




LITERATURE REVIEW

Optimal Diaphragmatic Breathing Patterns through Exercise Can Light Some Medical Problems

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ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received 23 January 2022 Received in revised form 29 May 2022 Accepted 30 May 2022 Available online 31 January 2022</p> <p><i>Keywords:</i> Chronic respiratory diseases, Diaphragmatic breathing, Human and health, Medical problems.</p>	<p>Breathing is an absolute human need. In an emergency, airway and breathing are the main problems that must be addressed immediately. Empirically, breathing techniques that people do in general are varied. Of all breathing patterns, it is believed that there must be the most optimal. One of them is diaphragmatic breathing (DB). DB plays the role of the diaphragm as the main muscle that performs the activity of inhaling and exhaling. Optimal breathing patterns, including certain DB, have the ability to relieve several medical problems. The aim of this study was to examine whether an optimal DB pattern could alleviate some medical problems. We conducted a literature study on 40 references consisting of 27 journals and 13 other appropriate literature sources. We searched library resources using the PubMed search engine through keywords: effectiveness of breathing, DB, and breathing exercises. Literature analysis was based on requirements, including inclusion and exclusion criteria. There were 26 journals which met the criteria. Optimal DB pattern can be a solution for chronic obstructive pulmonary disease (COPD), asthma, chronic stroke, congestive heart failure (CHF), gastroesophageal reflux disease (GERD), cerebral palsy (CP), labor pain management, and anxiety. It can be therapeutic to relieve some medical problems.</p>

INTRODUCTION

Breathing is an absolute human need. In emergency case, breathing is the most important thing that must be evaluated (air, breath, circulation).¹ Although humans breathe every day on a regular basis, it turns out that breathing is not necessarily effective.² In general, humans breathe 12-20 times per minute in adults aged 19-59 years old. One indicator of effective breathing would be relatively little energy is expended.⁴

Breath training is able to increase the strength of the respiratory muscles, breathing exercises practice good and correct breathing, train effective expectoration.⁴

Diaphragmatic breathing (DB) is one type of effective breathing. During inhalation, the diaphragm contracts, hence the lungs can expand into extra space and let in as much air as needed.⁵

It is stimulating deep breathing and expanding the lungs into the diaphragm rather than using the abdomen or ribs.^{6,7} DB technique is specific on the moderate rate of breath using processes such as counting breaths while increasing the stomach and inhaling deeply through the nose, pausing, followed by contraction of the stomach and exhaling slowly and completely through the mouth.⁶⁻⁸ This technique includes developing an inhalation and exhalation pattern to decrease the respiratory rate.⁷⁻¹¹ DB requires no special equipment, easy to practice, and saving costs. Optimal DB can produce a therapeutic effect to relieve diseases; such as chronic obstructive pulmonary disease (COPD), asthma, chronic stroke, congestive heart failure (CHF), gastroesophageal reflux disease (GERD), cerebral palsy (CP), pain management in labor, and anxiety.

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World Health Organization (WHO) notes that COPD is the fifth highest prevalence disease worldwide, with the death rate increasing every year. The prevalence of COPD in the moderate-severe category occurs at the age of 30 years old and over, with an average of 6.3% worldwide.¹² COPD is a progressive inflammatory lung condition which seriously affects human health. It is not only contributed to dyspnea and reduced lung function, but also accompanied by complex and systemic comorbidities which contributed to respiratory distress that further impairs capacity training.¹³

Asthma symptoms include recurrent episodes of coughing, shortness of breath, and chest tightness, along with symptoms that worsen periodically, known as exacerbations.¹⁴⁻¹⁶ Exacerbations can be fatal and are more frequent and more serious in high-risk patients or patients with uncontrolled asthma.¹⁵ Asthma is one of health problems which is a major cause of disability and the use of health resources for those affected, who may require emergency care including hospital admission. It affects about 1 to 18% of the population worldwide. WHO and Global Initiative for Asthma (GINA) estimated that 300 million people suffer from asthma worldwide. WHO report stated that 5 main lung diseases are 17.4% of all causes of death in the world.^{15,17}

According to WHO, 17.5 million people died from cardiovascular disorders worldwide.¹⁸ Dyspnea is a main symptom of CHF.¹⁹

GERD is a digestive system disorder and the prevalence is increasing from year to year. It is caused by disturbances in the movement of the upper digestive tract and reflux of stomach acid in the esophagus, which causes various sores and makes the body uncomfortable.²⁰

Stroke is a condition that occurs when the blood supply to the brain is reduced due to a blockage (ischemic stroke) or rupture of a blood vessel (hemorrhagic stroke). The respiratory function of stroke patients is directly/indirectly affected by a decrease in oxygen transport related to the function of the cardiovascular system and heart rate function as well as a decrease in paresis of the breast wall movement and a drastic decrease in the function of the cardiovascular system due to a decrease in the frequency of physical activity.^{21,22}

Anxiety is a state of understanding or worrying that something bad will happen soon.²³ It is also associated with characteristics of COPD parameters, including FVC, chest symptoms, and dyspnea.¹³

CP is a non-progressive syndrome of posture and motor impairment that causes activity limitation and is often accompanied by cognitive impairment or visual deficits. Brain damage is permanent and irreversible, but the symptoms of CP can be minimized.²⁴

DB interventions were presented in this systematic review, might be more cost-effective of

improving health outcomes when proven. Therefore, this systematic review aimed to examine DB exercise to reduce all kinds of medical problems through a Mendeley literature search with several topics identified for their feasibility.

