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Effects of respiratory function exercise combined with psychological nursing on cardiopulmonary function index, exercise tolerance, and quality of life in patients with stable chronic obstructive pulmonary disease

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Abstract

Background: To explore the efficacy of respiratory function exercise combined with psychological nursing on cardiopulmonary function index, exercise tolerance, and quality of life in patients with stable chronic obstructive pulmonary disease (COPD).

Methods: The data of 100 patients with stable COPD admitted to our hospital from June 2019 to June 2021 were retrospectively analyzed. Patients were assigned to the experimental group (n=50) and the control group (n=50) in alphabetical order by their initials. Patients in both groups were treated with conventional care combined with respiratory function exercise, and the experimental group additionally received psychological care intervention. Pulmonary function indicators, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), one-second rate (FEV1/FVC), 6-min walking test (6MWT) results, quality of life (physical health and role emotional), anxiety and depression self-rating scale scores, nursing satisfaction, and clinical efficacy were compared between the two groups before and after treatment.

Results: The two groups presented no significant differences in baseline data ($p > 0.05$). The experimental group outperformed the control group in terms of pulmonary function index, quality of life, and nursing satisfaction ($P < 0.05$). The observation group obtained lower negative emotion scores than the control group after nursing intervention ($P < 0.05$). After nursing, the FEV1/FVC in the experimental group was significantly higher than that in the control group [(58.63 ± 5.64) vs (46.36 ± 5.23)]. The 6MWT results in the experimental group were significantly better than those in the control group [(398.35 ± 28.65) m vs (348.97 ± 26.98) m] (all $P < 0.05$).

Conclusion: Respiratory function exercise combined with psychological nursing effectively improves the lung function of patients with stable COPD, eliminates patients' negative emotions, improves nursing satisfaction, and significantly boosts patients' quality of life, which merits clinical promotion.

Keywords: Psychological nursing; Functional exercise; Stable chronic obstructive pulmonary disease; Lung function

Introduction

Currently, few scholars have been able to draw on any systematic research into the combination of psychological nursing and respiratory function exercise in the treatment of stable COPD. Accordingly, this study aimed to investigate the practical effects of psychological nursing combined with respiratory function exercise. The results are as follows.

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Literature review

Chronic obstructive pulmonary disease (COPD) is an inflammatory pulmonary disease with symptoms such as cough and sputum, shortness of breath, and chest tightness. It is characterized by a high disability and mortality, and ranks third among the fatal diseases in China (Riccione & Nugent, 2019). The gradual increase in the number of stable COPD cases and mortality (Vogiatzis et al., 2020) necesstates the exploration of more feasible treatment methods for COPD. Currently, drug therapy is the mainstay for the treatment of the disease, in which anti-inflammatory drugs are used to lessen the sensitivity of the airways to irritating gases and mitigate the clinical symptoms of dyspnea. However, given the long and progressive course of the disease, drug treatment only achieve temporary relief of clinical symptoms at the stage of attack. In addition to the inability to improve the patient's respiratory function, long-term medication may also impair liver functions and give rise to drug toxicity. Accordingly, respiratory exercise has been applied in patients and was found to be effective in alleviating pulmonary symptoms and enhancing respiratory function in patients with stable COPD (Kawada, 2021), indicating that respiratory exercise contributes significantly to the improvement of respiratory muscle function. Nevertheless, the therapeutic efficiency of patients with COPD is subject to various factors such as the patient's economic status, physiological condition, and exercise endurance, Moreover, it may also lead to negative emotions of patients such as suicidal tendency, depression, and abandonment of treatment, which compromises the treatment efficiency (Ghobadi et al., 2021; Zinellu et al., 2021) and therefore underscores the significance of psychological nursing in the treatment of stable COPD. In psychological nursing, patients were instructed to develop positive emotions through psychological intervention and emotional regulation, so as to reduce or eliminate patients' psychological burden. Psychological nursing has been reported to effectively prevent the occurrence of depression, eliminate negative emotions, accelerate recovery, improve nursing efficacy, and increase patient motivation for treatment (Sun et al., 2020).

