



The effectiveness of inspiratory muscle training in improving respiratory function in COPD patients

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ARTICLE INFO

Article history:

Received November 16, 2020
Accepted November 30, 2020
Published December 05, 2020

Keyword:

Breathlessness
Inspiratory Muscle Training
Respiratory Functional
COPD

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DOI: <https://doi.org/10.30604/jika.v5i2.388>

ABSTRACT

The prevalence of Chronic Obstructive Pulmonary Disease (COPD) increases year by year worldwide and related to mortality and decreased quality of life. The majority of COPD patients complain about breathlessness and activity restrictions such as walking. To improve the status among COPD, implementing inspiratory muscle training was shown to benefit in reducing breathlessness. This study aims to determine the potential benefit of inspiratory muscle training in improving respiratory functional status by reducing breathlessness among COPD patients. This study applied the quasi-experimental approach with pre and post-test and control group design. 30 COPD patients participated in this study and were recruited using purposive sampling methods and divided into two groups, intervention and control. Data collection using the St George Respiratory Questionnaire (SGRQ) and 6-Minute Walk Test (6MWT). Data analysis applied T-paired test and the resulting p-value 0.001 for SGRQ, and 0.034 for 6MWT. This study finding concludes that inspiratory muscle training can improve respiratory functional status by decreasing breathlessness and improving tolerance in walking ability for 6 minutes in intervention groups.

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Introduction

As a pulmonary disease, chronic obstructive pulmonary disease (COPD) is a treatable, usually preventable, and, most frequently, insidiously progressive lung disease characterized by physiologic airflow limitation (Panos, 2015), persistent airflow limitation (Koblizek et al., 2016), and a significant cause of morbidity and mortality around the globe (Early et al., 2019). It was predicted to increase over the coming decades and is associated with a significant socio-economic burden (Miravittles & Ribera, 2017). COPD is the third leading cause of death worldwide and is a significant contributor to morbidity and mortality in the UK. Its estimated 1.2 million people in the UK live with diagnosed COPD, with varying undiagnosed COPD estimates, possibly as high as 2 million (Ramakrishnan et al., 2020).

COPD is associated with disabling breathlessness and with frequent infections, hospitalization and contact with healthcare services (Early et al, 2019). Breathlessness is the first reported symptom (Carette et al, 2019), and is the most

dominant symptom in COPD patients (Dunger et al., 2015). Breathlessness or shortness of breath (SOB) defines a subjective report in experiencing breathing discomfort that varies in intensity with qualitatively distinct sensation (Yodang, 2019). It is reported as the sensation of suffocation, choking or air hunger, an inability to take an adequate breath, and rapidity of breathing or increased effort related to breathing.

In Indonesia, there is no valid national data on COPD cases. However, the incidence of COPD at the level of health services such as hospitals continues increasing. At Benyamin Guluh Kolaka Hospital, the number of COPD cases was 109, 126, and 97 in 2016, 2017 2018. Meanwhile, the number of visits is as many as 236, 284, and 411 in 2016, 2017 and 2018. Medical Records Patients diagnosed with COPD at Benyamin Guluh Kolaka Hospital have high repeat visits rates in a year. In 2018 the majority of visits are recurrent in COPD cases.

Chronic obstructive pulmonary disease is a common disease characterized by dyspnea or primary shortness of breath (Yodang, 2018). Shortness of breath is a complex problem considering its causes various factors so that handling also requires handling comprehensively. One of the interventions that can be used to overcome and reduce shortness of breath in COPD patients is inspiratory muscle training (IMT), which is part of a holistic intervention (Yodang, 2019). The IMT interventions in COPD patients have been studied for the past 30 years. The results showed that BMI can increase muscle strength, breathing, endurance of the respiratory muscles, ability and endurance to walk, reduce spasms and improve the patient's quality of life (Dellweg, 2017). A national survey conducted in India that all respondents were physiotherapists identified that nearly 40% of them applied inspiratory muscle training to treat COPD patients. The study report shows that the IMT has been proven to reduce breathlessness, improve exercise capacity and enhance the health-related quality of life, and reduce the length of hospital stay (Jingar et al., 2013). So the management of shortness of breath through holistic therapy with IMT intervention can be an alternative therapy. Since the IMT has never been implemented in the hospital of the study plan, this study will provide new data related to the IMT intervention's effectiveness. This study aimed to assess IMT intervention's effectiveness on improvement of respiratory functional status by reducing shortness of breath in COPD patients at Benyamin Guluh Kolaka Hospital.

Method

This study applied quasy experimental approach with pre- and post-test and group control design.

