JURNAL ILMIAH ILMU KEPERAWATAN INDONESIA
Indonesian Nursing and Scientific Journal

Volume: 13
Issue: 03
Years: 2023

Research Article

Six Principles Energy Conservation Techniques for Respiratory Frequency and Oxygen Saturation in Chronic Obstructive Pulmonary Disease Patients

Michella Putri Pohaci[1], Suksi Riani[2*], Mugi Hartoyo[3]
[1]Nursing Study Program, Telogorejo Semarang College of Health Sciences, Indonesia
[*]Email Correspondent: suksi@stikestelogorejo.ac.id

Editor: KS
Received: 31/08/2023
Accepted: 11/10/2023
Published: 18/10/2023
Available Article: 10.33221/jiiki.v13i03.2730

Conflict of interest statement: This research has no conflict of interest either individually or organizationally, where this research was conducted independently by the entire team in this study.

Funding: STIKES Telogorejo Semarang.

Abstract

Background: Chronic obstructive pulmonary disease refers to chronic diseases, such as emphysema, chronic bronchitis, asthma, or a combination of them. The observed symptoms of chronic obstructive pulmonary disease include breathlessness, wheezing, repeated respiratory tract infection, losing weight, and prolonged fatigue.
Objectives: This research determined the influence of a 6-principle energy conservation technique on the respiratory frequency and oxygen saturation of Chronic Obstructive Pulmonary Disease (COPD) patients.
Methods: This quasi-experimental research applied one group pretest-posttest design. The research design was useful to measure the respiratory rate and oxygen saturation before and after the implementation of 6-principle energy conservation. The researcher involved 29 respondents taken by accidental sampling.
Results: The result showed the frequency mean before the intervention was 26.34 times per minute and after the intervention was 23.83 times per minute. The oxygen saturation, SpO2, before the intervention, was 97.17% while after the intervention was 96.76%. The Wilcoxon test found the influence of a 6-principle energy conservation technique toward the respiratory rate, a p-value of 0.000. On the other hand, the researcher did not find the influence of the 6-principle energy conservation technique on the COPD patient (p-value 0.944).
Conclusion: The researcher recommends the implementation of 6-principle energy conservation as the non-pharmacological intervention alternative to manage the abnormal respiratory rate of COPD patients.

Keywords: chronic obstructive pulmonary disease, energy conservation, oxygen saturation, respiratory rate

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable chronic respiratory disease.[1] COPD includes emphysema, chronic bronchitis, and asthma or a combination of all three.[2] Signs and symptoms of COPD patients are shortness of breath, wheezing sounds on auscultation examination, recurrent respiratory infections, weight loss, and prolonged fatigue.[1] According to WHO (2019), chronic obstructive pulmonary disease in the world is the third highest cause of death with 64 million patients and a COPD mortality rate of 3.23 million worldwide. The prevalence of COPD in Southeast Asia averages 6.3%, with the highest prevalence in Vietnam (6.7%).[3] Meanwhile, the results of the Basic Health Research (Riskesdas) in 2018 reported that the prevalence of COPD in Indonesia was 3.7%.[4] The prevalence of COPD in Central Java Province based on the Health Handbook in 2021 quarter 1 was 1.23% with a total of 10,797 cases.[5] Data from RSUD Dr. Gondo Suwarno Ungaran on the incidence of COPD from 2022 to March 2023 showed that there were 373 cases of COPD with most patients already experiencing acute to chronic exacerbations. The results of interviews and observations in 5 COPD patients on average complained of frequent shortness of breath, shortness of breath, and feeling tired quickly when doing activities in the inpatient room such as going to the toilet, dressing, eating, moving positions, and bathing in bed. Meanwhile, oxygen saturation in 5 COPD patients averaged in the range of 96% - 98% in 1 time measurement.

Individuals with COPD experience physical problems, with the main symptom that most often appears is shortness of breath (dyspnea).[6] Shortness of breath that appears can interfere with daily activities, this occurs because of the ability of the lungs to decrease and is characterized by limited airflow or persistent and progressive airflow resistance due to a chronic inflammatory response in the respiratory tract that continuously occurs due to exposure to pollution, harmful particles and gases and smoking habits.[7] The incidence of shortness of breath (dyspnea) in COPD patients causes inhibition of activities and functional status such as eating, bathing, dressing, elimination, mobilization, and especially doing strenuous activities.[8] Nursing actions that can be given to COPD patients to overcome the problem of COPD symptoms that arise such as shortness of breath, fatigue, inhibition of activity, changes in respiratory frequency, and oxygen saturation can be given nursing actions, namely by teaching and providing pulmonary rehabilitation measures.[9]

