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Effect of Breathing Exercise and Super Inductive System on Changes in Vital Capacity in Post-COVID 19 Patients

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Abstract

Coronaviruses are named after the Latin word corona, meaning crown, because their surface structure resembles a crown when observed under an electron microscope. Coronavirus disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), has become a global pandemic and causes respiratory system disorders. Clinical evidence suggests that alveolar injury and interstitial changes are the primary mechanisms of impaired O_2/CO_2 exchange in COVID-19 patients. Approximately 75% of patients who have been treated for the disease continue to experience symptoms up to six months after recovery, primarily fatigue and impaired respiratory function. This condition requires rehabilitative treatment, one of which is physiotherapy. This study aims to determine the effect of Breathing Exercise and the Super Inductive System on changes in Vital Capacity in post-COVID-19 patients.

This study is a pre-experimental study with treatment variables being Breathing Exercise and the Super Inductive System and response variables being Vital Capacity. The study sample consisted of 40 post-COVID-19 patients at the Makassar Center for Community Lung Health (BBKPM). Vital Capacity measurements were performed using a spirometer before and after the intervention, which was administered twice weekly for four sessions.

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The results showed that the group receiving the combination of Breathing Exercise and the Super Inductive System experienced a statistically significant increase in Vital Capacity ($p < 0.05$), with an average increase of 28.57. In contrast, the group receiving only Breathing Exercise did not show a significant increase in Vital Capacity ($p > 0.05$). A comparison test between groups showed that the combination of Breathing Exercise and the Super Inductive System provided a significantly better effect than Breathing Exercise alone in increasing Vital Capacity in post-COVID-19 patients.

In conclusion, the combination of Breathing Exercise and the Super Inductive System is effective in increasing Vital Capacity and can be recommended as part of a physiotherapy rehabilitation program for post-COVID-19 patients.

Keywords: Breathing Exercise; Super Inductive System; Vital Capacity; COVID-19.

1. Introduction

The first COVID-19 case in Indonesia was announced on March 2, 2020 or about 4 months after the first case in Wuhan, China. The first case in Indonesia was found as many as 2 cases and continues to grow. As of October 11, 2021, the number of COVID-19 cases in Indonesia has reached + 4 million cases. The peak of the first COVID-19 cases occurred in January 2021 with the number of daily cases reaching 14,000 new cases. The peak of the second case occurred in July 2021 with the number of daily cases reaching 51,000 new cases with a death rate of 2000 cases per day [1].

Coronavirus is named from the Latin word corona, which means crown, because it is like a crown on the surface as it looks when viewed under an electron microscope [2,3]. Coronavirus is a new virus that belongs to a large family of virus types that can cause diseases ranging from mild to severe symptoms [4]. Coronavirus infection may be asymptomatic or accompanied by fever, cough, shortness of breath, and gastrointestinal irritation [5]. In certain cases, especially in the elderly and immunocompromised individuals, coronavirus infection can lead to severe pneumonia and later, the patient's death. Coronavirus Disease 2019 (COVID-19) caused by the new Beta coronavirus, severe acute respiratory syndrome, coronavirus 2 (SARS-CoV-2) is currently a global pandemic. Clinical evidence collected in COVID-19 patients suggests that alveoli injury and interstitial changes are the main mechanisms of O2/CO2 exchange disruption [6].

Common signs and behaviors of COVID-19 infection include symptoms of acute respiratory disorders such as fever, cough, and shortness of breath. The average incubation period is 5-6 days with the longest incubation period of 14 days [7]. To treat post-COVID syndrome, physiotherapy may be given [8].

Physiotherapy can provide physiotherapy services in accordance with its classification, providing health services for certain movement disorders and body functions in accordance with the specificity of hospital services. Physiotherapy measures are given in the form of a super inductive system and breathing exercises. Super Inductive System (SIS), which is electromagnetic waves with high intensity. SIS has a variety of functions, such as being used to mobilize (move) joints, and provide relaxation to tense muscles (spasme).

The results of the research conducted by Kesicki and his colleagues[9] show positive effects of the applied therapy. Paying attention to the answers given before and after rehabilitation, the respondents' condition improved by 20.18%. Comparison of research results shows that the quality of life of patients improves.

