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Meta-Analysis

Meta-Analysis: The Effect of Breathing Exercise on Respiratory Function in COVID-19 Patients

Lilik Sigit Wibisono[1)], Lily Nabillah[2)]

[1)]Health Polytechnic of the Ministry of Health, Surakarta
[2)]Health Polytechnic of the Ministry of Health, Jakarta III

ABSTRACT

Background: COVID-19 is an infectious disease caused by a virus. Globally, in January 2022 the number of new cases of COVID-19 increased by 5%, which is more than 21 million new cases. Signs and symptoms commonly found in COVID-19 patients are acute respiratory disorders such as fever, cough, and shortness of breath. Breathing exercise in the form of a method of breathing in a certain way helps to improve and improve lung performance which is good for quality of life. This study aims to analyze the effect of breathing exercises on respiratory function in COVID-19 patients.
Subjects and Method: A systematic review and meta-analysis was conducted by collecting articles from the Google Scholar, PubMed, and Science Direct databases. The articles were filtered using the PICO model, including: Population= confirmed COVID-19 patients. Intervention= breathing exercises. Comparison= conventional breathing exercises. Outcome= respiratory function. The keywords used were "breathing exercise" AND "respiratory rehabilitation" AND "pulmonary rehabilitation" OR "respiratory rehabilitation" AND "respiratory function" AND "Randomized Controlled Trial" OR "RCT". Inclusion criteria were full text, randomized control trials, published from 2019 to 2021. Articles were collected by using PRISMA diagrams and quantitative synthesis was assessed by using Review Manager (RevMan) 5.3.
Results: A total of 9 articles analyzed in this study came from 2 continents, namely the Asian continent (China and India) and the American continent (United States). The forest plot results in this meta-analysis showed that breathing exercises improved respiratory function in COVID-19 patients by 1.20 times compared to conventional breathing exercises and the results were statistically significant. (SMD=1.20; 95% CI=0.61 to 1.79; p<0.001).
Conclusion: Breathing exercise help to improve respiratory function in COVID-19 patients.

Keywords: breathing exercise, respiratory function, Meta-analysis.

Correspondence:
Lily Nabillah. Masters Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: lilynabillah09@gmail.com. Mobile: +6282111356435

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BACKGROUND

In 2019, the virus that originated in Wuhan, China spread to all corners of the world. Which is then referred to as Corona virus disease or COVID 19. It is an infectious disease caused by the SARS-CoV-2 virus. This virus can spread through tiny fluid particles from the mouth and nose of an infected person when the person talks, sneezes or even breathes. Then, a person will be infected after touching the eyes, nose, mouth after breathing or touching

objects contaminated with the virus (Vignesh et al., 2021).

Globally, the number of new COVID-19 cases increased by 5% in the past week, with more than 21 million new cases reported, representing the highest weekly number of cases recorded since the beginning of pandemic. Nearly 50,000 new deaths were also reported. In January 23rd, 2022, more than 346 million confirmed cases and more than 5.5 million deaths have been reported in total (WHO, 2022).

Signs and symptoms commonly found in COVID-19 patients are acute respiratory disorders such as fever, cough, and shortness of breath. In severe cases it can cause pneumonia, acute respiratory syndrome, kidney failure, and even death. Clinical signs and symptoms reported in most cases were fever, with some cases having difficulty breathing, and X-rays showing extensive pneumonia infiltrates in both lungs (Hairunisa and Amalia, 2020). Therefore, breathing exercise in the form of breathing training methods in a certain way to improve lung performance is good for the quality of life (Liu et al., 2020).

According to research conducted at the Hainan Affiliated Hospital of Hainan Medical Univeristy in 2020, the participant subjects were 72 elderly people, where the group was divided into 2, namely 36 people who received breathing exercises for 6 weeks and 36 people who did not do breathing exercises at all. The breathing exercise method was done in 6 weeks. It has been proven that breathing exercise in respiratory rehabilitation can improve lung function in elderly participants affected by COVID-19 (Liu et al., 2020).

In addition to Hainan University in China, the collaboration of several universities in Chennai, India, namely the Saveetha Institute of Medical and Technical Sciences and the Department of Physiotherapy, College of Health Sciences, Gulf Medical University also conducted research on 48 participants with an age range of 18-60 years old. The 48 participants were divided into 2 groups, 24 participants did breathing exercises in the form of a yoga category called Bhastrika Pranyama for 6 weeks with a duration of 5 minutes which was carried out 3 times a day and the other 24 people did breathing exercises using a tool called Incentive Spirometry 5-10 times using the tool 3 times a day for 6 weeks. The final results obtained were significant changes in the two groups that had performed this breathing exercise (Vignesya et al., 2021).