METHODS

This systematic review consisted of literature search, selection based on inclusion and exclusion criteria, analysis, and drawing conclusions. Initially, literature search was performed on Mendeley Reference Manager, and the literature obtained was published between 2012-2021. The number of literatures obtained was 27, with details of 8 journal reviews and 19 studies in the form of direct clinical trials. The inclusion criteria were focused on the use of breathing exercise interventions and the results of previous studies or reviews should show positive results between breathing exercises and improvement of a number of medical problems. The medical problem in question could be in the form of physical illness or psychological disease. Other inclusion criteria were the existence of groups of variables or the existence of variations in the treatment of variables. The treatment for the variable was prioritized in the form of DB exercises, but other exercises that were still in the respiratory optimization corridor could also be included as comparison material. A study or review could be included in one of the treatment models in the previous sentence or both. The exclusion criteria were if in one study breathing exercises were combined with other exercises and the results of the study/review did not give positive results between breathing exercises and certain medical problems.

Then, all potential studies which met the inclusion criteria were reviewed. The studies then were grouped by type, namely reviews and direct clinical trials. Each study is directly described based on the author, objectives, respondents, methods, and outputs. Meanwhile, each journal review is described based on the author, the purpose of the review, the number of studies collected, the respondents, and the variety of methods. The analysis used in this review was a comparison between studies and reviews.

DISCUSSION

This systematic review aimed to provide evidence on the benefits of breathing exercises for human health. The included studies were studies which assessed the effectiveness of breathing exercises. These interventions could be based on breathing and pursed-lip exercises, relaxation breathing exercises, and deep breathing. The result of analysis is seen in Table 1 and 2.

Table 1. Characteristics of research

Writer	Purpose	Response	Methods	Outputs
Ibaí, López-de-Urvalde-Villanueva, <i>et al.</i> , 2018	Primary: Evaluation of the addition of manual therapy and therapeutic exercise protocols to inspiring muscle exercises is more effective in increasing maximum inspiration pressure than inspiration muscle exercises separately. Secondary: Assesses the effects produced by these two interventions on measurements of spirometry and posture (forward head posture and thoracic kyphosis).	43 patients Age: (18-60 years old)	Group 1 (n = 21): Inspiration muscle exercises (n = 21, 20 minutes). Group 2 (n = 20): Inspiration muscle exercises (20-minute sessions) combined with manual therapy programs (15-minute sessions) and therapy exercises (15-minute sessions). All groups exercised for 12 sessions over 6 weeks (2 sessions per week).	Maximum inspiration pressure, spirometry measurements, forward head posture, and thoracic kyphosis, at the beginning and after treatment.
Chen, Yu-Fen, <i>et al.</i> , 2017	Evaluate the effectiveness of DB relaxation program in reducing anxiety.	Unknown	Variable group: Beck Anxiety Inventory test and biofeedback test for skin conductivity, peripheral blood flow, heart rate, and breathing rate. Control group: Without treatment. All groups were monitored for 8 weeks. The variable group performed the test for 12 sessions.	Beck Anxiety Inventory score, peripheral temperature, heart rate, and breathing rate.
Valenza M., <i>et al.</i> , 2014	Evaluate that breathing techniques can improve anxiety and depression in inpatients due to COPD exacerbations.	46 men Age: 67-86 years old	Variable group: Re-axation exercises, pursed-lip breathing (PLB), and active expiration, controlled breathing programs twice daily during hospitalization, physiotherapy (30 minutes), 3 minutes of rest when needed. Control group: Without treatment.	Levels of dyspnea, anxiety, and mobility.
Eherer A., <i>et al.</i> , 2012	Breathing exercises can relieve GERD.	19 people	Variable group (n = 10): Active breathing exercises. Control group (n = 9): Without treatment. All groups were monitored for 4 weeks.	pH-metri, quality of life score and PPI use after 9 months.
Langer D., <i>et al.</i> , 2018	Identify physiological mechanisms of increased dyspnea and endurance exercise after inspiring muscle training (BMI) in patients with COPD and low maximum inspiration pressure.	Unknown	Variable group: BMI exercises. Control group: Exercise with existing methods.	Dyspnea levels, muscle endurance, and maximum inspiration pressure.
Jerath R., <i>et al.</i> , 2015	This breathing technique can be used to reduce stress, anxiety, depression, and emotional disorders.	Unknown	Meditation group: Yoga and pranayama exercises. Treatment group: Using a previously existing treatment. Placebo group: Suggestive treatment.	Levels of stress, anxiety, depression, and some emotional aspects.
Balas M., <i>et al.</i> , 2014	Evaluate the effectiveness and safety of Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility (ABCDE) bundle in daily practice.	296 patients Age: minimum 19 years old	Variable group: ABCDE bundle. Control group: Regular care. All groups were monitored from November 2010 to May 2012.	The relationship between the implementation of bundles and ventilator releases, as well as the relationship between awakening and breathing coordination, delirium monitoring/management, and early

