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Influence of Breathing Exercise Education Applied on Patients with Heart Failure on Dyspnoea and Quality of Sleep: A Randomized Controlled Study

Oz Alkan H[1]*, Uysal H[1], Enç N[1] and Yigit Z[2]

[1]*Medical Nursing Deparment, Istanbul University, Turkey*
[2]*Department of Cardiology, Istanbul University Cardiology Institute, Turkey*

**Corresponding e-mail: havvaoz@hotmail.com*

ABSTRACT

The research has been conducted experimentally in randomized controlled way on total 56 patients for determining influences of breathing exercise education on dyspnoea level and quality of sleep on patients with heart failure. ***Methods:*** *Basal Dyspnoea Index (BDI) and Pittsburgh Sleep Quality Index (PSQI) were applied to patients in experiment (breathing exercise training was given) and control group in the study at the first visit and at the end of twelve weeks.* ***Results:*** *While there isn't any difference between experiment and control group for dyspnoea level and sleep quality before training, it has been determined that dyspnoea level was lower in the group having breathing exercises at the end of 12th week ($p<0.001$). While improvements were observed in sleep quality both in experiment ($p<0.001$) and control group ($p<0.039$) at the end of 12th week, it has been seen that improving of sleep quality in experiment group was much better.*

Keywords: Heart failure, Dyspnoea, Sleep, Breathing exercises

INTRODUCTION

Chronic heart failure is an important cause of mortality and morbidity despite medical developments. Most marked symptom of heart failure is shortness of breath (dyspnoea). Dyspnoea is that the patient conscious about increased respiratory effort. This condition may appear at rest or with minimal activity. Patient is aware of failure in taking sufficient breath. Hypoxemia causes dyspnoea in patients with acute pulmonary oedema. However, dyspnoea is also seen in patients on whom more chronic type of heart failure is seen and who doesn't have direct relation with raised pulmonary capillary blood pressure or other hemodynamics. Similarly, level of dyspnoea isn't simply associated with death space inhalation. Chronic dyspnoea at rest or with minimal activity appears depending on multiple peripheral mechanisms including tiredness of respiratory muscles, increase of physiological death area, decreased pulmonary compliance, increased airway resistance, endothelial dysfunction, abnormal skeletal muscle metabolism [1]. Dyspnoea influences daily functions [2], physical activity [2] and the quality-of-life [3,4] negatively by increasing risk of development of sedentary life style in patients.

It is known that sleep quality is poor in patients with heart failure [5]. Cause of sleep disturbances in heart failure is symptoms of heart failure such as paroxysmal nocturnal dyspnoea, orthopnoea, Cheyne-stokes respiration, cough, palpitation, tiredness and nocturia [6]. Death anxiety experienced especially due to dyspnoea prevents patients to get into sleep [7].

Decreasing symptoms developed due to disease in patients with heart failure increases quality-of-life and therefore, helps arranging sleep of patient. For this reason, it is primarily targeted to decrease symptoms [7].

Purpose

Although there are researches examining influence of exercise training program and inspiratory muscle training in patients with cardiac failure, any study hasn't been seen showing influence of breathing exercises on symptoms and sleep quality. This study has been conducted in order to determine effects of breathing exercise training on dyspnoea level and sleep quality in patients with cardiac failure. We hypothesize the following:

- Participants assigned to either intervention group were expected to more reduction in dyspnoea level when compared with the control group.
- Participants assigned to either intervention group were expected to more increase in sleep quality when compared with the control group.

MATERIAL AND METHODS

Study design

The research has been conducted in a randomized controlled way between February 01, 2014 to September 01, 2014 in University Cardiology Institute. Before the research, a randomization checklist prepared in Microsoft Excel program was used to divide the patients into two groups according to their admission order as control and experiment.

Setting and sample

Total 70 patients with chronic heart failure being 35 experiments and 35 control group have been included in the study, who applied to Istanbul University Cardiology Institute at dates when the research have been performed, who accepted to participate in the study, who don't have any communication problem. Research has been completed with 29 patients in experiment group and 27 patients in control group due to 3 in experiment group and 4 in control group couldn't be reached, 3 in experiment group and 4 in control group became exits at the stage of data collection (Figure 1).

