcomes, emphasizing the importance of tailored nursing interventions based on the Transtheoretical Model. In a broader context, these findings may inform healthcare practices by emphasizing the value of personalized, stage-based interventions in CHF rehabilitation, offering a framework for more effective and patient-centric care strategies.

This research can significantly impact CHF patient treatment in clinical settings. By incorporating nursing interventions aligned with the Transtheoretical Model, clinicians can tailor strategies to patients' specific behavior change stages, enhancing treatment compliance and self-care. The study's insights on reducing rehospitalization rates provide a practical framework for clinicians to improve long-term patient outcomes. Overall, this research offers evidence-based tools for a more personalized and effective approach to CHF management in real-world clinical practice.

In envisioning future research endeavors, exploring the enduring effects of Transtheoretical Model-based nursing interventions over the long term becomes paramount. Investigating sustained treatment compliance, lasting improvements in quality of life, and extended cardiopulmonary benefits will deepen our understanding of intervention impact. Additionally, extending the scope to encompass diverse chronic conditions could unravel the model's broader applicability, offering valuable insights for holistic healthcare strategies. Exploring the scalability of these interventions and potential customization for varied patient populations opens avenues for advancing patient-centered care paradigms in chronic disease management.

Although this study has yielded some findings regarding the application of nursing interventions based on the Trans-Theoretical Model in the rehabilitation treatment of CHF patients, it is important to acknowledge several limitations in the research itself: (1) Limited Sample Size: The sample size in this study was relatively small, comprising only 156 CHF patients. This may have constrained the statistical power of the research, potentially preventing the detection of some underlying differences. (2) Study Design Constraints: This study employed a single-center, non-randomized controlled trial design, which may have introduced some issues related to selection bias and internal validity. (3) Self-Reporting and Subjective Assessment: Some of the assessment measures in this study, such as patient-reported quality of life and self-care abilities, relied on self-reporting by patients, introducing the possibility of subjectivity and memory bias. (4) Limited Duration of Study: The observational period in this study was relatively short, spanning from May 2019 to September 2022. CHF is typically a chronic condition, and its rehabilitation and treatment processes may require a longer duration. In future research endeavors, we intend to address these limitations to enhance our studies' scientific quality and practical utility, aiming to provide more comprehensive insights and guidance for a better understanding and management of CHF.

CONCLUSION

Our study underscores the transformative impact of Trans-Theoretical Model-based nursing interventions on the management of CHF. Notably, patients receiving TTM-based care exhibited marked enhancements in treatment adherence,

self-care abilities, and cardiopulmonary function. These interventions translated into tangible improvements in the quality of life and a substantial reduction in rehospitalization rates, reaffirming the model's efficacy in addressing the multifaceted challenges of CHF.

The clinical significance of these findings is profound. Improved treatment adherence implies better control over CHF progression, potentially leading to enhanced overall well-being for patients. The observed advancements in self-care abilities signify an empowering shift, fostering patients' capability to navigate the complexities of their condition more effectively. Concurrently, the positive impact on cardiopulmonary function underscores the physiological benefits of TTM-based interventions, promising a comprehensive approach to CHF management.

Beyond CHF, the broader implications of adopting TTM-based interventions in chronic disease management are noteworthy. The success witnessed in our study suggests a promising avenue for application across various chronic conditions. By addressing the dynamic nature of behavior change, TTM offers a patient-centric framework adaptable to diverse healthcare contexts.

Looking ahead, future research endeavors should explore the sustainability of these interventions over the long term, examining enduring effects on treatment adherence and overall patient outcomes. Additionally, investigating the cost-effectiveness and scalability of TTM-based interventions can provide valuable insights for widespread implementation in diverse healthcare settings.

In conclusion, our study not only reinforces the pivotal role of TTM-based nursing interventions in CHF management but also propels the discourse towards innovative, patient-centered strategies with far-reaching implications for the broader landscape of chronic disease care.

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