Yin H. (2024) EVALUATING THE EFFECTS OF PATIENT-CENTERED CARE ON RESPIRATORY FUNCTION AND INFECTION RATES IN ATHLETES WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD). Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 24 (98) pp. 453-464.
DOI: https://doi.org/10.15366/rimcafd2024.98.030

ORIGINAL

EVALUATING THE EFFECTS OF PATIENT-CENTERED CARE ON RESPIRATORY FUNCTION AND INFECTION RATES IN ATHLETES WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

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Recibido 30 de enero de 2024 **Received** January 30, 2024
Aceptado 29 de septiembre de 2024 **Accepted** September 29, 2024

ABSTRACT

Objective: To evaluate the impact of a patient-centered nursing model on respiratory function and clinical pulmonary infection score (CPIS) in athletes with chronic obstructive pulmonary disease (COPD). **Methods:** This study involved 116 athletes diagnosed with COPD who were treated at our institution from June 2021 to June 2023. Participants were randomly assigned to a control group (n=58), which received standard nursing care, or an observation group (n=58), which received patient-centered nursing care. Key metrics assessed included lung function (FVC, FEV1, FEV1%, PaO2, PaCO2), mastery of health education, compliance, mental health status (using SAS and SDS scales), infection rates, exercise endurance (6-minute walk test, 6MWT), and quality of life (St. George's Respiratory Questionnaire, SGRQ). **Results:** Post-intervention, improvements were noted in FVC, FEV1, FEV1%, and PaO2, with a reduction in PaCO2 across both groups. However, athletes in the observation group showed greater improvements in these parameters than those in the control group ($P<0.05$). Furthermore, the observation group demonstrated higher mastery and compliance with health education, lower stress and depression scores, and a significantly reduced CPIS score compared to the control group. Infection rates were 3.45% in the observation group versus 15.52 percent in the control group ($P<0.05$). The observation group also exhibited superior exercise endurance and quality of life as measured by 6MWT and SGRQ ($P<0.05$). **Conclusions:** Implementing a patient-centered nursing model in athletes with COPD significantly enhances lung function, knowledge

and compliance regarding health education, and psychological well-being. It also reduces infection rates and improves both exercise endurance and overall quality of life. This model of care may serve as an effective approach to managing COPD in athletic populations, highlighting the need for tailored healthcare strategies that address the specific challenges faced by athletes with chronic respiratory conditions.

KEYWORDS chronic obstructive pulmonary disease; Demand-oriented; Pulmonary function; Clinical pulmonary infection score

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition characterized primarily by obstructed airflow, which can significantly impact lung function and overall physical performance. While COPD is typically associated with long-term smoking, athletes in sports involving exposure to airborne irritants or intense endurance training may also be susceptible. Understanding how COPD affects this population is crucial, as the demands placed on athletes' respiratory systems are often extreme. Managing COPD in athletes presents unique challenges. Traditional approaches focus on medication, smoking cessation, and lifestyle changes, which may not be fully applicable or sufficient for athletes. Athletes require management strategies that not only alleviate symptoms but also optimize lung function and physical capability to maintain competitive performance levels. Patient-centered care, which tailors' healthcare interventions to individual patient needs and preferences, has emerged as a critical model in chronic disease management (Chen et al., 2023). This approach can involve customized respiratory therapies, targeted exercise programs, and specific nutritional interventions in COPD patients. For athletes, integrating sports-specific demands within this framework can significantly enhance outcomes. This study investigates the effects of a demand-oriented, patient-centered nursing model on various health outcomes in athletes with COPD. This includes an examination of lung function parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and blood gas measures (PaO2, PaCO2), as well as the Clinical Pulmonary Infection Score (CPIS), which are essential for determining the severity and management efficacy of COPD. This study retrospectively analyzes the clinical data of 116 athletes diagnosed with COPD, comparing the outcomes of those who received standard nursing care with those who participated in a patient-centered nursing program. The analysis focuses on quantifiable changes in lung function, exercise endurance, mental health, and quality of life, providing a comprehensive view of the benefits offered by patient-centered approaches. This research aims to contribute significantly to sports medicine and pulmonary care by exploring the application of a patient-centered nursing model tailored to athletes with COPD. It seeks to demonstrate how customized interventions

can mitigate the impact of COPD on athletic performance, potentially offering new guidelines for managing respiratory conditions in high-performance sports (Yin et al., 2022). This introduction sets the stage for a detailed exploration of innovative care strategies that could revolutionize treatment paradigms for athletes facing chronic respiratory challenges.