1. Materials and Methods

1.1 Study design

This is a retrospective study, conducted in our hospital from June 2019 to June 2020, to investigate the effects of respiratory function exercise combined with psychological nursing on the cardiopulmonary function indexes, exercise endurance, and quality of life in patients with stable COPD. The study was set up at a double-blind level, with neither the study subjects nor the investigator being aware of the trial grouping, and the study designer was responsible for the arrangement and control of the entire trial.

1.2 Recruitment of research subjects

The data of 100 patients with stable COPD admitted to our hospital from June 2019 to June 2021 were retrospectively analyzed and patients were included according to the following criteria. (1) Patients who were diagnosed with COPD confirmed by pulmonary function test, lung X-ray, and chest CT (Sun et al., 2020); (2) Patients who were <80 years old, with a disease duration of 4-8 years, and a slow progression of symptoms; (3) Patients whose disease was in a stable stage and lasted more than 4 weeks (Lee et al., 2019); and (4) Patients without hospital referral, death, or discontinuation of treatment during the nursing. Patients were excluded according to the following criteria: (1) Patients with hearing, speech, mental, behavioral, or physical dysfunction that prevented cooperation in the treatment; (2) Patients with withdrawal from treatment, death, or loss of follow-up; (3) Patients with other serious organ diseases; (4) Patients with the disease shifting from stable to acute exacerbation; (5) Patients with low compliance and disobedience to hospital uniform management.

1.3 Steps

A total of 100 patients were included in this study, and divided into the experimental group (n=50) and the control group (n=50) in alphabetical order by initials. This study used stratified sampling by capturing key population characteristics in the sample, similar to the weighted mean, to produce characteristics in the sample that are proportional to the overall population. The patients filled in the basic information and clinical symptoms faithfully upon admission, followed by the detection of their lung function indices through four laboratory tests including lung function, lung x-ray, chest CT, and blood gas tests. A professional questionnaire was used to measure the patients' 6 min walking test (6MWT) results, negative emotion score, role emotional score, physical health score, and quality of life score. After nursing, the patients filled out questionnaires and underwent laboratory tests, and the patients' basic data, laboratory reports, and questionnaire data before and after nursing were retained by the laboratory staff (Lewis et al., 2018; Singh et al., 2014).

1.4 Ethical considerations

The study complied with the principles of the Declaration of Helsinki (Ali, 2016) and was approved by the review board of the hospital's ethical review committee. After recruitment, the patients were informed of the purpose, significance, content, and confidentiality of the study and signed an informed consent form.

1.5 Withdrawal criteria

The case record forms of those who had the following conditions and were judged by the research group to be unsuitable for continuing the experiment were retained, but data analysis was not performed: (1) those who had adverse events or serious adverse events; (2) those whose condition deteriorated during the experiment; (3) those who had some serious co-morbidities or complications; (4) those who were unwilling to continue the clinical trial in the course of the clinical trial and request to withdraw from the trial.