Participants

The study conducted in a public general hospital in regency level in Kolaka, Southeast Sulawesi Province. Population is all COPD patients, and the participant selected using the purposive sampling method. There were 30 patients meet all the inclusion criteria of the study. All participants were recruited meet inclusion criteria such as patient who attend inpatient care, have a stable COPD, age ranging from 30 years old and above, intend to participate in the study. While exclusion criteria were patients with multiple co-morbidities (cardiovascular disease, cerebral vascular disease, lung cancer, diabetes mellitus, osteoporosis, and cachexia), they were still smoking and already attending

pulmonary rehabilitation programs. Participants were divided into two groups, the intervention and the control group.

Procedure

All participants assessed their breathlessness and respiratory function by using St George Respiratory Questionnaire and a 6-Minute Walk Test (6MWT) before and after the intervention.

IMT performed using The Official Bas Rutten O2 Trainer. The training was conducted in four sets of twelve with a one minute break in between sets. Its conducted at least three times a day during the patient in patient care. While the control group assessed when attending outpatient care visit. Ethical Commission already approved this study procedure for Health Research of Ikatan Ahli Kesehatan Masyarakat Indonesia Chapter Sulawesi Tenggara with registration number No.119b/KEPK-IAKMI/IV/2020.

Results and Discussion

The study result will explain into sections which are the sociodemographics of the participants, measurements of breathlessness using SGRQ and functional status measured by using 6MWT test in both groups, and comparison among intervention and control groups.

30 respondents participated in this study and were divided into intervention and control groups. Based on the age group category, most respondents in 51-60 years old group counted for around 66.7% in intervention group, while in the control group age group morethan 60 years old was dominated, approximately 11 respondents (73.3%). According to Meiner (2013 cited in Yodang, 2019) explained, increasing the age will affect respiratory function since the aging process some changes occur in respiratory system that affect that system's physiologic function. Further, the aging process will affect respiratory function by reducing lung elascity and respiratory muscle strength, which could trigger breathlessness (Yodang, 2019).

Regarding gender, men were predominantly in both groups which counted for around 80% in the intervention group and 86.7% in control group. Even in the previous study, breathlessness was associated with gender, however, there is no exact information about how different gender affect breathlessness (Yodang, 2019). However, there is a link to a previous lifestyle, such as smoking, where the men are more likely to smoke than women.

Table 1. Respondents Characteristics

Characteristics	Intervention Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
Age group (Years old)				
41-50	2	13.3	1	6.7
51-60	10	66.7	3	20.0
>60	3	20.0	11	73.3
Gender				
Male	12	80.0	13	86.7
Female	3	20.0	2	13.3
Smoking History(Years)				
1-10	1	6.7	0	0.0
11-20	8	53.3	9	60.0
>20	6	40.0	6	40.0

All respondents who recruited have experienced in smoking and all of them already cessatiated since in different times. Smoking history, the majority of them have experienced for around 11 to 20 years which equivalents to 53.5% in intervention group and 60% in the control group. A study conducted by Ruiz and Colleagues (2017) identified that nearly 85% of COPD cases are caused by tobacco consumption. To manage breathlessness among COPD patients, smoking cessation is necessary. Since that intervention already approved and ranked as a top recommendation for managing breathlessness in COPD. (See table 1).

Respiratory functional status and breathlessness condition were measured by SGRQ before intervention were found that the highest score was 52. After attend IMT session during inpatient care for around two weeks the highest score was 44. The gap score before and after intervention was decreased among respondents which ranging from -1 to -12. This result show us there is improvement among participants in intervention group were they have breathlessness decreased in different increments. While the functional status was measured by using Six minute walk test (6MWT), the longest walk among participants in intervention group was 126 metres. After IMT session the ability to walk for 6 minutes increased to 258 metres. The gap score for walking ability among respondents in intervention group was increased in different increments which ranging from 10 to 74 metres. This study finding show us the improvement in breathlessness will affect the ability walk for 6 minutes among respondents. The more decreased

