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Determining effect of controlled breathing on sleep quality in patient with chronic obstructive pulmonary disease

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ABSTRACT

Background & Aim: The aim of this clinical trial study was to evaluate sleep quality in patients with chronic lung disease and the role of controlled breathing to improve the quality of sleep.

Methods & Materials: Sixty-four patients with chronic lung disease in two group (experimental and control group) enrolled in a 7 weeks. Before interventions, the Pittsburgh Sleep Quality Index (PSQI) and the Demographic Information Questionnaire were completed by the samples in the control and intervention groups. Next, the pursed-lip breathing, diaphragmatic breathing and coughing techniques were taught to the experimental group, whereas the control group received the typical treatments. Seven weeks after the breathing exercises the PSQI was once again completed by the samples in the control and intervention groups. The resulting data were analyzed using SPSS.

Results: The results show that after controlling the differences of mean groups sleep quality scores in pre-exam, the intervention (breathing exercises) has affected on the means of the dependent variable scores (quality of sleep) in post-exam ($P < 0.001$). In other words, the sleep quality of intervention group has improved.

Conclusion: The researcher recommends the administrators, decision makers, and members of treatment groups to use non-pharmacologic methods and incorporate controlled breathing exercises into the sleep management and improvement programs designed for patients with chronic obstructive pulmonary disease.

Introduction

With non-communicable conditions accounting for nearly two-thirds of deaths worldwide, the emergence of chronic diseases as the predominant challenge to global health is undisputed (1). In its 2010 report on the global status of the challenges presented by chronic diseases, World Health Organization (WHO) noted that non-communicable conditions – including cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases accounted for nearly two-thirds of deaths worldwide (2). In the USA, chronic diseases are the main causes of poor health, disability, and death, and account for most of health care expenditures (1). Teaching patients is a necessary duty that has to be accomplished by nurses and other professionals dealing with chronic diseases. According to the definition by the WHO, treatment training helps patients obtain the skills and solutions required for adapting their lives with their chronic diseases. It also helps the patients and their families understand the diseases, the treatments and solutions to the improvement of life quality. These trainings include the following: provision of mental support; design of master plans for becoming familiar with patients, the required cares and hospitals; treatment measures; and provision

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of training on disease-related behavior to patients (3). Patient education is the combination of learning experiences that help to protect the health and develop changes in individuals' behaviors. The aim is to help patients increase their decision-making skills related to health care by correcting their health-related behaviors and enabling them to cope with diseases. In recent years, patient education has been regarded as a key to increasing levels of adaptation and satisfaction, decreasing costs, decreasing morbidity and mortality, improving life quality and increasing patient autonomy (4). One of the existing chronic diseases is chronic obstructive pulmonary disease (COPD), which is a preventable and curable disease. This disease is characterized by the progressive and irreversible limitation of the airways and chronic inflammation of the airways (5). This disease is caused by a combination of diseases of the small airways (obstructive bronchitis) or destruction of the lung parenchyma (emphysema) (6). Although the mortality caused by diseases such as cardiovascular diseases and stroke has reduced considerably in the past 20 years, the mortality caused by COPD is still increasing. The main cause of this increasing trend is the continuation of smoking cigarettes in the developed countries (7). According to the WHO statistics, 65 million people suffer from COPD around the globe, and about 90% of the moralities caused by this disease occur in low- to average-income countries (8). According to the GOLD estimations, by 2020 COPD will be the third cause of mortality and the fifth cause of disability in the world (9). Based on the WHO report, the mortality caused by COPD in Iran is equal to 26.3 in 100,000 people and the disability resulted from this disease is 395 in 100,000 people (10). Sleeping is one of the necessities of life and accounts for about one-third of our lifetime. It also plays an important role in the improvement of health and performance of humans. Similar to activity and food, sleeping also acts as a regulator that contributes to our physical growth, maturity, and health. Also, sleeping also plays an important role in protein synthesis and growth and repair of the body. On the other hand, sleep deprivation leads to cognitive problems, consciousness disorders, problems with emotional stability risk-taking, increased appetite, and lack of glucose tolerance (11). Sleep disorders are one of the common health concerns and directly affect the life quality of patients (12). One of the most important disorders experienced by COPD patients is a sleep disorder, which is the third common condition experienced by COPD patients after dyspnea and fatigue (13). That is to say, about 40% of COPD patients under study complained about sleep disorders (14). Delayed sleeping, reduction in the rapid eye movement stage of sleep, reduced length of effective sleep and rapid variations in sleep stages were observed and reported in patients with COPD (15). Most COPD patients have problem sleeping that is caused by coughing and sputum production. Moreover, these patients also suffer from other problems such as nocturnal oxygen desaturation which increases sleep problems (12). The low sleep quality in patients with chronic diseases leads to a reduction in the life quality of patients. Therefore, in patients with COPD low sleep quality also reduces life quality (16). In the past, treatment measures taken for COPD patients were mostly focused on preventing and inhibiting the worsening of conditions as well as recovering the patients using medicines without the considering the needs of the patients. However, today pulmonary rehabilitation (PR) is considered a non-pharmacological method which is focused on the needs of patients and their families (17). The PR program is a combination of exercises, and training and conduct programs. These programs are aimed to help the patients with COPD so that they can control their symptoms and improve their daily activities (18). The effective breathing techniques include diaphragmatic breathing, pursed-lip breathing, and deep breathing. These are part of the PR program that should be taught to the companion(s) of each patient in the self-care training courses (19). Diaphragmatic breathing reduces the breathing speed and increases alveolar ventilation (20). Pursed-lip breathing contributes to the reduction in the speed of exhaling, prevention of small airways collapse, and control of the speed and depth of breaths. This technique helps the patient control his/her dyspnea and relax by the