Based on this description, the researchers conducted a study with the aim of estimating the average effect of breathing exercise on respiratory function in COVID-19 patients.

SUBJECTS AND METHOD

1. Study Design

This study used a systematic review and meta-analysis design. This study article was obtained from the electronic databases of Google Scholar, PubMed, and Science Direct. Some of the keywords used are: "breathing exercise" AND "respiratory rehabilitatoin" AND "pulmonary rehabilitation" OR "respiratory rehabilitation" AND "respiratory function" AND "Randomized Controlled Trial" OR "RCT".

2. Inclusion Criteria

The inclusion criteria used in this study were full-text articles with a randomized controlled trial study design. The articles were published in English from 2019 to 2021. An analysis of perceived benefits and perceived barriers to study outcomes was reported using mean and SD.

3. Exclusion Criteria

In this study, the exclusion criteria were articles that had been meta-analyzed, inac-

cessible articles and articles that were not in English.

4. Operational Definition of Variables

The articles included in this study were PICO-adjusted. The search for articles was carried out by considering the eligibility criteria determined by using the following PICO model: Population= Patients with COVID-19 Intervention= breathing exercises Comparison= without breathing exercises Outcome= respiratory function.

Breathing Exercise is a method of breathing exercises in a certain way to fix and improve lung performance which is good for quality of life

Respiratory Function is to take oxygen from the atmosphere into the body's cells and to transport carbon dioxide produced by the body's cells back into the atmosphere.

5. Instrument Study

This study was guided by PRISMA flow diagrams and assessment of the quality of articles using Critical Appraisal from Randomized Controlled Trial (CEBM, 2019) .

6. Data Analysis

Data processing in this study was carried out by identifying articles obtained from several databases, followed by screening to obtain articles that fulfilled the requirements. Then the quality of the study was assessed using a Randomized Control. Study from the Center for Evidence Based Management (CEBM). The article were analyzed by using the Review Manager application (RevMan 5.3).

RESULTS

This article search process was carried out through several journal databases including Google Scholar, PubMed, and Science Direct. The review process regarding this journal can be seen from the flow of the Prisma Flow Diagram in Figure 1. Research related to the effect of breathing exercises on respiratory function in COVID-19 patients which consists of 9 journals from the initial search process has obtained 810 articles, after the process of deleting the articles, 69 articles which fulfilled the requirements for a full-text review were obtained. A total of 9 articles met the quality assessment and were included in quantitative synthetic using meta-analysis.