1.6 Methods

The control group was given routine nursing care and respiratory function exercises. The specific steps of routine nursing care are as follows. (1) Condition management. Within 1-4 days after stabilization of disease, the patients' condition was closely monitored by nursing staff, and their lung function indexes were determined.The patients were provided with aerosol, and the parameters of the ventilator (Wanman auto-ST/S bi-level ventilator, National Machinery Injection 20182541700) were adjusted properly according to the disease development to ensure an uneventful passage through the disease attack. (2) Drug instruction. The patients were given azithromycin sodium phosphate, levofloxacin, and cefoperazone sulbactam according to the medical prescriptions, and their conditions were monitored to strictly prevent and control respiratory distress. In the stable phase of the disease, administration of antioxidants and bronchodilators was performed to alleviate the disease symptoms and reinforce the overall effectiveness of nursing care. (3) Dietary guidance. The patients were given a uniform and light diet, with a daylong stream of mini-meals. (4) Self-care. The patients were instructed to perform daily exercise according to their respiratory status and clinical conditions. The specific steps of respiratory function exercise are as follows. (1) Abdominal breathing. The patients adopted a semi-recumbent posture with knees half flexed, abdominal muscles relaxed, left hand placed on the chest, and right hand placed on the abdomen. The right hand raised upward during slow inhalation and lowered during exhalation, in which the chest breathing was gradually shifted to abdominal breathing. (2) Breathing exercises. The patients inhaled through the nose with their mouth closed and exhaled slowly with their lips in a whistle-like manner (lip-retracted breathing), and the breathing exercises were performed with body movements during lip-retracted breathing. (3) Blowing experiment. The patients progressively exercised their lung breathing by blowing up balloons according to their condition. The maximum time of exhalation per day was recorded. (4) Daily straight line training. The patients walked in a straight line for 15 minutes a day, stopped when they felt shortness of breath or fatigue and continued with normal breathing. The exercise time was gradually increased. The experimental group was given psychological nursing on the basis of the control group, and the specific steps of psychological nursing are as follows. (1) Psychological guidance. Psychological counseling was conducted by medical psychologists to relieve patients' depression and enhance their compliance with the treatment. Condition exchange sessions were arranged for patients to share their conditions and provide mutual comfort and psychological support to alleviate their negative emotions. (2) Health education. Physicians conducted health education of the disease to explain to all patients the causes, symptoms, and daily self-management of COPD, to help patients develop a understanding of their disease, enhance communication among patients, and prevent retarded recovery due to excessive depression or frustration.

1.7 Observational criteria

(1) General information: General information included the number of hospitalizations, name, gender, age, weight, disease duration, degree of illness, smoking history, exercise, monthly income, air pollution status of residence, physical condition, nutritional status, occupational exposure, education level, and genetic factors.

(2) Forced expiratory volume in one second (FEV1)/forced vital capacity (FVC): The ratio of exertional expiratory volume in one second to total lung volume is a common clinical indicator of lung ventilation function. The first-second expiratory volume and expiratory spirometry values of the patients were counted and the one-second rate was calculated for each patient using the pulmonary function parameter table (Gao & Chen, 2021; Kuo et al., 2013). One-second rate (%) = FEV1(L)/FVC (L). The lung function parameter table contains SVC test parameters, PVC test parameters, and FEV1 test parameters, with

FEV1/FVC as the common diagnostic criterion. One-second rate index (Barstow & Forbes, 2019): >70% is normal, <70% suggests obstructive ventilatory dysfunction, 50%-69% is a mild reduction, 35%-49% is a moderate reduction, and <35% is a severe reduction. The patients were instructed to exhale after maximum inhalation into the measuring instrument to record their expiratory volume. The volume of exhaled gas in the first second after the patients started exhaling and the maximum volume of exhaled gas was recorded. The test was performed twice. A small difference between the two measurements was acceptable as study data, and patients with a large difference between the two measurement results were required to perform the test again after 10 minutes of rest to ensure the accuracy of the results. After the test results were tallied, the one-second rate was calculated for each patient.

(3) 6MWT: The patients' walking distance, blood pressure, heart rate, and SpO2/SaO2 were counted using a 6 min walking distance scale (Qi et al., 2020). The patients walked alone in a straight line, rested immediately when they felt fatigued or were in conditions such as shortness of breath and dyspnea, and continued the test after getting comfortable. The 6 min walking distance of the patients was recorded. The nursing staff encouraged the patients appropriately during the walk and reminded them the time.

(4) Quality of life: The patients' role emotional scores and physical health scores before and after nursing were recorded using the MOS 36-item short-form health survey (SF-36) (Geng et al., 2020). The SF-36 is designed to assess health and functional status across multiple age groups, different diseases, and control populations, and contains eight dimensions: physical functioning (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). SF-36 scale score = (actual score - lowest possible score for that aspect / highest possible score for that aspect - lowest possible score for that aspect) * 100%. The higher the score, the better the physical health status.