Breathing exercises as part of respiratory rehabilitation improve respiratory parameters in patients hospitalized with COVID-19. Further studies are needed to determine the long-term effects of breathing exercises on overall respiratory function in patients with COVID-19. However, respiratory rehabilitation is non-invasive, safe, easy to apply, and cost-effective [10].Breathing Exercise or deep breathing exercises that are held are almost the same technique as *deep breathing exercises*. The exercise also emphasizes maximum inspiration plus holding at the end of maximum inspiration for two to three minutes. This attracted the attention of the author to examine the effect of breathing exercise and super inductive system on changes in Vital Capacity in post-COVID-19 patients.

2. Material and Method

2.1. Description of the Study Area

The study was conducted at Community Lung Health Center, Makassar, Indonesia in June to August 2024. The type of this research is experimental using Quasi Experimental design and using pre test and post test two-group design method. The first group was given the BE+SIS intervention, while the second group was given the BE intervention.

2.2. Population and Sample

The study population is all patients at Community Lung Health Center Makassar. The sample of this study was 40 post-COVID-19 patients at BBKPM Makassar at the time of the study using random sampling. The sample was divided into 2 groups, group 1 was given Breathing Exercise and Super Inductive System, group 2 was given Breathing Exercise.

2.3. Collecting Data and Procedure Intervention

The data collection procedure was carried out in several stages. First, an initial test (pre-test) was conducted by examining the vital capacity using a spirometer on all samples before being treated. Furthermore, treatment was given twice a week for four weeks. Group 1 received a combination of Breathing Exercise and Super Inductive System (SIS), while group 2 was only given Breathing Exercise. After the treatment was completed, a final test (post-test) was conducted by re-examining the vital capacity using a spirometer to see the changes that occurred after the intervention.

2.4. Ethical consideration and clearance

Ethical approval for this study was obtained from The Ethics Committee, Health Polytechnics of Makassar, Department of Physiotherapy, Makassar, Indonesia.

3. Result

This study uses a type of quasi-experimental research using a pre-test post-test two-group design. This research was conducted in June – August 2024 at the Makassar Lung Health Center. The treatment given for group 1 is Breathing Exercise and Super Inductive System, for group 2 is Breathing Exercise. Vital Capacity is measured using spirometry. The intervention was given 4 interventions, in the last intervention a remeasurement was carried out to assess Vital Capacity as a result of the post test.

Table 1: Characteristics of Respondents

Subject Characteristics		BE+SIS Treatment		BE Treatment	
		n	%	n	%
Age					
a.	18-35 years old	4	20	3	15
b.	36-45 years old	2	10	2	10
c.	46-59 years old	9	45	3	15
d.	60 years and above	5	25	12	60
Total		20	100	20	100
Gender					
Male		11	55	13	65
Female		9	45	7	35
Total		20	100	20	100

Table 1 shows the characteristics of post-COVID-19 patients. Based on age, they are generally between 36-55 years old for the BE+SIS group, and between 46-59 years old for the BE group, based on gender, there are more male than female for both groups.

Table 2: Vital Capacity before and after intervention

Vital Capacity Differences	n	Mean	SD	p-value
BE+SIS Treatment Group				
Pre test	20	47,394	19,234	0,000*
Post test	20	75,964	20,041	
Difference	20	28,570	16,260	
BE Treatment Group				
Pre test	20	44,662	20,504	0,635*
Post test	20	43,025	20,882	
Difference	20	-1,637	15,193	

Information: *Paired sample t test

The results showed that there was an effect of BE+SIS Treatment on increasing Vital Capacity in Post Covid 19 patients, and there was no effect of BE+SIS Treatment on increasing Vital Capacity in Post Covid 19 patients.

Table 3: Differences between the two treatment groups

Differences Between Groups	n	Average change	p-value
BE+SIS Treatment Group	20	28,570	0,000*
BE Treatment Group	20	-1,637	

Information: *Independent Paired sample t test

The results showed that there was a difference in influence between the two treatment groups, where the treatment group with BE+SIS was better than the treatment group with BE.

4. Discussion

This study's findings demonstrate that the integration of Breathing Exercise (BE) with the Super Inductive System (SIS) markedly enhanced Vital Capacity (VC) in post-COVID-19 patients. The statistically significant increase in mean VC in the BE + SIS treatment group post-intervention compared to pre-intervention was seen ($p = 0.000$).