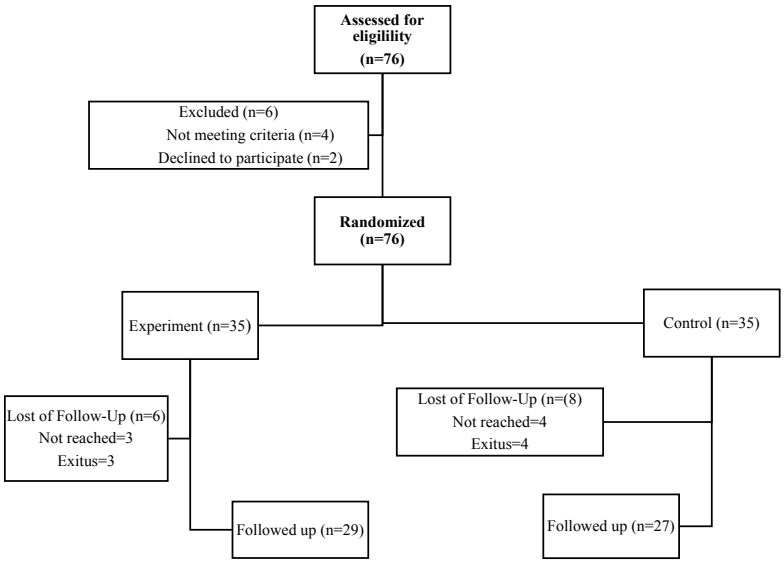

Figure 1 Participant flowchart

Ethical considerations

This study was approved by the Institutional Review Board of the University (IRB approval no: 22.06.2012/08). Individuals included in the study have been informed about purpose and method of the research, and consent has been obtained related that they are volunteer by paying attention for volunteer principle. Individuals have been informed verbally about that they can terminate their participation at any stage of the research, and they have the right to reject giving information. Also, patients have been informed about that information obtained from them won't be disclosed by obeying principle of confidentiality and confidentiality will be obtained.

Measurements/Instruments

Data were collected with general information form, Basal Dyspnoea Index (BDI) and Pittsburgh Sleep Quality Index (PSQI) in the research.

General information form

Expressions inquiring features related to socio-demographic characteristics and features related to disease in general information for prepared by investigating the literature about the subject.

Basal Dyspnoea Index (BDI) has been developed by Mahler, et al. for performing clinical classification of dyspnoea [8]. BDI measures dyspnoea occurred during activities in daily living. Scale consists of three parts as functional disorder, importance of task leading dyspnoea and importance of activity leading dyspnoea. Performer scores severity of dyspnoea of patient based on answers for different questions that are part of clinical history of respiratory functions for all three dimensions. Performer asks open-ended questions inquiring dyspnoea experience of patient, and simultaneously focuses on specific criteria for evaluating severity of dyspnoea. BDI focal score (0-12) is formed from addition of scores (from 0 (severe) to 4 (no effect)) taken from each three parts. The lower focal score, the greater severity of dyspnoea [8].

Pittsburgh Sleep Quality Index (PSQI) established in determining sleep quality has been developed by Buysse, et al. in 1989. Scale includes total 24 questions. Out of those questions 19 are questions for self-evaluation. The 19th question isn't taken into consideration in scoring. The 6th question is answered by partner or friend of the individual. These 6 questions are used only for clinical information, and isn't included in scoring and isn't taken into consideration in determining total and component points of scale. Self-evaluation questions contain various factors related to sleep quality. These determine sleep duration, sleep latency and frequency and severity of specific problem related to sleep. Scored 18 articles have been grouped in 7 component points. Some of components consist of a single article and some are obtained by grouping several articles. Each article is evaluated with a point between 0-3. Being total scale point high demonstrates that sleep quality is poor. Being PSQI total score at 5 and above indicates poor sleep quality. Minimum 0 and maximum 21 points is taken from the scale [9].

Breathing exercises

Diaphragmatic and pursed lip respirations are respiration techniques used for taking respiration under control and relieving it. Pursed lip respiration is to make expiration in a slow way with pursed lips. It is a respiration technique used for taking dyspnoea under control and relieving it in situations where need for respiration increases during exercise and daily activities. This method is used for obtaining control and making emptying of alveoli easier at maximum level during expiration. Pursed lip respiration increases gas exchange, lowers respiratory rate, increases tidal volume, and increases activity of inspiratory and expiratory muscles. Arterial SaO_2 level increases 3% to 4% in many patients by pursed lip respiration. This respiration relieves dyspnoea and it is frequently used in acute states occurred due to activity, anxiety, and respiratory disorders.