(5) Anxiety and depression scores. Self-rating anxiety scale (SAS) and self-rating depression scale (SDS) (Gómez Pereira et al., 2005; Gorini et al., 1996) were used to obtain the anxiety and depression scores of the two groups. An SAS score of 50-60 points is considered as mild anxiety, 61-70 points as moderate anxiety, and >70 points as severe anxiety. An SDS score of 53-62 points is considered as mild depression, 63-72 points as moderate depression, and >73 points as severe depression.

(6) Nursing satisfaction: The patients' nursing satisfaction was recorded using a quality of care satisfaction questionnaire (Schuetz et al., 2015). The scale contains items such as basic nursing service, nursing service attitude, observation frequency, operation technique level, medication instruction, rehabilitation, and health instruction. The total score is 100 points. A score of 100-80 points is very satisfied, of 80-60 points is satisfied, of 60-40 points is moderately satisfied, of 40-20 points is unsatisfied, and of 20-0 points is very unsatisfied. A score of 100-60 points is considered satisfied, and below 60 is considered unsatisfied.

(7) Clinical efficacy. The clinical global impression (CGI) (Schuetz et al., 2015), including global improvement (GI), severity of illness (SI), and efficacy index (EI) was used to evaluate the treatment efficacy, which ranges from markedly effective, effective, slightly effective, and unchanged or deteriorated.

1.8 Statistical methods

The data processing software selected for this study was SPSS 20.0, and GraphPad Prism 7 (GraphPad Software, San Diego, USA) was used to plot the graphics. This study included count data and measurement data. The measurement data were expressed as mean ± standard deviation using the t-test, and the count data were expressed as case (percentage) using the chi-square test. $P<0.05$ was considered statistically significant.

2 Results

2.1 General information

There was no statistical difference between the general data of the two groups of patients ($P > 0.05$), as shown in Table 1.

2.2 Comparison of FEV1/FVC

Before nursing, the two groups had no significant differences in the one-second rate ($P>0.05$). After nursing, the one-second rate was significantly higher in the experimental group than in the control group ($p < 0.001$), as shown in Figure 1.

2.3 Comparison of 6MWT results

Before nursing, there was no significant difference between the experimental group and the control group in terms of 6MWT results ($P > 0.05$). After nursing, the 6MWT results in the control group were significantly shorter than those in the experimental group ($P < 0.001$), as shown in Figure 2.

2.4 Comparison of quality of life

The scores of physical health and role emotional in the experimental group were significantly higher than those of the control group ($P < 0.001$), as shown in Figure 3.

2.5 Anxiety and depression scores

After nursing, the experimental group had significantly lower negative emotion scores than the control group ($P < 0.05$). See Figure 4.

2.6 Comparison of nursing satisfaction

The nursing satisfaction of patients in the experimental group was significantly higher than that of the control group ($P < 0.05$), as shown in Figure 5.

2.7 Clinical efficacy

The experimental group yielded a remarkably higher efficacy in contrast to the control group ($P < 0.05$). See Table 2.