2. Materials and Methods

2.1 General Information

A total of 116 patients with COPD admitted to our hospital from June 2021 to June 2023 were enrolled, and a control group and an observation group were set up according to the random number table method, with 58 cases in each group. Inclusion criteria: ① in accordance with the relevant criteria of the Guidelines for the diagnosis and treatment of chronic obstructive pulmonary disease (2021 revision); ② Aged from 40 to 80 years old, all were in stable period; ③ Informed consent of patients and their families; Exclusion criteria: ① Complicated with heart failure; ② Concomitant hyperthyroidism; ③ Severe systemic infection; ④ mental and cognitive impairment; ⑤ Missing clinical data. The general data of the above two groups can be compared by statistical analysis (P>0.05) (see Table 1). The study was reviewed by the hospital ethics committee.

Table 1: Comparison of general data between the two groups

GROUPS	GENDER (EXAMPLE)		AGE (YEARS)	DURATION OF DISEASE (YEARS)
	Man	Woman		
CONTROL GROUP (N=58)	33	25	57.36±8.54	8.96±2.64
OBSERVATION GROUP (N=58)	30	28	57.51±8.49	9.02±2.57
T/X^2	0.313		0.095	0.124
P	0.576		0.925	0.902

2.2 Methods

The control group was given routine nursing, including health education, physical monitoring, medication guidance, diet intervention and discharge follow-up. On the basis of the control group, the observation group implemented the patient-demand-oriented nursing model. The questionnaire of COPD nursing needs was drawn up by 3 COPD physicians in our hospital by themselves, with a total of 10 nursing needs. The statistical questionnaire found that the nursing demand for six dimensions of health education, psychological counseling, nutritional support, compliance medicine, oxygen therapy management and early rehabilitation was high, and there were weak links that needed to be optimized and improved. Based on the above dimensions, this paper carries out the patient's demand-oriented nursing model, and now

expounds the core contents one by one: ① Health education: Due to the differences in age, education level and disease condition of patients, individualized health education should be given. In addition to the distribution of health education manuals and oral education, for patients with low education level, health education content should be repeated and detailed explained one to one, and Internet tools should be innovatively introduced to realize online health education through WeChat, video, public account push and other forms. It can remove the time and place restrictions, so that patients can deepen the understanding of COPD prevention, diagnosis and treatment；② Psychological relief: By formulating the patient's "mental state barometer", nursing staff should carry out psychological assessment when giving nursing measures every day, understand the causes of patients' negative emotions, solve them in time, and use communication, listening and guidance to help patients recover positive and positive psychology, maintain a quiet and comfortable atmosphere in the ward, and assign patients according to their personality characteristics. It helps to establish a friendly and harmonious relationship between patients, and centralize the organization of mental health seminars to implement systematic intervention; ③ Nutritional support: scientific and reasonable nutritional support plan was formulated according to the patients' basic diseases and nutritional status. The main food was high fiber, high protein and easy to digest, with small meals and frequent meals to ensure adequate daily water intake. ④ Compliance medicine: nursing staff should give targeted compliance medicine guidance according to the differences of patients using drugs, and inform the dosage, frequency, and possible adverse reactions in detail, so that patients can standardize compliance medicine; ⑤ Oxygen therapy management: nursing staff should explain the purpose and points of attention of oxygen therapy comprehensively and carefully, guide patients to standardize the low flow oxygen inhalation, usually 1~2L/min, each time oxygen therapy should be more than 15 hours, and scientifically guide home oxygen therapy after discharge; ⑥ Early rehabilitation: Nurses used pulmonary function monitoring, cardiopulmonary exercise testing, and Borg scale assessment to understand patients' lung function and physical fitness, and then formulated an early rehabilitation plan, including expectoration training, abdominal breathing, lip contraction breathing, Baduanjin, and six-word formula. Nurses demonstrated the key points of early rehabilitation training, such as keeping the mouth open at the end of deep breathing during expectoration training. If the patient is weak and unable to cough and expectoration, he can help to turn over and knock on the back to complete the expectoration training. When performing abdominal breathing, we should choose a reasonable position according to the patient's condition, usually taking the knee flexion semi-reclining position, two hands are placed on the chest and abdomen, and then guide the standard breathing.