Pulmonary rehabilitation aims to restore the patient's independence in carrying out daily activities consisting of physical exercises to train breathing (pursed lip breathing exercises, postural drainage, and chest physiotherapy), exercise (walking, running, and cycling), health education, extremity training, and education related to self-management, namely energy conservation techniques.[10] This energy conservation technique consists of 6 principles, namely Prioritize your activities, Plan your schedule, Pace yourself, Positioning, Pursed Lips Breathing, and Positive attitude.[11] These techniques are taught directly over a certain period based on the progressiveness of COPD, symptoms of shortness of breath, fatigue, and decreased activity due to energy insufficiency.[12] Education is given gradually and in the order of energy conservation principles, carried out over the next few days but still under supervision.[13] According to the results of research on energy conservation techniques conducted by Rochester (2014) after performing several activities, lung capacity during exercise, symptoms of shortness of breath, and pulse frequency were measured again. The results show that there is an effect as evidenced by (change in the outcome: exercise capacity +) or lung capacity during exercise shows a positive effect on all recommended activities so that it can be achieved maximally with a p-value = 0.0227. However, after being given treatment to COPD patients and re-measured, there was no effect in overcoming the problem of shortness of breath symptoms that arise when doing activities (change in the outcome: -) with a p-value = 0.167.[14]

Based on the existing phenomena and the results of previous studies, some other research results show that there is an effect before and after treatment, but some other

studies only partially show an effect and are even insignificant in the results of the examination of respiratory frequency and oxygen saturation between before and after treatment. Therefore, researchers are interested in re-examining and knowing the effect of the 6-principle energy conservation technique on respiratory frequency and oxygen saturation in COPD patients at RSUD dr. Gondo Suwarno Ungaran.

Methods

This research design uses a quasi-experimental research method (pre-experiment) with a one-group pre-test and post-test design. The instrument used in this research is an observation sheet that is used to observe respiratory frequency and oxygen saturation. Respondents conducted a pre-test (initial observation) by measuring respiratory frequency and oxygen saturation before being given the 6-principle energy conservation technique, then providing the 6-principle energy conservation technique, then conducting a post-test (final observation) by measuring respiratory frequency and oxygen saturation again carried out on the same individual. Steps for providing the 6-principle energy conservation technique are prioritizing your activities, planning your schedule, pacing yourself, positioning, pursed lips breathing, positive attitude. This technique trains patients to be able to manage energy expenditure to treat or prevent fatigue and optimize lung function.

The population in this study were all patients with chronic obstructive pulmonary disease at RSUD dr. Gondo Suwarno Ungaran had as many as 373 patients so the average per month was 32 patients. This study uses an accidental sampling technique that considers inclusion criteria and exclusion criteria. Inclusion criteria in this study are compositional consciousness, the patient not receiving oxygen therapy and mild and moderate levels of COPD exacerbation. Exclusion criteria in this study are emergency conditions, not cooperative, daily living activities being fully assisted, and having lung cancer. Data analysis in this research is univariate analysis and bivariate analysis. Univariate analysis in this study includes data on respondent characteristics such as age, gender, smoking history, comorbidities, and length of COPD illness, as well as changes in respiratory frequency and oxygen saturation. Bivariate analysis using statistical tests when processing the data. The Wilcoxon Test to determine the effect of the 6-principle energy conservation technique on respiratory frequency and oxygen saturation in COPD patients at RSUD Dr. Gondo Suwarno Ungaran. The test results can be said to have an effect if the p value ≤ 0.05, and it is said that there is no effect if the p value> 0.05. This study passed the ethical test with No: 067/IV/KE/STIKES/2023.

Results

Table 1. Characteristics of Respondents Based on Age, Gender, Length of Suffering, Comorbidities, Occupation, Smoking History in COPD Patients

Characteristics of Respondents	Frequency (f)	Percentage (%)
Age		
Age 18 – 30	1	3.4
Age 30 – 60	10	34.5
Age > 60	18	62.1
Gender		
Male	18	62.1
Female	11	37.9
Duration of Suffering		
Sick ≤ 5 Years	21	72.4
Sick > 5 Years	8	27.6
Comorbidities		
Chronic Heart Disease	7	24.2

Diabetes Mellitus	1	3.4
None	21	72.4
Occupation		
Work	10	34.5
Doesn't Work	19	65.5
Smoking History		
Smoking	17	58.6
No Smoking	12	41.4
Total Respondents	29	100

Based on Table 1, it can be seen that the age of most respondents is the age range > 60 years, namely 18 (62.1%) respondents. The most common gender is male 18 (62.1%) respondents with COPD illness duration ≤ 5 years, namely 21 (72.4%). Most COPD patients do not have comorbidities with several respondents 20 (69.0%) who do not work as many as 19 (65.5%) respondents and have a history of smoking as many as 17 (58.6%) respondents.