the breathlessness the more increased the functional status include walking ability. On the other hand, in control group which found the highest SGRQ score was 44 both in an initial and the last measurements. While the gap score was counted ranging from -6 to 6. From this data finding, inform us there are some respondents to have experienced in breathlessness decreased while other have increased. Further, in walking ability for 6 minutes the longest walk was 186 metres in an initial measurement, and 222 metres in the last measurements. The gap score was found ranging from 0.00 to 48 metres. According to that report, we know that some of the respondents have no improvement in walking ability, while others have experienced in improvement walking ability for around 48 metres. The study results show us the changing of SGRQ score may have influencing in the walking ability of respondents (see table 2). Indonesian scholars reported that IMT which applied to COPD patients in three times a week during 12 consecutive weeks can improve thoracic and lung expansion and as a result breathlessness decreased (Permadi & Putra, 2018). Further, the scholars suggest that since the study on the effectiveness of IMT in reducing breathlessness among COPD in Indoensia is limited, the similar study is needed in order to offers and provide best information for recommendation in the next future. Interestingly to notice that, a study in Egypt point out that IMT session will increase muscle strength in internal and accesorius of respiratory muscle, and also the study report that the adaptation of patient during attend the training will improve respiratory tolerance and decrease the breathlessness (Elmorsi et al, 2016).

Table 2. SGRQ score and 6MWT in both groups

Intervention Group		Measurements	Mean	Std Deviasi	Min	Max
SGRQ		Pre-Intervention	45.40	3.96	40	52
		Post-Intervention	40.80	2.36	36	44
		Gap Pre-post	-4.60	3.24	-12	-1
6MWT		Pre-Intervention	137.20	29.84	108	126
		Post-Intervention	166.80	34.77	120	258
		Gap Pre-post	29.60	17.99	10	74
Control Group						
SGRQ		Pre-Intervention	41.06	1.83	38	44
		Post-Intervention	40.80	2.36	36	44
		Gap Pre-post	-0.26	3.01	-6	6
6MWT		Pre-Intervention	128.40	20.60	96	186
		Post-Intervention	145.86	29.28	112	222
		Gap Pre-post	17.46	15.03	0.00	48

There is significantly difference in breathlesness indicator which measured by using SGRQ between intervention and control groups, based on statistical analysis in T paired test found that the p value in Sig. 2 tailed was 0.001. While in 6MWT indicator for walking ability during 6 minutes also found in significantly difference between

intervention and control group which p value in Sig 2-tailed was 0.034. This study finding informs us the Inspiratory muscle training has potential benefit in improving respiratory functional status by reducing breathlessness among COPD respondents, and in the same time also improves tolerance in walking ability during 6 minutes.

**Table 3
pre dan post analysis in intervention and control groups**

Measurements	Mean	Std Deviasi	CI (95% L-U)	df	Sig. (2-tailed)
SGRQ	-4.33	4.16	-6.64-2.02	14	0.001
6MWT	12.13	20.02	1.04-23.22	14	0.034

The study finding is similar with Xu and colleagues study result where all participants in that study shows improvement in respiratory muscle strength both inspiratory and expiratory muscles after attended 8 weeks training for IMT. The participants applied exercise 15 minutes two times a day, and the final study they reported that they could tolerate the training and the impact was breathlessness

decreased (Xu et al, 2018). Another study also reported that COPD patients who attend IMT for 15 minutes in two sessions a day during 8 consecutive weeks improve their functional status by increasing the walking ability for 6 minutes round. The study conducted in a national referral hospital in Indonesia (Nusdwinuringtyas et al, 2019). Since the IMT as a part of physical exercise which affect the human

body especially cardiorespiratory system, the training stimulates the tolerance and adaption of the body system related to work out sessions. From this point of view the intervention decrease breathlessness by increasing and improving respiratory functional status of respondents. Besides that, the duration and the period of the training also affect the improvement, the more longer period and duration of training the more improve of the respondents they have. However, applying the IMT also need impeccable assessment among participants before attend the intervention in order to prevent the fatality event to the respondents.

Conclusions and Recommendations

It was concluded that the intervention of IMT in improving the respiratory functional status among respondents who have sufferers from COPD with have breathlessness. Besides that the intervention also improve the tolerance in walking ability, thus the walking distance increased significantly since the breathlessness decrease. In contrast, in control group some of respondents improve their respiratory functional status while others have getting worse in breathlessness. The IMT has potential benefit in COPD patients.

Even the this study report the beneficial of the intervention in improving respiratory functional status among COPD respondents, however there some issues need take into consideration such intervention in randomized control trial, smoking cessation history, smoking package per year, disease progression, disease history and co-morbidities. All of these should investigate for the next study in order to provide the best evidence of the benefit of inspiratory muscle training for COPD patients.

Acknowledgements

The researchers would like to thanks to Directorate of Research and Community Engagement, Directorate General of Research and Development, Ministry of Research and Technology/National Board of Research and Innovation for research grants. Its research funding declare under decree number 066/SP2H/LT/DRPM/2020, and the budget offers in 2020.

Declaration of Conflicting Interests

The authors declared that no potential conflicts of interests with respect to the authorship and publication of this article.

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