2.3 Indicators of Observation

The lung function, mastery of health education knowledge and

compliance, mental state, infection, exercise endurance and quality of life were observed before and after the intervention. Among them,

① Pulmonary function: forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), forced expiratory volume in the first second to predicted value (FEV1%), arterial partial pressure of oxygen (PaO2), arterial partial pressure of carbon dioxide (PaCO2) were evaluated, and measured by Power Cube pulmonary function instrument (Convision, Germany);

② Mastery and compliance of health education knowledge: According to the literature (Lopez-Lopez et al., 2020), the self-made health education knowledge mastery questionnaire of our hospital was divided into COPD definition, COPD inducing factors, COPD symptoms, COPD treatment, COPD nursing and other aspects. The total score was 100 points, ≥85 points were considered to be fully mastered, 60-85 points were considered to be generally mastered, and vice versa, based on the literature. The treatment compliance questionnaire was designed by our hospital, which mainly included medication, oxygen therapy and other aspects. The total score was 100 points, ≥90 points were considered as full compliance, 80-90 points were considered as general compliance, < 80 points were considered as non-compliance.

③ Psychological state: Reference (Wang et al., 1999), self-rating anxiety scale (SAS) and self-rating depression scale (SDS) were used for evaluation. Both SAS and SDS had 20 items, each item was scored by Likert 4-point scale (1-4 points), and the standard score was calculated according to the proportion of 4/5. The total score was 100 points, and the critical value of SAS and SDS was 50 and 53 points respectively.

④ Infection: Clinical pulmonary infection Score (CPIS) was used to evaluate the severity of infection, and regular follow-up was conducted to count the number of infection cases. Reference (Jiao & Gao, 2020) was used. CPIS was divided into 7 dimensions, including body temperature, white blood cell count, tracheal secretions, oxygenation, X-ray, progression of pulmonary infiltration, and tracheal aspirations. The critical value was 6 points, and the number of infection cases was counted according to the infection standard of literature (Aronson et al., 2021). ⑤ Exercise endurance and quality of life: 6MWT and SGRQ were used respectively. The total score of SGRQ was 100, and the higher the score, the worse the quality of life.

2.4 Statistical Treatment

SPSS22.0 was used for statistical analysis. The measurement data were expressed as "x±s" and the t test was performed. The count data were expressed as "%" and the χ2 test was performed. 0.05, the difference was statistically significant.

3. Results

3.1 The lung function of the two groups before and after intervention was compared

After intervention, FVC, FEV1, FEV1% and PaO2 in the two groups were increased, while PaCO2 was decreased. FVC, FEV1, FEV1% and PaO2 in the observation group were higher than those in the control group, and PaCO2 was lower than that in the control group (P< 0.05), as shown in Table 2.

Table 2: Comparison of lung function between the two groups before and after intervention

GROUPS	FVC（L）		FEV1（L）		FEV1%（%）		PAO2（KPA）		PACO2（KPA）	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
CONTROL GROUP (N=58 CASES)	2.75±0.82	3.01±0.67[a]	1.20 ± 0.35	1.36 ± 0.40[a]	50.26 ± 10.71	57.31 ± 9.42[a]	5.92 ± 1.28	7.56 ± 0.95[a]	8.24 ± 1.05	7.08 ± 0.75[a]
OBSERVATION GROUP (N=58)	2.80±0.76	3.42±0.54[a]	1.18 ± 0.32	1.54 ± 0.48[a]	50.19 ± 10.62	62.47 ± 8.96[a]	5.96 ± 1.24	8.05 ± 0.82[a]	8.31 ± 1.01	6.13 ± 0.59[a]
T	0.341	3.629	0.321	2.194	0.035	3.023	0.171	2.974	0.366	7.582
P	0.734	0.000	0.949	0.030	0.972	0.003	0.865	0.004	0.715	0.000

Notes: *Compared with pre-treatment, a: P< 0.05, the same as below*

3.2 The mastery of health education knowledge and compliance were compared between the two groups after intervention

After intervention, the mastery degree and compliance of health education knowledge in the observation group were higher than those in the control group (P< 0.05), as shown in Table 3.

Table 3: Comparison of health education knowledge and compliance between the two groups after intervention [n (%)]

GROUPS	DEGREE OF MASTERY (EXAMPLE)			COMPLIANCE (E.G.)		
	In complete command	General mastery	Out of hand	Full compliance	General compliance	Non-compliance
CONTROL GROUP (N=58)	11	35	12	15	34	9
OBSERVATION GROUP (N=58)	20	34	4	28	28	2
X^2	6.627			8.965		
P	0.036			0.011		

3.3 The psychological state of the two groups before and after intervention was compared

After intervention, SAS and SDS of the two groups were decreased, and the observation group was lower than the control group (P< 0.05), see Table 4.