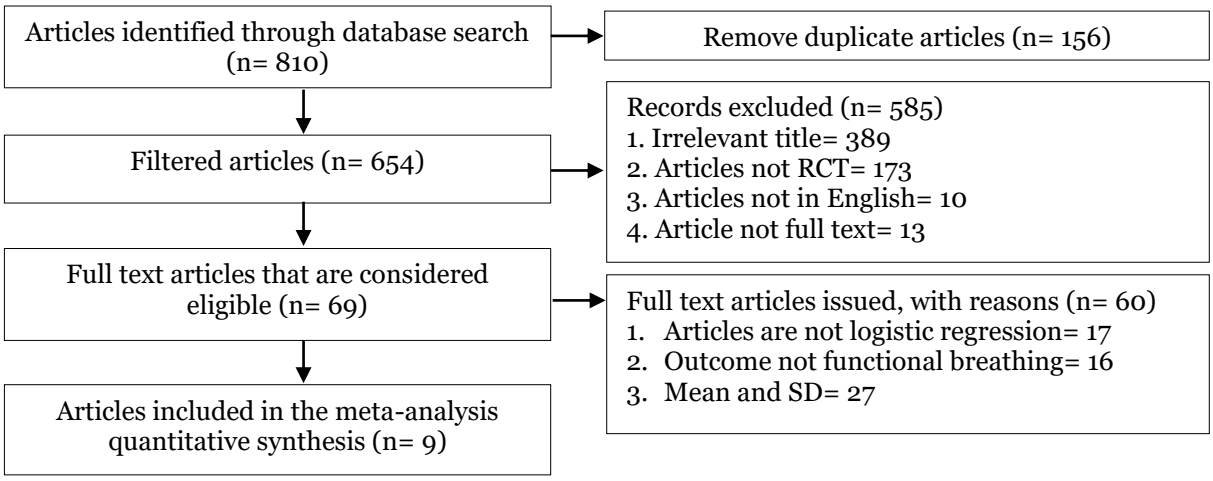

Figure 1. PRISMA Flow Diagram

Figure 2. Map of the study area

It can be seen in Figure 2 that the primary research included in the meta-analysis came from 2 continents, namely Asia (China and India) and America (United States). Assessment of study quality is shown in table 1. Description of the primary study of 9 articles on the effect of Breathing Exercise on respiratory function in COVID-19 patients.

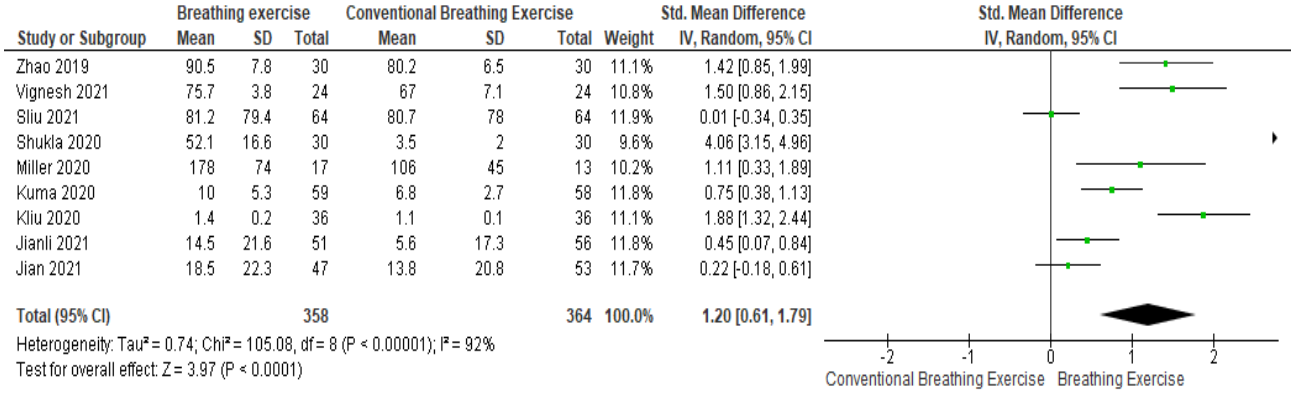

Figure 3. Forest plot of the effect of breathing exercise on respiratory function in COVID-19

Based on the results of the forest plot (Figure 3), the results of a meta-analysis of a randomized controlled trial showed that respiratory function improved in COVID-19 patients by 1.20 times compared to conventional breathing exercises and the results were significant (SMD=1.20, 95% CI=0.61 to 1.79; p<0.001). The heterogeneity of the research data showed I^2 = 92%, so that the distribution of the data was stated to be heterogeneous (random effect model).

Table 1. Assessment of study quality published by the Center for Evidence-Based Medicine (CEBM)

No	Questions	Publication (Author and Year)								
		Zhao et al., 2019	Kuma et al., 2020	Liu et al., 2020	Shukla et al., 2012	Miller et al., 2020	Jian'an et al., 2021	Vignesh et al., 2021	Li et al., 2021	Liu et al., 2021
1	Does this study address a clear study focus?	1	1	1	1	1	1	1	1	1
2	Is the Randomized Controlled Trial research method appropriate to answer the study question?	1	1	1	1	1	1	1	1	1
3	Are there enough subjects in the study to establish that the findings were not coincidental?	1	1	1	1	1	1	1	1	1
4	Are the subjects randomly divided into the experimental and control groups? If not, can this be biased?	1	1	1	1	1	1	1	1	1
5	Does the study use inclusion/exclusion criteria?	1	1	1	1	1	1	1	1	1
6	Are the two groups comparable at the start of the study?	1	1	1	1	1	1	1	1	1
7	Are objective and unbiased outcome criteria used?	1	1	1	1	1	1	1	1	1
8	Is the measurement method used objective and valid to measure the results? If not, is there any blinding in the study?	1	1	1	1	1	1	1	1	1
9	Is effect size practically relevant?	1	1	1	1	1	1	1	1	1
10	Is the estimated effect correct? Is there a confidence level interval?	0	1	1	1	1	1	0	0	0
11	Are there any confounding factors that have not been taken into account?	1	1	1	1	1	1	1	1	1
12	Can the results be applied to your research?	1	1	1	1	1	1	1	1	1
Total score		**11**	**12**	**12**	**12**	**12**	**12**	**11**	**11**	**11**