3 Discussion

Stable COPD is a typical disease in the decaying lung function pathology, with main clinical symptoms such as dyspnea, hypoxia, and hypercapnia. The lungs are the body's main organ for ventilation and air exchange, and impaired lung function may trigger a cascade of pathological reactions in the organism. Pulmonary ventilation and air exchange processes primarily rely on the alveolar membrane whereby the body physically exchanges oxygen and carbon dioxide by the diffusion effect to increase blood oxygen levels and ensure normal respiration. COPD induces a reduction in alveolar membrane area and inadequate pulmonary ventilation, resulting in dysfunctional blood flow and dyspnea. In addition, pulmonary ventilation dysfunction disrupts the air exchange, in which oxygen fails to enter the bloodstream and blood oxygen protein decreases, resulting in hypoxia and the accumulation of carbon dioxide in the pulmonary vasculature, which may further develop into hypercapnia. Long-term hypoxia seriously inhibits the patient's cardiopulmonary function, impairs the normal functioning of organs, and also compromises the patient's organism exercise endurance, and quality of life. Therefore, respiratory function exercises and clinical care interventions demonstrate great potential in alleviating the clinical symptoms of patients with COPD. It has been shown that respiratory function exercises could effectively improve pulmonary function and quality of life in patients with stable COPD (Wei et al., 2013; Yong et al., 2013). The respiratory function exercise mainly includes lip retraction training, abdominal breathing, breathing exercises, and blowing experiments, with an aim to alleviate the patient's dyspnea and hypoxia caused by the chest lesion. It facilitates patients to cultivate combined abdominal and chest breathing and fosters the normal functioning of the respiratory muscles. However, Pancera Simone et al. found that some patients with stable COPD were predisposed to symptoms such as muscle fatigue and decreased muscle strength (Pancera et al., 2021), with less severe symptoms of pulmonary dysfunction and more severe muscle dysfunction, where respiratory function exercises fail to mitigate muscle dysfunction, indicating that the efficacy of respiratory function exercises requires further amelioration.

A study by Rijn A et al. demonstrated that patients with stable COPD are under high psychological stress due to economic, medical, and family factors, while chronic psychological stimulation may trigger somatization symptoms and aggravate muscle dysfunction (van Rijn et al., 2019). Therefore, the improvement of the patient's psychological condition is crucial for the optimal application of respiratory function exercises. The joint application of respiratory function exercise and psychological nursing intervention is an all-round and multi-level scientific nursing model, with pulmonary function exercise and psychological regulation of disease conditions. This nursing model can alleviate the patient's pulmonary dysfunction and regulate the psychological conditions of patients, allowing nursing staff to perform the appropriate nursing care in different nursing sessions to enhance the patient's rehabilitation efficacy and exercise adaptability, and regulate their mentality. Studies have revealed that the probability of patients experiencing negative emotions in conventional care is 78%-92%, while only 53%-68% of patients experience negative emotions after the implementation of the psychological intervention model (Kling & Williams, 2021; Samaranayake et al., 2020), indicating that this model of nursing care eliminates the negative emotions and psychological stress in patients. The limitation of this study lies in the absence of a large sample size, which will be expanded in future studies to provide more reliable conclusions.

Study implications

Respiratory function exercise combined with psychological nursing effectively improves the lung function of patients with stable COPD, relieves patients' negative emotions, improves nursing satisfaction, and significantly boosts patients' quality of life, which merits clinical promotion.

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Table 1. **Comparison of general information of patients**

Groups	Experimental group（n=50）	Control group（n=50）	T/x^2	P
Gender			1.56	0.21
Male	35	29		
Female	15	21		
Age (years)			0.01	0.99
Range	58-75	62-79		
Average age	66.5±12.12	70.23±4.65		
Mean weight (kg)	58.36±2.53	59.23±3.12	1.53	0.13
Duration of disease (years)			0.22	0.83
Range	4-8	4-8		
Average duration of disease	4.98±2.36	5.06±1.12		
Disease degree (grade)				
Ⅰ	9	12	0.54	0.46
Ⅱ	18	20	0.17	0.68
Ⅲ	23	18	1.03	0.31
Smoking history (years)				
<3	12	7	1.62	0.20
3-9	29	32	0.38	0.54
＞9	9	11	0.25	0.62
Exercise			0.18	0.67
Yes	15	17		
No	35	33		
Monthly income (yuan)			0.71	0.40
≥4000	19	15		
<4000	31	35		
Air pollution			0.48	0.49
Light	11	14		
Heavy	39	36		
Physical condition				
Better	8	7	0.08	0.78
Fair	15	20	1.10	0.30
Poor	27	23	0.640	0.424
Occupational exposure			1.27	0.26
Yes	34	39		
No	16	11		
Nutritional status			1.71	0.19
Good	18	12		
Poor	32	38		
Genetic factors			0.36	0.55
Family history	24	21		
Personal history	26	29		
Education level			0.05	0.83
High school and below	36	35		
University and above	14	15		