				exercise/mobility bundle and prevalence/duration of delirium and coma, early mobilization, mortality, return time, and change of residence.
Vieira, D., <i>et al.</i> , (2014)	Effects of breathing exercises on breathing patterns and thoracic movements (lungs).	15 participants Age: 20-30 years old BMI = 18.5 – 29.9 kg/m ²	Evaluation using optoelectronic plethysmography system with supine body position and slope of 45°. Continued with random breathing exercises (DB and intercostal peeling).	Tidal volume and breathing rate.
Seo K., <i>et al.</i> , (2017)	The effect of inspirational DB exercises and pursed-lip expiratory breathing exercises on the activation of chronic stroke patients' respiratory muscles.	30 stroke patients	Variable group (n = 15): 15-minute DB exercise and 15-minute oral expiratory breathing exercise. Control group (n = 15): Basic exercise treatment and auto med. All groups exercised 5 times per week for 4 weeks.	Activation rate of respiratory muscles.
Nirmalasari N., <i>et al.</i> (2020)	Knowing the effect of deep breath exercise combined with active range of motion to physiological responses in CHF patients.	32 patients Age: Over 17 years old	Variable groups: Deep breathing exercises as many as 30 times, followed by a gradual active range of motion on the hands, feet, hips, and knees with each movement performed 5 times. The intervention was performed 3 times a day for 3 days.	Cystol, diastole and frequency of breathing.
Wibrata D., <i>et al.</i> , (2019)	Evaluating the effects of breathing exercises: PLB and DB in COPD patients.	16 patients Age: 40-75 years old	Experimental group (n = 8): Receive pursing lip breathing exercises and DB. Control group (n = 8): Without treatment. All groups were monitored for 4 weeks.	Frequency of COPD attacks.
Lee H., <i>et al.</i> , (2014)	Comparing differences in respiratory pressure and lung function and the effectiveness of assistive breathing exercises based on the walking ability of a child with CP.	23 people Gender: 11 men and 12 women	Group 1 (n = 12): Walk independently. Group 2 (n = 11): Walking with aids. Each group was directed to walk on a respirator for 20 minutes 3 times per week within 4 weeks. In addition, each group continued to get therapy for 30 minutes 2-3 times a week with a focus on motor and functional activities.	Maximum inspiration pressure (MIP), maximum expiratory pressure (MEP), forced vital capacity (FVC), forced expiratory volume per second (FEV1), peak flow of expiration (PEF).

Table 2. Characteristics of the review

Writer	Purpose	Number of studies collected	Subjects	Variety of methods
Castilho T., <i>et al.</i> , 2018	Describe the effects of inspiration muscle exercises and breathing exercises in children with asthma through a systematic literature review.	8 studies	288 children with asthma Age: 15 years old	Observational: 2 studies. Inspiration muscle training: 6 studies.
Lu Y., <i>et al.</i> , 2020	Evaluated the effects of breathing exercises on lung function, muscle strength breathing, exercise capacity, dyspnea, and HRQOL in subjects with COPD.	13 studies (period 1 January 2008 - 31 December 2018)	998 subjects	DB, yoga, breathing exercises, and singing.
Mayer A., <i>et al.</i> , 2018	Conduct a systematic review of crossovers, randomized and quasi-randomized controlled trials investigating the acute effects of PLB use in exercise performance, dyspnea, respiratory parameters, and oxygen	8 studies	Number unknown, but minimum age: 40 years old	PLB