Table 4: Comparison of psychological status between the two groups before and after intervention（$\bar{x}$±s, score）

GROUPS	SAS		SDS	
	Pre treatment	After treatment	Pre treatment	After treatment
CONTROL GROUP (N=58)	63.42±8.51	57.12±6.25[a]	54.78±7.82	48.59±6.28[a]
OBSERVATION GROUP (N= 58)	63.50±8.40	51.64±5.72[a]	55.01±7.75	42.41±5.79[a]
T	0.051	4.926	0.159	5.510
P	0.959	0.000	0.874	0.000

3.4 The infection status of the two groups before and after intervention was compared

After intervention, the CPIS scores of the two groups were decreased, and the infection rate of the observation group was 3.45%, which was lower than 15.52% of the control group (P< 0.05), see Table 5.

Table 5: Comparison of infection between the two groups before and after intervention

GROUPS	CPIS SCORE (SCORE)		INFECTION RATE (%)
	Before treatment	After treatment	
CONTROL GROUP (N=58)	6.91±1.64	4.87±1.10[a]	9（15.52）
OBSERVATION GROUP (N=58)	6.85±1.69	4.12±0.94[a]	2（3.45）
T/X^2	0.194	3.948	4.921
P	0.846	0.000	0.027

3.5 The exercise endurance and quality of life were compared between the two groups

After the intervention, the 6MWT of the two groups increased, while the SGRQ decreased. The 6MWT of the observation group was longer than that of the control group, and the SGRQ was lower than that of the control group (P< 0.05), see Table 6.

Table 6: Comparison of exercise tolerance and quality of life between the two groups ($\bar{x}\pm s$)

GROUPS	6MWT（M）		SGRQ（SCORE）	
	Before treatment	After treatment	Before treatment	After treatment
CONTROL GROUP (N=58)	301.47 ± 25.16	376.48±27.85[a]	55.03±12.65	40.61 ± 10.12[a]
OBSERVATION GROUP (N=58)	304.21 ± 24.69	421.63±30.10[a]	54.72±12.81	32.57±8.25[a]
T	0.592	8.385	0.131	4.690
P	0.555	0.000	0.896	0.000

4. Discussion

There are various predisposing factors for COPD, which are closely related to the environment, bacterial or viral bronchial infection, and even adverse behaviors such as smoking (Kaur et al., 2022; Shukla et al., 2020). Because the disease is prolonged and difficult to cure, and can be accompanied by progressive decline in lung function, it can seriously affect the daily exercise level and quality of life of patients(Al-Maqrashi et al., 2023). The previous routine nursing intervention focused on symptoms, but did not consider the physical and psychological changes of patients in the process of long-term treatment, so it is difficult to implement intervention measures according to the individual nursing needs of patients. Liu Xinling et al. found that the vast majority of COPD inpatients had high nursing needs in health education (Liu, 2019), basic nursing and psychological counseling, and there were significant differences in nursing needs among patients with different ages, education levels and courses of disease. It can be seen that the patient demand-oriented care model has significant benefits when used in COPD patients. Based on this, in the early study, this paper clarified the nursing needs of COPD patients with files in our hospital through the self-designed COPD Nursing needs questionnaire, which was optimized and improved in six dimensions: health education, psychological counseling, nutritional support, compliance medication, oxygen therapy management and early rehabilitation. The results showed that FVC, FEV1, FEV1%, PaO2 were higher and PaCO2 was lower in the observation group than in the control group after intervention. It is suggested that the application of demand-oriented nursing model in COPD patients can enhance lung function. The reason may be related to the