Table 2. **Comparison of clinical efficacy [n (%)]**

Groups	Markedly effective	Effective	Slightly effective	Unchanged	Total effectiveness (%)
Experimental group	21（42）	25（50）	3（6）	1（2）	92
Control group	5（10）	9（18）	16（32）	20（40）	28
X^2					42.67
P					0.00

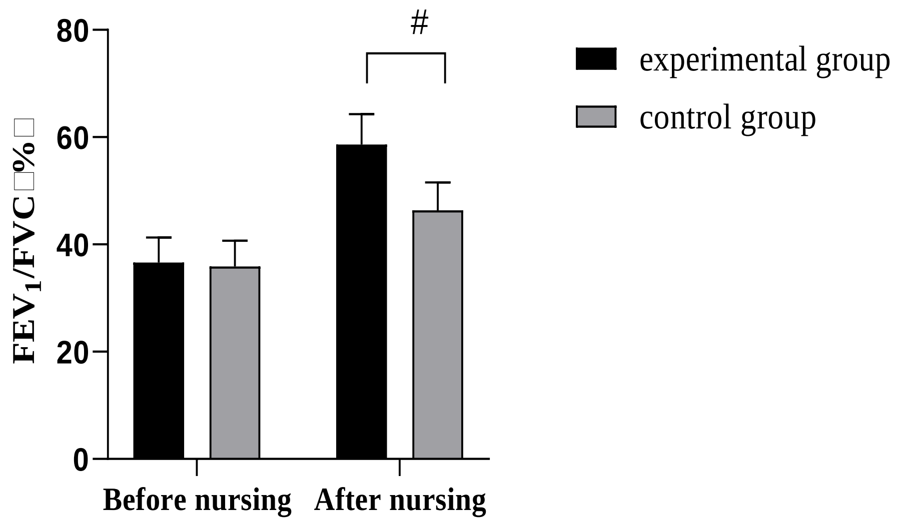

Figure 1. **Comparison of FEV1/FVC of patients ($\bar{X}$±S, %)**

Note: The abscissa from left to right is before nursing and after nursing, and the ordinate is FEV1/FVC (%); the black area in the figure is the experimental group and the gray area is the control group; # indicates p < 0.001.

Before nursing, there was no statistical difference in FEV1/FVC between the control and experimental groups (35.89 ± 4.82 vs. 36.65 ± 4.65, P > 0.05); after nursing, FEV1/FVC in the control group was significantly lower than that in the experimental group (46.36 ± 5.21 vs. 58.63 ± 5.64, P < 0.001).

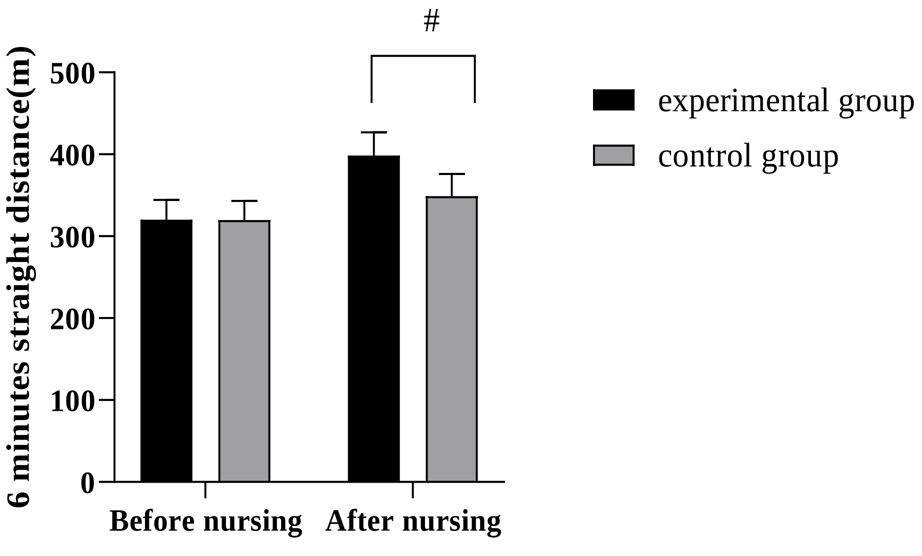

Figure 2. **Comparison of 6 min walking distance before and after nursing ($\bar{X}$±S, m)**

Note: The abscissa from left to right is before and after nursing, respectively, and the ordinate is 6 min walking distance (m); the black area in the figure is the experimental group and the gray area is the control group; # indicates P < 0.001.