Note: 1= Yes; 0= No

Table 2. Description of the primary studies included in the meta-analysis primary studies

Author (Year)	Country	Study Design	Sample		Population	Intervention	Comparison	Outcome	Mean		SD	
			BE	CBE					BE	CBE	BE	CBE
Zhao et al., 2019	China	RCT	30	30	COVID-19	Pulmonary rehabilitation	Conventional Breathing Exercise	Respiratory function	90.50	80.02	7.80	6.50
Kuma et al., 2020	India	RCT	59	58	COVID-19	Breathing exercise	Conventional Breathing Exercise	Respiratory function	10.00	6.80	5.30	2.70
Liu et al., 2020	China	RCT	36	36	COVID-19	Respiratory rehabilitation	Conventional Breathing Exercise	Respiratory function	1.40	1.10	0.20	0.10
Shukla et al., 2020	India	RCT	30	30	COVID-19	Breathing exercise	Conventional Breathing Exercise	Respiratory function	52.10	3.50	16.60	2.00
Miller et al., 2020	USA	RCT	17	13	COVID-19	Breathing exercise	Conventional Breathing Exercise	Respiratory function	178.00	106.00	74.00	45.00
Jian'an et al., 2021	China	RCT	51	56	COVID-19	Tele-rehabilitation (breathing exercise)	Conventional Breathing Exercise	Respiratory function	14.50	5.60	21.60	17.30
Vignesh. et al., 2021	India	RCT	24	24	COVID-19	Breathing exercise	Conventional Breathing Exercise	Respiratory function	75.70	67.00	3.80	7.10
Li et al., 2021a	China	RCT	47	53	COVID-19	Tele-rehabilitation (breathing exercise)	Conventional Breathing Exercise	Respiratory function	18.50	13.80	22.30	20.80
Liu et al., 2021	China	RCT	64	64	COVID-19	Breathing exercise	Conventional Breathing Exercise	Respiratory function	81.20	80.70	79.40	78.00

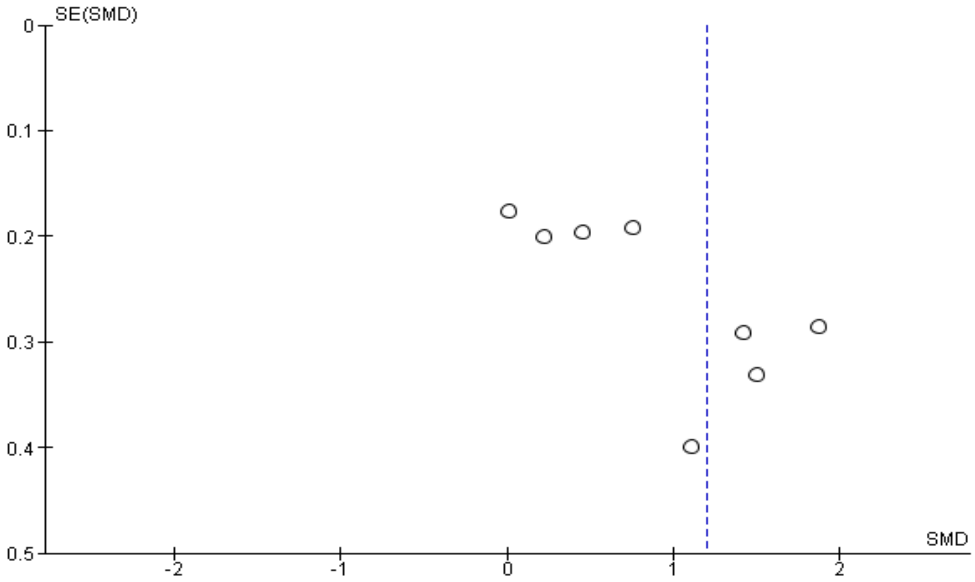

Figure 4. Funnel Plot of the effect of breathing exercise on respiratory function in COVID-19

The funnel plot results showed a publication bias with an underestimate effect which was indicated by an asymmetric distribution between the right and left plots. There were five plots on the right, four plots on the left, and one plot touching the vertical line. The plot on the right side of the graph has a standard error (SE) between 0.2 and 0.4. The plot on the left side of the graph has a standard error (SE) between 0.1 and 0.4.