Diaphragm is pushed upward by abdominal muscles during expiration at diaphragmatic respiration. This also increases efficiency of diaphragm as an inspiratory muscle. Because diaphragm muscle is used during diaphragmatic respiration instead of other muscles, respiratory work decreases and therefore, aeration level of lungs increases and respiration improves. Diaphragmatic respiration is frequently used together with pursed lip respiration and relaxation techniques. Diaphragmatic respiration can be used as a method decreasing anxiety during acute dyspnoea attacks or as a relaxation technique. In general, diaphragmatic respiration can provide a symptomatic relief in patients, and it may create a control feeling. Diaphragmatic respiration technique; is started to be applied after pursed lip respiration technique, that's to say when patient experienced less dyspnoea and had more control on respiration. Deeper and more effective inspiration is provided with this respiration [10].

Data collection/procedure

Forms used in the research were collected from patients by face-to-face interview method. Individual interview was made in order that patients can easily answer the questions asked. General information form was filled on first interview with individuals in experiment and control group participated to the study, and BDI and PSQI were applied. Breathing exercises were taught to patients in experiment group and they were told to make breathing exercises for 30 minutes daily. Breathing exercises were taught to patients by demonstration and explanation technique, and a written text describing breathing exercises was given to patients. Patients in experiment group have been followed up for 12 weeks, and BDI and PSQI were applied again on patient's in experiment and control group at the end of 12 weeks. 3 times of phone interview was made and support was given to patients in experiment group.

Data analysis

Data were evaluated by entering into database prepared in SPSS statistics program. On evaluation of data obtained within the context of research, definitive statistical methods frequency, percentage, average, standard deviation and

person's qui-square test, Mann Whitney U-test, Wilcoxon signed rank test were used within the context of research. Results were evaluated at 95% confidence range and $p<0.05$ significance level.

RESULTS

Distribution of variables of experiment and control group related to socio-demographic variables and variables related to disease are seen on Table 1. There aren't significant differences between groups related to variables. According to it, while average of ages of patients in experiment group is 64.86, average age of patients included in control group is 63.89. Majority of patients are married and employed. While most of patients don't have smoking and coffee drinking habit, they have tea drinking habit.

Table 1 Socio-demographic characteristics related to experiment and control group and features related to disease (N=56)

Variables		Experiment		Control		Statistical analysis
		n	%	N	%	
Age (year) ± s		64.86 ± 13.13		63.89 ± 12.69		Z=0.33; p=0.743
Sex	Female	15	51.7	19	70.4	X^2=2.04
	Male	14	48.3	8	29.6	p=0.153
Education Status	Uneducated	6	20.7	5	18.5	X^2=0.05
	Preliminary-Middle education	19	65.5	18	66.7	p=0.977
	Higher Education	4	13.8	4	14.8	-
Marital Status	Married	19	65.5	21	77.8	X^2=1.03
	Divorced	10	34.5	6	22.2	p=0.31
Occupational status	Employed	5	17.2	4	14.8	X^2=0.06
	Non-employed	24	82.8	23	85.2	p=0.805
Smoking habit	Present	0	0	1	3.7	X^2=1.504
	Absent	29	100	26	96.3	p=0.471
Coffee drinking habit	Present	5	17.2	5	18.5	X^2=0.02
	Absent	24	82.8	22	81.5	p=0.901
Tea drinking habit	Present	22	75.9	19	70.4	X^2=0.22
	Absent	7	24.1	8	29.6	p=0.643
Alcohol habit	Present	2	6.9	6	22.2	X^2=2.68
	Absent	27	93.1	21	77.8	p=0.101
Time of diagnosis for heart failure (year)		4.28 ± 4.31		6.37 ± 6.76		Z= -1.04; p=0.299
NYHA classification	NYHA-II	5	17.2	10	37	X^2=2.79
	NYHA-II	24	82.8	17	63	p=0.095

While there isn't any difference between experiment and control groups for dyspnoea level (Table 2) and sleep quality (Table 3) before training, it was determined that dyspnoea level of the group that had breathing exercises training was low at the end of 12th week (p=0.000) (Table 2). While improvements were observed in sleep quality of both experiment (p=0.000) and control group ($p<0.039$) at the end of twelfth week, it was seen that improvement in sleep quality of experiment group was much greater (Table 3).