Table 2. Respiratory Frequency Before and After Being Given the 6-Principle Energy Conservation Technique in COPD Patients

Variables	Mean	Std. Deviation	Minimum	Maximum
Breathing Frequency Before	26.34	5.709	15	35
Breathing Frequency After	23.83	4.622	15	30

Table 2 shows that the average respiratory frequency before the intervention was 26.34 times/minute and after the intervention was 23.83 times/minute. The standard deviation value of respiratory frequency before the intervention was 5.709 and after the intervention, the standard deviation value was 4.622. This means that the respiratory frequency values before and after each sample member are similar and accurate because the standard deviation value is smaller than the mean value.

Table 3. Oxygen Saturation Before and After Being Given the 6-Principle Energy Conservation Technique in COPD Patients

Variables	Mean	Std. Deviation	Minimum	Maximum
Oxygen Saturation Before	97.17	2.285	88	99
Oxygen Saturation After	96.76	4.595	74	99

Table 3 shows that the average oxygen saturation before the intervention was 97.17% and after the intervention was 96.76%. The standard deviation value of oxygen saturation before the intervention was 2.285% and after the intervention the standard deviation value was 4.595. The meaning is that the value of oxygen saturation before and after the intervention for each sample member is similar and the value is accurate because the standard deviation value is smaller than the mean value.

Table 4. Effect of 6-Principle Energy Conservation Technique on The Respiratory Frequency of COPD Patients

Respiratory Frequency		N	Mean Rank	Sum of Ranks	Z	P value
Pre-Post	Negative Ranks	25	15.14	378.50	-3.503	0.000
	Positive Ranks	4	14.13	58.50		
	Ties	0				
	Total	29				

Table 4 shows that the p-value = 0.000 means that there is an influence between the 6-principle energy conservation technique on the respiratory frequency of COPD patients. The results of the negative rank value or those who experienced a decrease in respiratory frequency values after being given the intervention of the 6-principle energy conservation technique were 25 respondents. While the positive rank or who experienced an increase in respiratory frequency value was only 4 respondents.

Table 5. Effect of 6-Principle Energy Conservation Technique on Oxygen Saturation Of COPD Patients

Oxygen Saturation		N	Mean Rank	Sum of Ranks	Z	P value
Pre-Post	Negative Ranks	9	12.61	113.50	-0.070	0.944
	Positive Ranks	12	9.79	117.50		
	Ties	8				
	Total	29				

Table 5 shows that the p value = 0.944 means that there is no intermediate influence between the 6-principle energy conservation technique on the oxygen saturation of COPD patients. The results of the negative rank value or those who experienced a decrease in oxygen saturation values after being given the intervention of the 6-principle energy conservation technique were 9 respondents. While the positive rank or who experienced an increase in oxygen saturation value was 12 respondents. Meanwhile, 8 respondents did not experience changes in oxygen saturation.

Discussion

The results of this study show that the majority of respondents were over 60 years old. Based on data from Riskesdas (2018) the number of people with COPD was 40,180 with an age range of 65 - 74 (5.8%) years. The elderly will experience a decrease in the function of several organs, including a decrease in lung function.[8] Physiological changes occur in the age range of 60 - 74 more, the muscles of the chest wall and lower respiratory organs experience a decrease in function so that they are susceptible to infection and airway obstruction occurs, this disrupts oxygen supply and lung ventilation, and lung elasticity decreases, resulting in a risk of COPD.[15] In this study, most COPD respondents were men. Risk factors for COPD are greater in men, one of which is caused by smoking (Monica and Sutanto, 2020). According to data from the National Socio-Economic Survey (SUSENAS) (2020), 68% of the Indonesian male population has an active smoking habit. Some studies report that more than 50% of smokers will develop COPD although not all smokers suffer from COPD as many as 25-30% of smokers will be at risk of COPD.[16] Comorbidities appear in COPD patients differently, caused by risk factors such as age, genetics, and lifestyle.[17] The theory described by Yin et al. (2017) there is a relationship between comorbidity and age level, the prevalence of comorbidity is significantly higher in older patients (aged >70 years) with more severe COPD exacerbations. In this study, COPD respondents who had heart disease were 63-73 years old, diabetes mellitus was on average 57 years old and hepatitis was 51 years old. Another supporting theory explains that as many as 90% of elderly COPD patients aged 60 years and over can have at least one comorbidity.[18]

COPD patients in this study, on average over 60 years of age, had a history of working as laborers and factory employees, after being sick they did not work, this is by Van Der Molen's theory (2018)[19] that elderly COPD patients have worked with smoking habits, and work in dusty environments. Dusty environments with high pollution have dust particles that easily enter the upper respiratory organs, causing respiratory tract disorders.[20]