decrease in the stress levels. Pursed-lip breathing during exercise accelerates recovery of the body and reduces breathing speed after the exercise (21). Various studies have been conducted on the effect of PR programs on patients with COPD. Results of these studies indicated that PR programs improve the life quality, increase activity tolerance, reduce fatigue, and improve the clinical condition and sleep quality of patients. However, no study has so far investigated the effect of controlled breathing exercises (including the pursed-lip breathing technique, diaphragmatic breathing, and coughing) on sleep quality. Hence, due to the significance of the sleeping in the life of COPD patients and the importance of patient trainings, the researcher decided to carry out a study titled "Analysis of the effect of controlled breathing exercises on the sleep quality of COPD patients."

Methods

This was a semi-experimental study in patients enrolled in the controlled breathing program during a 7 weeks period from July to September, 2014. Selection criteria for PR included: age ≥ 25 years; diagnosis of chronic lung disease confirmed by medical history, physical examination, and clinically stable (no recent acute respiratory exacerbation, normotensive with or without medication, no symptoms of acute heart failure or coronary symptoms, and no other medical conditions that would interfere with full participation in the program). According to the article, Zohal et al., and the reliability and validity of the 95% and 99%, the number of samples for each group based on the following formula equal to 6/25 patients (of 26) will be in each group.

$$n = \frac{(S_1^2+S_2^2)(Z_{1-\frac{\alpha}{2}}+Z_{1-\beta})^2}{(\overline{x_1}-\overline{x_2})^2}$$

$$n = \frac{(3.66^2+2.8^2)(2.57+1.96)^2}{(8.03-4.2)^2} = 25.6 \cong 26$$

By calculating the loss of 20% of the samples, 32 patients in each group, and a total 64 COPD patients is studied. In this random clinical trial, 64 patients with COPD who were hospitalized in the internal diseases section of the Shariati and Imam Khomeini treatment and training centers were selected using a random method and were put into the following two groups: experimental group and control group. The pursed-lip breathing, diaphragmatic breathing, and coughing techniques were taught to the experimental group whereas the control group received the typical treatments. Breathing exercises were taught to the samples in the experimental group in a 2 hours session. Afterward, a training package, including an illustrated manual and CD of relevant breathing exercises were delivered to the patients. Data collection tools in this study included demographic data form and Pittsburgh Sleep Quality Index (PSQI). The demographic data form included questions about age, gender, educational degree, number of children, insurance status, employment status, cigarette smoking, pipe smoking and the use of opioids, the number of hospitalization in year, smoking cessation and marital status. Sleep quality was evaluated with the PSQI (28). The PSQI consists of 19 items and provides a well-validated global index of sleep quality over the previous 1-month time interval. It can be divided into 7 components that evaluate various aspects of sleep quality: subjective sleep quality; latency, duration, efficiency, and disturbances of sleep; use of sleep medication; and daytime dysfunction. The global PSQI score has a range of 0-21, with higher scores indicating worse sleep quality. PSQI > 5 is generally considered to be an indicator of poor sleep quality. Before the interventions, the PSQI and the Demographic Information Questionnaire were completed by the samples in the control and intervention groups. Eight weeks after the breathing exercises the PSQI was once again completed by the samples in the control and intervention groups. The article, with the registration number IRCT2014060717989N1 was registered in the Iranian Registry of Clinical Trial. Data from the questionnaire, using SPSS software (version 21, SPSS Inc., Chicago, IL, USA) was analyzed. For analyze the data, chi-square test, Fisher test, independent t-test, paired t-test, analysis of variance, Pearson correlation, multivariate analysis of variance and covariance analysis were used.