Before nursing, there was no significant difference between the experimental group and the control group in terms of 6 min walking distance (320.06±24.26 vs. 319.65±23.45, P<0.05); after nursing, the experimental group had a significantly higher 6 min walking distance than the control group (398.35±28.65 vs. 348.97±26.98, P<0.001).

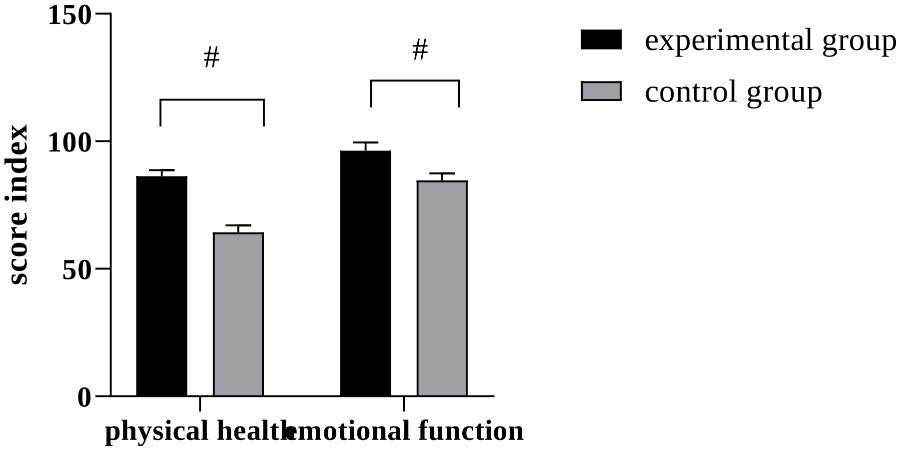

Figure 3. **Comparison of patients' quality of life (X̅±S, points)**

Note: The abscissa from left to right is somatic health and emotional function, and the ordinate is the score; the black area in the figure is the experimental group and the gray area is the control group; # indicates P < 0.001.

After nursing, the role emotional scores were significantly higher in the experimental group than in the control group (96.35 ± 3.21 vs. 84.63 ± 2.76, P < 0.001); the somatic health scores were significantly higher in the experimental group than in the control group (86.35 ± 2.39 vs. 64.35 ± 2.65, P < 0.001).

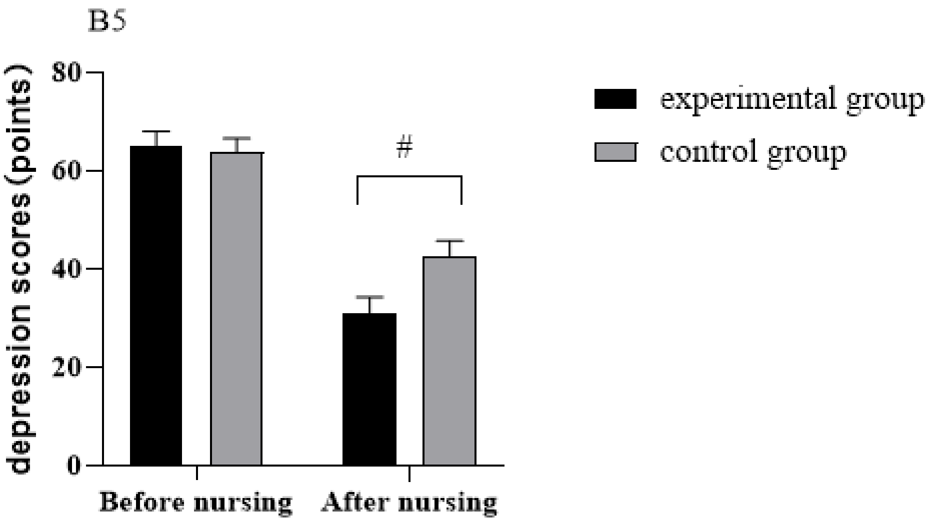

Figure 4. **Comparison of anxiety and depression scores of patients before and after nursing (X̅±S, points)**