Continuous exposure to dust and pollution increases morbidity in respiratory tract disease symptoms which will be chronic so that it can interfere with activities.[21] In this study, 17 respondents had a history of smoking (58.6%) of respondents. Research conducted by Ghofar (2014) on "The Relationship between Smoking Behavior and the Incidence of COPD at the Cempaka Pavilion, Jombang Hospital" showed that COPD patients with a history of smoking were 15 (86.7%). Individuals with smoking behavior occur changes in the structure and function of the airway and lung tissue because mucosal cells undergo hypertrophy or enlargement and excessive mucus production as a result small respiratory tracts easily cause mild inflammation and can also cause narrowing due to the accumulation of secretions. In addition, there is an increase in the number of inflammatory cells and damage to the alveoli as a result there are changes in lung function in smokers.[22]

Velloso and Jardim (2016) explain that the use of energy conservation techniques during pulmonary rehabilitation helps reduce energy expenditure during activity and reduce shortness of breath. High respiratory frequency with short expiratory time causes dynamic hyperinflation. COPD patients while using conservation techniques experienced a 60% decrease in tidal volume and a 60% increase in expiratory time. Changes in tidal volume cause a decrease in dynamic hyperinflation resulting in a decrease in shortness of breath. In addition, there is a metabolic decrease and changes in ventilation function at inspiratory and expiratory times so that shortness of breath and fatigue are reduced during activities.[23] Palinggi (2018) explains that the 6-principle energy conservation technique is taught to COPD patients with mild to moderate degrees of obstruction and exacerbation levels so that it can further assist in recovery to increase lung inspiration and expiration. This technique trains the respiratory organs periodically and continuously to improve lung function, especially the muscles of the pulmonary diaphragm, and increase activity tolerance to exercise gradually so that patients with symptoms of shortness of breath and fatigue can gradually decrease.[24] The theory described by Theander et al. (2019) energy conservation techniques can improve lung functional capacity, but not improve the structure of the lung organs. Factors that can affect changes in oxygen saturation (SpO2) in COPD patients are body temperature, blood pH, PO2, PCO2, lung function quality, and activity.[25] Activity results in an increase in blood PO2 and PCO2 in systemic capillaries, and carbon dioxide diffuses from blood cells, causing a decrease in hemoglobin activity to oxygen in the blood.[15] Changes in body performance during activity when followed by poor lung function quality, make the body adapt to these conditions with low saturation levels.[26]

There are research results that say there is an effect of energy conservation techniques on oxygen saturation, based on the theory described by Hafiizh (2013) explaining that energy conservation techniques work by increasing the partial pressure of oxygen in the arteries (PaO2), which causes a decrease in pressure on oxygen demand in the body's metabolic processes, thus causing a decrease in shortness of breath. In addition, energy conservation techniques can increase tidal volume and reduce symptoms of air trapping or air trapped in the alveoli, reduce hyperinflation, thereby improving ventilation and perfusion, and reduce the level of PaCO2 content in the blood as a result of an increase in hemoglobin-bound oxygen and an increase in PaO2 levels.[27]

Researchers stated that from the results of this study, the provision of energy conservation techniques is given in stages, namely 3 principles are taught first and the next 3 principles are taught at a later stage, with the aim that patients better understand the principles to be carried out, after which the 6 principles are applied simultaneously when patients move. Based on the results of related research, it can be concluded that there is an effect of the 6-principle energy conservation technique on respiratory frequency before and after intervention and there is a significant decrease in respiratory frequency values after

being given the intervention of the 6-principle energy conservation technique. Researchers stated that from the results of research and related research, there is no significant effect on oxygen saturation. There is a possibility that the provision of the 6 principles of energy conservation technique given in stages results in the patient's understanding when applying the technique being lacking so that the existing time lag causes rapid changes in oxygen saturation after applying the energy conservation technique to be unmeasurable. Lung functional factors, PO2 and PCO2, and activity result in an increase in blood PO2 and PCO2 in systemic capillaries, carbon dioxide diffuses from blood cells, causing a decrease in hemoglobin activity towards oxygen in the blood and then a decrease in oxygen saturation.

Conclusion

The results of this study showed the effect of the 6-principle energy conservation technique on the respiratory frequency of COPD patients. However, there is no effect of the 6-principle energy conservation technique on the oxygen saturation of COPD patients. The research carried out was limited by the short duration of the intervention so during the intervention the patient did not fully understand and apply the 6 principle energy conservation techniques correctly. Researchers could not control the activities carried out by respondents outside the time of intervention which could trigger shortness of breath.

Conflict of Interest Declaration

This research has no conflict of interest either individually or organizationally, where this research was conducted independently by the entire team in this study.

Acknowledge

The researcher declares that the data obtained from the results of this study are correctly stated using appropriate research methods and have passed the research ethics test. The researcher would like to thank the entire research team involved especially STIKES Telogorejo Semarang for facilitating this research.

Funding

This research was funded by STIKES Telogorejo Semarang.

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