	saturation during exercise in patients with COPD.			
Yang Y., <i>et al.</i> , 2012	Evaluation of PLB effects combined with DB training on lung function and exercise capacity in patients with COPD.	15 studies	1098 people	Treatment group: PLB exercises combined with DB. Control group: No treatment.
Qiu K., <i>et al.</i> , 2020	Evaluate the effects of breathing exercises on GERD patients, i.e. symptoms that arise can be reduced.	7 studies	194 patients and 16 healthy people	DB: 63 patients. General breathing muscle exercises: 41 people. Intramuscular muscle breathing: 20 people. Abdominal breathing and medication: 10 patients. Treatment only: 29 patients. Placebo group: 16 patients. Non-treatment: 31 patients.
Santino T., <i>et al.</i> , 2020	Evaluate the level of confidence in the efficacy of breathing exercises in people with asthma problems.	22 studies (9 RCT and 13 reviews)	2880 people	Variable group: Yoga: 14 studies Buteyko: 1 study Buteyko and pranayama: 1 study Papworth: 1 study DB: 1 study Others: 4 studies Control group: No treatment: 20 studies Asthma education: 2 studies
Beaumont M., <i>et al.</i> , 2018	Verification of inspiratory muscle training (IMT) effects using threshold devices in COPD patients on dyspnea, quality of life, exercise capacity, and inspiring muscle strength, and additional effects on PR-related BMI dyspnea (pulmonary rehabilitation).	37 studios	Unknown	IMT

Breathing exercises are a series of exercises that can be performed to influence breathing patterns. It can optimize thoracoabdominal motion. It has many forms, one of which is DB which aims to increase lung ventilation.²⁵ In a systematic review, breathing exercises can relieve various diseases such as asthma, GERD, pain management, anxiety, COPD, stroke, CHF, gynecological cancer, lung cancer, and delirium.

Asthma is a serious public health problem. Symptoms of asthma exacerbations can be fatal and are more frequent and more serious in high-risk patients or patients with uncontrolled asthma.^{15,17} In asthmatic patients, inspiratory muscle training combined with conventional therapy and a therapeutic exercise program are more effective than its separately application, hence it can increase maximum inspiratory pressure and improve forward head posture.²⁶ In addition, BMI breathing exercises in children with asthma have benefits, namely increasing inspiratory and expiratory muscle strength.²⁷ Therefore, breathing exercises are widely used for asthma management in both adults and children.

COPD can cause dyspnea and reduced lung function.²⁸ One of the therapies used in COPD patients is breathing exercises. It is performed in many forms such as BMI. It is effective for increasing inspiratory muscle strength, quality of life, and reducing dyspnea.²⁹ Breathing exercises for COPD patients can also be performed at home. In addition, deep breathing exercises

are also effective for people with COPD and can reduce dyspnea.³⁰

For people with anxiety and depression, DB relaxation training programs are effective in reducing anxiety.^{31,32} In GERD patients, breathing exercises can improve quality of life and reduce the use of acid suppressants.^{33,34}

Breathing exercises are also effective for pain management. Based on previous studies, breathing exercises combined with inhalation and deep expiration in pregnant women are effective in reducing pain and shortening the length of the second stage of labor.³⁵

In CHF patients, deep breathing exercises and active range of motion reduce systolic significant.³⁶ Respiratory rehabilitation exercises are thought to induce a positive effect on the respiratory muscles of stroke patients through DB and PLB exercises.³⁷

From previous study, it was found that breathing exercise can reduce physiological failure in gynecologic cancer patients who are undergoing therapy. Breathing exercises have a significant impact on decreasing piper fatigue scale (PFS) scores when performed for 30 minutes 4 times per day.³⁸

Critically ill patients in the ICU who were managed with ABCDE bundle spent 3 more days breathing unaided, reducing delirium, and easier to be mobilized during their ICU staying than patients who were treated with usual care. Therefore, breathing exercises can reduce delirium in patients in the ICU.¹

Breathing exercises are known to have benefits in children with CP. It is also explained that children who cannot walk independently perform breathing exercises. It can strengthen the respiratory muscles and help the child's development to walk independently. This is proved by MIP, MEP, FVC, FEV1, and PEF. In children with CP who walked alone, these parameters give more significant changes than children with CP who could not walk independently.³⁹

The studies included in Table 1 and 2 used various breathing exercise methods on variable groups. There were studies that specifically mentioned the breathing exercise in question, some only mentioned in general terms. In the description of various studies and reviews in Table 1 and 2, DB exercises were the most used. All studies with DB methods gave positive results in the improvement of various medical problems. Therefore, based on this review, DB exercise method is the most recommended method.

From the description, breathing exercises have many benefits for adult patients and children as well as for healthy people and even for runners. Hence, breathing exercises can be a supportive therapy to light symptoms of the disease for the patients.

SUMMARY

Breathing exercises can light some medical symptoms, both physically and psychologically. The majority of studies used DB exercises as a treatment which gave positive results due to reduced disease problems.

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Conflict of Interest

The author stated there is no conflict of interest in this study.

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Author's Contributions

Concept and design: ALM. Data collection: HYZ and UQH. Analysis and data interpretation: ALM and UQH. Article draft: HYZ. Critical revision: AR and AL. Stastitical expertise: ALM, HYZ, and UQH. Final check: AR, AL, and AD. All authors contributed and have approved the final version.

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