Note: The abscissa from left to right is before and after care; the black area in the figure is the experimental group and the gray area is the control group; # indicates P < 0.001.

Figure 4A shows the anxiety rating scale; before nursing, there was no significant difference between the anxiety scores of the two groups (65.39±2.89 vs. 64.36±3.01, P>0.05); after nursing, the anxiety scores of the experimental group were significantly lower than those of the control group (38.65±3.15 vs. 49.68±4.34, P<0.001).

Figure 4B shows the depression score scale; before nursing, there was no significant difference in depression scores between the experimental and control groups (64.89±3.13 vs. 63.69±2.97, P>0.05); after nursing, the depression scores of the experimental group were significantly lower than those of the control group (30.86±3.35 vs. 42.68±3.05, P<0.001).

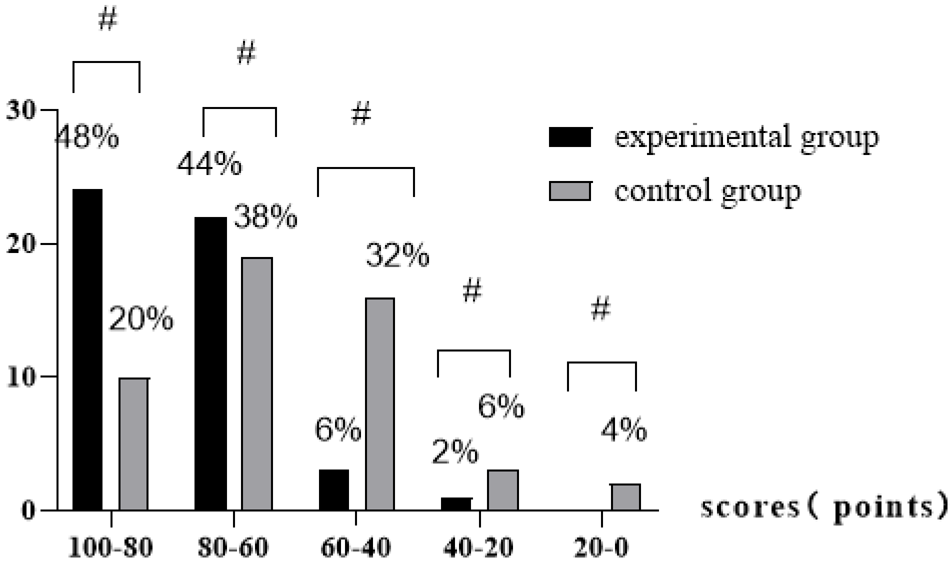

Figure 5. **Comparison of nursing satisfaction [n (%)]**

Note: The abscissa from left to right are satisfaction scores 100-80 (points), 80-60 (points), 60-40 (points), 40-20 (points), 20-0 (points); black area in the figure is the experimental group and gray area is the control group; # indicates $P < 0.05$.

In the experimental group, there were 24 patients (48%) with nursing satisfaction scores of 100-80 points, 22 patients (44%) with scores of 80-60 points, 3 patients (6%) with scores of 60-40 points, 1 patient (2%) with scores of 40-20 points, and 0 patients with scores of 20-0 points; in the control group, there were 10 patients (20%) with scores of 100-80 points, 19 patients (38%) with scores of 80-60 points, 16 patients (32%) with scores of 60-40 points, 3 patients (6%) with scores of 40-20 points, and 2 patients (4%) with scores of 20-0 points.