Results

Sixty-four patients (41 males and 23 females)

are aged 30-86 years (mean ± standard deviation = 66.62 ± 1.70 years) were included in the study. The demographics and baseline characteristics of the studied population are shown in table 1. Poor quality of sleep (PSQI < 5) was present in 50 patients (78.1%). In this study, the effect of controlled breathing exercises on the sleep quality of patients with COPD was examined. The inequality of sleep quality in the control and intervention groups could affect the results as an intervention variable. Therefore, the researcher carried out a basic assessment to determine the score of sleep quality of participants prior to the intervention. Hence, to attain the first goal that was "to determine the pre-intervention sleep quality of COPD patients in the two groups." Table 2 was used, and the pre-intervention sleep quality of patients was analyzed. The average sleep quality scores in the experimental and control groups were 10.9 and 11, respectively. Results of the independent t-test method, which was shown in table 2, suggest that no significant statistical difference exists between the sleep quality of the study groups (= 0.937).

In the attempt to "determine the sleep quality of COPD patients in the control and experimental groups after teaching controlled breathing exercises" the following results were obtained: The average sleep quality score for the control group was 11, whereas the average sleep quality score for patients in the intervention group was 7. Therefore, a significant statistical difference can be observed between the results of obtained prior to the intervention and following the intervention (= 0.001) (Table 2).

Also, to determine whether breathing exercises can improve the sleep quality of patients, the test "covariance analysis" was used. Results of table 3, show that after controlling the differences of mean groups sleep quality scores in pre-exam, the intervention (breathing exercises) has affected on the means of the dependent variable scores (quality of sleep) in post-exam (P < 0.001). In other words, the sleep quality of intervention group has improved (Figure 1). Given the size of the effect, it can be said that 67.6% of dependent variable changes in the post-exam is due to the intervention (Table 3).

Discussion

The results of this study suggest that sleep is severely disturbed in patients with COPDs. Also, in patients with COPD sleep quality improves significantly after controlled breathing include; pursed-lip breathing, diaphragmatic breathing, and effective cough. Because improvement in sleep quality after controlled breathing has not been reported previously, this may represent an important health issue not adequately addressed in current controlled breathing programs and guidelines. Epidemiological

Table 1. Notable demographic variables of the patients in control and experimental groups

Variable	Control group N (%)	Experimental group N (%)	P value
Age	64.68	68.56	0.264
Sex			
Male	22 (66.8)	19 (59.4)	0.434
Female	10 (31.2)	13 (40.6)	
Marriage			
Married	24 (75)	26 (81.2)	0.545
Single	8 (25)	6 (18.8)	
Degree			
Illiterate	18 (56.2)	21 (65.6)	
Diploma	11 (34.4)	7 (21.9)	0.532
Academic	3 (9.4)	4 (12.5)	
Smoking			
Yes	22 (68.8)	22 (68.8)	Similar
No	10 (31.2)	10 (31.2)	
Exposure to smoke			
Yes	25 (78.1)	22 (68.8)	0.396
No	7 (21.9)	10 (31.2)	

Table 2. Compare the sleep quality of COPD patients in the control and experimental groups before and after teaching controlled breathing