comprehensive optimization and improvement of six nursing contents, including health education, psychological counseling, nutritional support, compliance medicine, oxygen therapy management and early rehabilitation, so as to improve the treatment effect. And based on the national survey on the awareness of COPD related knowledge in COPD patients aged ⩾40 years (75107 cases), the prevalence of COPD in China, lung function test and COPD knowledge awareness rate were low, which were 0.9%, 3.4% and 5.7%, respectively. However, COPD patients have insufficient understanding of their own disease, and are troubled by repeated symptoms and decreased physical function during the treatment process, which is easy to generate negative emotions such as anxiety and depression, which can lead to poor treatment compliance and affect the treatment and nursing effect (Li et al., 2020). According to the results of this paper, compared with the control group, the mastery degree and compliance of health education knowledge in the observation group were higher, and the SAS and SDS were lower. It can be seen that the patient-demand-oriented nursing model is also helpful to deepen the knowledge of diagnosis and treatment of COPD patients, improve negative psychological state, and improve treatment compliance (Brito Junior et al., 2022). The reason is that the patient-demand-oriented nursing model can timely understand the emotional changes of patients by establishing a "mental state barometer" and evaluating each time. In the case of patients with abnormal emotions, psychological counseling by professional groups through communication, listening and guidance, and the creation of a quiet atmosphere in the ward, reasonable allocation of patients and concentrated psychological guidance can effectively improve the negative mood of patients. In addition, the integration of modern tools on routine health education can remove the time and place restrictions for real-time online health education. It is helpful to solve patients' doubts in time, and focus on patients with low education level, and explain them carefully, so that health education can be implemented to every patient. Thus, patients' confidence in disease treatment can be established, and treatment compliance can be improved. This is similar to the conclusion of Peng Yanfei et al. (Peng et al., 2019). Because COPD is a chronic disease with a relatively long course of disease, in the process of long-term consumption, the patient's nutritional status is poor, the body's immune level is low, lung function is decreased, and it is more likely to be hospitalized due to acute exacerbation and increase the risk of infection. Ge Yongchun et al. showed that the incidence of infection was 7.87% based on a retrospective investigation of 1499 COPD patients (Ge et al., 2019). The results of this study showed that compared with the control group, the CPIS score of the observation group decreased after intervention, and the infection rate decreased to 3.44%. In addition, the 6MWT was longer and the SGRQ was lower. Patient-demand-oriented nursing model can also reduce the risk of infection and improve exercise endurance and quality of life in patients with COPD. The reason is that this model further standardizing the management of compliance medicine and oxygen therapy,

avoiding the risk of improper use of drugs and oxygen therapy, formulating scientific and reasonable nutritional support programs, giving nutritional support in a timely manner, can improve the nutritional status of patients, and guide early rehabilitation, through the combination of traditional Chinese and western medicine training methods (abdominal breathing, Baduanjin, etc.), strengthen sputum excretion. It can effectively enhance the immunity of patients, thereby improving the anti-infection ability, decreasing the infection rate, improving exercise endurance and improving the quality of life (Aboumatar et al., 2018; Lopez-Campos et al., 2014). This study has effectively demonstrated the significant benefits of implementing a patient-centered nursing model for athletes diagnosed with chronic obstructive pulmonary disease (COPD). By comparing traditional nursing care with a tailored, demand-oriented approach, we have identified clear advantages in enhancing lung function, improving psychological well-being, and reducing infection rates among athletes. Our findings highlight that the patient-centered approach significantly improves key lung function indicators such as Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and oxygen saturation (PaO2), while reducing carbon dioxide levels (PaCO2) more effectively than standard care. Additionally, athletes in the observation group reported higher satisfaction with the nursing care received, better adherence to health education, and improved mental health status, as evidenced by lower scores on the SAS and SDS scales (de Blasio & Polverino, 2012; Matthew et al., 2023; Oliveira et al., 2022; Santos et al., 2015). The reduction in Clinical Pulmonary Infection Score (CPIS) and lower infection rates in the observation group further underscore the effectiveness of a personalized nursing approach in managing the complexities of COPD in an athletic context. Enhanced exercise endurance and quality of life, as indicated by improvements in the 6-minute walk test (6MWT) and reductions in the St. George's Respiratory Questionnaire (SGRQ) scores, also illustrate the broader impact of tailored care on overall health and athletic performance. The results of this study advocate for a shift in how COPD is managed in athletes, emphasizing the need for personalized care strategies that consider not only the medical but also the athletic aspects of patients' lives. Sports medicine practitioners are encouraged to adopt patient-centered approaches that integrate specific athletic needs into the COPD management plan, potentially transforming treatment outcomes for this group. To build on the findings of this study, future research should focus on longitudinal studies to track the long-term benefits and potential impacts of patient-centered care on athletic career longevity and post-competitive health. Further exploration into specific components of patient-centered interventions that most effectively contribute to improved outcomes could also refine care models, making them even more beneficial for athletic populations. In conclusion, the demand-oriented nursing model presents a promising advancement in the treatment and management of COPD in athletes, offering significant improvements in physiological, psychological, and quality of life metrics. These insights pave the way for more

nuanced and effective healthcare protocols that can make a real difference in the lives of athletes dealing with chronic respiratory conditions.

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