DISCUSSION

This systematic review and meta-analysis research used the theme of the effect of breathing exercises on respiratory function in COVID-19 patients. This meta-analysis used studies that controlled for confounders using multivariate analysis and the statistical outcome reported was SMD. The combined results of the effect of breathing exercises on respiratory function in COVID-19 patients were processed using the RevMan 5.3 application, while the results of a systematic review and meta-analysis were presented in the form of forest plots and funnel plots.

The forest plot results in this meta-analysis showed that breathing exercises can affect respiratory function in COVID-19 patients by 1.20 times compared to conventional breathing exercises and the results are significant (SMD=1.20; 95% CI=0.61 to 1.79; p<0.001).

Breathing exercises are methods of breathing in a certain way to fix and improve lung performance for a good quality of life. The rehabilitation program consists of respiratory rehabilitation (2 sessions per week for 6 weeks), once a day for 10 minutes. The interventions carried out included respiratory muscle exercises, cough exercises, diaphragm exercises, stretching exercises and exercises at home. Respiratory muscle exercises were performed for three sets with 10 breaths in each set using a commercial handheld device, parameters were set at 60% of the individual's maximal expiratory mouth pressure, with a rest period of 1 minute between the two sets. This

is followed by 10 effective coughing exercises (Liu et al., 2020).

Breathing exercises in COVID-19 are part of the Pulmonary Rehabilitation (PR) or Respiratory Rehabilitation Program (RRP) which has been shown to have a positive impact in repairing lung damage due to lung disease or the installation of mechanical ventilation devices (Chou et al., 2019). Before carrying out the PR and RRP programs, patients must first measure their lung function ability by walking for six minutes (Prakash et al., 2013). Research conducted at the Hainan Affiliated Hospital of Hainan Medical Univeristy in 2020 whose participant subjects used were 72 elderly people, where the group was divided into 2, namely 36 people who received breathing exercise for 6 weeks and 36 people who did not do the same breathing exercise. The breathing exercise method was done in 6 weeks. It has been proven that breathing exercise in respiratory rehabilitation can improve lung function in elderly participants affected by COVID-19 (K. Liu et al., 2020).

Lung capacity measurements were carried out by spirometry, namely measuring Forced Vital Capacity (FVC): the volume of air exhaled after maximal inspiration without providing force, and measuring Force Expiratory Volume 1 (FEV1): the volume of air that can be exhaled in the first second when performing FVC. The result was an increase in FEV1 and FVC, from 66.7 ± 16.0 and 59.1 ± 15.2 to 81.2 ± 14.2 and 72.9 ± 15.2, respectively. Post-COVID-19 patients undergoing Pulmonary Rehabilitation are also assessed for their physical activity abilities with a 6-minute walk (6MWT) test. After strengthening and walking exercises for approximately 5 weeks, the results showed an increase in walking distance or 6 minutes of walking (6MWD) for patients with the COVID-19 ICU Post from 138.7 ± 144.4 to 343.4 ± 139.6 meters. Meanwhile, in Post ICU Non-COVID-19 patients, the increase in 6MWD was not as large as for COVID-19 patients, from 136.6±151.9 to 223.2±170.5 meters (Chikhanie et al., 2020).

In a study done by Wootton (2020), it is stated that to perform breathing exercises in the rehabilitation process for healing COVID-19 patients, patients must undergo pre-intervention, monitoring, and post-intervention. Where a pandemic condition can be an obstacle and one of the risks if mo-nitoring has to be done face-to-face. Monitoring programs such as telehealth rehabilitation can assist in the process of monitoring the rehabilitation of COVID-19 patients. Monitoring is carried out by trained medical personnel who have mastered the procedures for breathing exercises and physical exercises according to the patient's needs for the initial 4-6 weeks after being discharged from the hospital.

AUTHORS CONTRIBUTION

Lilik Sigit Wibisono and Lily Nabillah are the main researchers who choose the topic, search for, and collect research data.

FUNDING AND SPONSORSHIP

This study is self-funded.

CONFLICT OF INTEREST

There was no conflict of interest in this study.

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