Variable	Group	Status	Mean ± SD	Paired t-test
Subjective sleep quality	Experimental	Pre-test	1.96 ± 0.822	< 0.001
		Post-test	1.12 ± 0.751	
	Control	Pre-test	2 ± 0.803	0.572
		Post-test	1.96 ± 0.822	
Sleep latency	Experimental	Pre-test	1.43 ± 1.04	< 0.001
		Post-test	0.875 ± 0.751	
	Control	Pre-test	1.4 ± 1.07	0.161
		Post-test	1.34 ± 1.03	
Sleep duration	Experimental	Pre-test	1.9 ± 0.777	< 0.001
		Post-test	1.03 ± 0.739	
	Control	Pre-test	1.96 ± 0.782	0.325
		Post-test	2 ± 0.762	
Sleep efficiency	Experimental	Pre-test	2 ± 0.803	< 0.001
		Post-test	1.06 ± 0.8	
	Control	Pre-test	2.09 ± 0.777	0.662
		Post-test	2.06 ± 0.759	
Sleep disturbance	Experimental	Pre-test	1.53 ± 0.983	< 0.001
		Post-test	1.03 ± 0.822	
	Control	Pre-test	1.56 ± 0.948	0.999
		Post-test	1.56 ± 0.913	
Use of sleep medication	Experimental	Pre-test	1 ± 0.803	0.161
		Post-test	0.937 ± 0.8	
	Control	Pre-test	1 ± 0.803	0.999
		Post-test	1 ± 0.803	
Daytime dysfunction	Experimental	Pre-test	1.06 ± 0.8	0.044
		Post-test	0.937 ± 0.759	
	Control	Pre-test	0.968 ± 0.822	0.184
		Post-test	1.06 ± 0.8	
Total score of sleep quality	Experimental	Pre-test	10.9 ± 4.84	< 0.001
		Post-test	7 ± 4.45	
	Control	Pre-test	11 ± 4.65	0.999
		Post-test	11 ± 4.38	

COPD: Chronic obstructive pulmonary disease, SD: Standard deviation

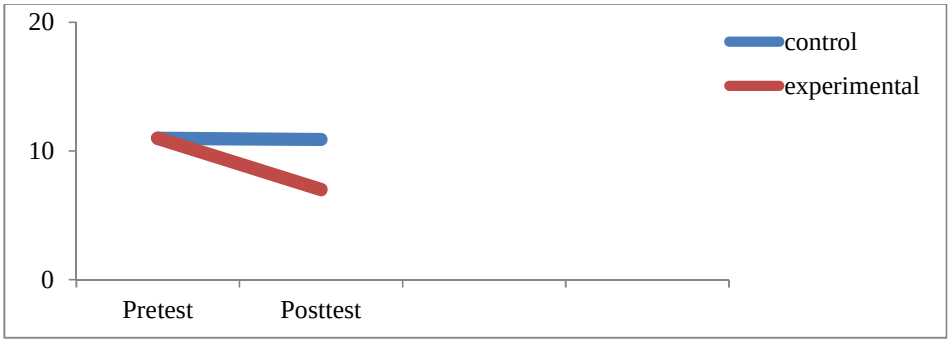

Figure 1. The average sleeps quality in chronic obstructive pulmonary disease patients of the pre-test to post-test in the intervention and control groups

Table 3. The results of analysis of covariance to compare sleep quality average COPD patients participating in the study, with regard to the group

Source	Total squares	Degree of freedom	Mean squares	F	Significant	Effect size	Power of test
Pre-exam	1092.21	1	1092.21	565.26	< 0.001	0.903	0.1
Group	245.48	1	245.48	127.12	< 0.001	0.676	0.1
Error	117.78	61	1.93				

COPD: Chronic obstructive pulmonary disease

studies have demonstrated a higher risk of cardiovascular disease, lower quality of life, and increased health care costs in patients with various sleep disorders. Published large epidemiologic studies found a similar prevalence of poor sleep in the elderly, comparable to our results. In a study of Nunes et al. which aims to determine the effect of sleep quality on the quality of life in patients with COPD, 30 ambulatory-based patients attending the COPD Clinic at the University Hospital of the Federal University of Ceara, Brazil were studied. Poor quality of sleep (PSQI < 5) was present in 21 patients (70%). In this study, the effect of controlled breathing exercises on the sleep quality of patients with the COPD was examined. Research results showed that controlled breathing exercises lead to the improvement of sleep quality of patients with COPD ($P < 0.001$). Other studies have been done that is in accordance with the results of this study. In a study by Soler et al., in 2013, the effect of the rehabilitation program included breathing exercises; individual and group psychological support, and training were evaluated in 64 patients with COPD. The results showed that rehabilitation program led to a significant improvement in dyspnea, exercise tolerance, sleep quality, efficacy and quality of life of the participants that the results of this study are accordance with the current study (12). Therefore, the researcher recommends the administrators, decision makers, and members of treatment groups to use non-pharmacologic methods and incorporate controlled breathing exercises into the sleep management and improvement programs designed for patients with COPD. The training on the application of these methods should also be available through pamphlets, CDs, and training courses to patients with COPD. The teachings should be also provided to the public through mass media and should be presented to the researchers and authorities by publishing research findings in journals and books. The use of these practices and methods should also be promoted. The researchers hope that the findings of this research are used in the treatment and research centers and are considered by authorities in making decisions.

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Conflict of interest

The authors declare no conflict of interest.

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