Table 2 Comparison of dyspnoea scores of experiment and control groups at baseline and 12th week (N=56)

Variables		Experiment		Control		Statistical analysis	
		X	± S	X	± S	Z*	p
Dyspnea	Basal	3.52	0.99	4.15	1.96	-1.16	0.25
	12th Week	5.72	1.46	4.81	2.17	-2.34	0.02
Statistical analysis	X^2**	-4.51		-2.65		-	-
	P	0.00		0.08		-	-
*Mann Whitney U; **Wilcoxon signed rank test							

Table 3 Comparison of PUKI scores of experiment and control groups at baseline and 12th week (N=56)

Variables		Experiment		Control		Statistical Analysis	
		X	±S	X	± S	Z*	p
PUKI	Basal	12.8	4.03	12.85	4.24	-3.62	0.717
	12th Week	6.1	3.35	11.63	4.39	-4.38	0.00
Statistical analysis	X^2**	-4.65		-2.06		-	-
	P	0.00		0.039		-	-
*Mann Whitney U; **Wilcoxon signed rank test							

DISCUSSION

In studies conducted during recent years, it is indicated that exercise training programs demonstrate positive effects on exercise capacity [11,12], functional capacity [13], symptomatic status [14], quality-of-life [12-14] and sleep quality [11,15] in patients with cardiac failure.

Inspiratory muscle training (IMT) is applied as an alternative for exercise train in patients with severe and advanced heart failure who cannot make exercise. It has been demonstrated in randomized controlled studies on patients with heart failure that cardiovascular response to exercise improved [16,17] and exercise capacity increased [18] with addition of IMT to aerobic exercise. In a study in which resistance exercise training and IMT training were added to aerobic exercise training; significant improvement has been determined in peripheral and respiratory muscle weakness, cardiovascular functions, dyspnoea level and quality of life in the group where all three trainings were applied compared to the group applying only aerobic exercise [19].

In other studies, it has been suggested that IMT training increased inspiratory muscle strength [20-22], decreased dyspnoea [20,21] and increased exercise capacity and functional capacity [21]. It has been shown on mice with heart failure that respiratory muscle training improved hemodynamics, autonomic functions, baroreceptor sensitivity and respiratory mechanism [23].

Sleep disturbance, difficulties maintaining sleep, excessive daytime sleepiness are more common in patients with HF [4]. HF patients with poor sleep tended to have acute dyspnoea between midnight and dawn [24]. In the study of Gau, et al. where they examined factors related to sleep influencing quality of life of young and elderly patients with cardiac failure, it has been found that dyspnoea seen both in young and elderly individuals is the most important determinant of poor sleep quality [3]. In another study, it has been found that cardiovascular symptoms such as dyspnoea and feeling palpitation at night influenced sleep quality negatively in patients with heart failure [25]. In a study conducted with patients having stable cardiac failure, it has been found that sleep quality and undisturbed sleep reported by patients were associated with functional performance and mental health [26].

Providing adequacy of tissue perfusion and developing activity tolerance is important in patients who developed dyspnoea. Coughing and breathing exercises provides arrangement of gas exchange. Slow, flexible and rhythmic breathing allows patients with dyspnoea to be able to use their capacity completely. Patient learns how to control his/her respiration with the help of breathing exercise training [10].

Hochstetler et al. have suggested that pursed lip and diaphragmatic respiration have made positive effect on perception of shortness of breath at advanced stages of malignant or non-malignant diseases [27]. In a study performed with COPD patients, it has been determined that these exercises improved dyspnoea level [28] it has been suggested that deep breathing exercises lowered blood pressure of patients with hypertension [29] and heart rate of patients with heart failure [30].

While there isn't any difference for the aspect of dyspnoea level and sleep quality between experiment and control group prior to training in this study, it has been determined that dyspnoea level of group given breathing exercise training was lower at the end of 12^{th} week ($p=0.000$). While improvements have been observed in sleep quality of both experiment ($p=0.000$) and control group ($p<0.039$) at the end of twelfth week, it was seen that improvement in sleep quality of experiment group was much greater.

Study limitations

According to research results, breathing exercise training applied to patients with heart failure improves dyspnoea level and sleep quality. This information may motivate HF patients with dyspnoea and poor sleep to part practice breathing exercises and encourage greater referral to established breathing exercise training programmers by health professionals for this patient group. Larger, well designed trials to assess objective and subjective measures of dyspnoea and sleep disturbance and its consequences will help to clarify the emerging role of breathing exercise training as an important non-pharmacological therapy for HF. Basal dyspnoea that is an indirect measuring method in evaluation of dyspnoea was used in this research.

CONCLUSION

Evaluation of dyspnoea by direct measuring methods can be recommended in future researches because this would allow association of these measurements with physiological variables such as minute ventilation and oxygen consumption and this would allow objective evaluation of dyspnoea.

Because the research was performed in a single centre, research results couldn't be generalized to all patients with heart failure but can be generalized to persons having similar characteristics with the research group. Data were obtained in line with expressions of patients by interview method. Therefore, confidence of data is limited with reports of participants.

DECLARATIONS

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Conflict of interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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