In the BE + SIS group, the average VC rose from 47,394 at pre-test to 75,964 at post-test, resulting in a difference of 28,570. This rise signifies that the combined intervention is both statistically significant and therapeutically relevant. The enhancement in vital capacity signifies enhanced pulmonary ventilation, augmented lung and chest wall elasticity, and strengthened respiratory muscles, which are significant issues in patients post-COVID-19 infection. Conversely, the BE monotherapy group had no significant elevation in VC. The average VC declined from 44,662 to 43,025, exhibiting a difference of -1.637 and a p-value of 0.635. The findings suggest that the implementation of Breathing Exercise alone, without other modalities, was insufficient to enhance lung vital capacity in post-COVID-19 patients during the intervention period of this study. This condition is probably attributable to BE's constraints in effectively activating respiratory muscle tissue, particularly in individuals with lingering lung inflammation and reduced lung compliance following COVID-19.

The comparison of the two treatment groups (Table 3) further corroborates these findings. The BE + SIS group exhibited a mean change in VC of 28.570, whereas the BE group demonstrated a change of -1.637, indicating a statistically significant difference ($p = 0.000$). The independent t-test results demonstrated that the combination of BE and SIS significantly enhanced lung vital capacity compared to BE alone.

Physiologically, the Super Inductive System (SIS) works through exposure to high-intensity electromagnetic fields that can induce neuromuscular depolarization and muscle contraction non-invasively and profoundly. This stimulation can reach the major respiratory muscles, including the diaphragm and intercostal muscles, thereby contributing to increased respiratory muscle strength and endurance, improved thoracic wall expansion, and optimized alveolar ventilation. Several studies based on peripheral magnetic stimulation have reported that this

approach is effective in improving lung function parameters such as forced vital capacity (FVC), forced expiratory volume (FEV_1), and maximal inspiratory and expiratory pressures, reflecting improved functional respiratory muscle performance [11,12].

Patients who have recovered from COVID-19 often still experience disorders in their respiratory system, such as decreased lung vital capacity. An intervention that can help increase the vital capacity of the lungs in post-COVID-19 patients is Breathing Exercise [13] and Super Inductive System (SIS) [14].

SIS uses high-intensity electromagnetic field technology to produce intense yet gentle contractions of respiratory muscles. The goal is to strengthen the diaphragm, intercostal muscles, and improve blood circulation in the thoracic area. SIS uses high-intensity electromagnetic field technology to produce intense yet gentle contractions of respiratory muscles. The goal is to strengthen the diaphragm, intercostal muscles, and improve blood circulation in the thoracic area [14]. The high-intensity electromagnetic field generated by the SIS causes depolarization of the nervous system, resulting in contraction of the respiratory muscles. Contractions of respiratory muscles induced by the electromagnetic field of SIS strengthen major respiratory muscles such as the diaphragm and intercostal muscles. This strengthening of the respiratory muscles increases the patient's ability to inhale deeper and exhale more forcefully. In addition, SIS also improves blood circulation in the thoracic area, which helps supply oxygen and nutrients needed for the recovery of lung tissue damaged by COVID-19 infection [14]. Meanwhile, Breathing Exercises Breathing exercises such as deep breathing exercises, pursed lip breathing exercises, and active cycle of breathing technique (ACBT) have proven to be effective in increasing lung vital capacity in post-COVID-19 patients [13].

Research showing that Breathing Exercise and Super Inductive System (SIS) have a positive effect on increasing vital capacity highlights the benefits of both methods in strengthening respiratory function. Breathing Exercise, through techniques such as diaphragmatic breathing or pursed-lip breathing, trains the respiratory muscles and increases lung elasticity, thereby increasing the volume of lungs used. Meanwhile, SIS, which uses electromagnetic fields to stimulate the respiratory muscles, provides intensive stimulation so that these muscles become stronger and are able to support increased vital capacity. The combination of these two methods can provide a synergistic effect, significantly increasing lung endurance and capacity, especially in individuals with decreased lung capacity or in the process of respiratory rehabilitation.

The study aligns with research showing that a breathing exercise (inspiratory muscle training) program combined with Super Inductive System (SIS) therapy is associated with increased vital capacity (VC) in post-COVID-19 patients compared to standard controls. These findings are consistent with literature reports showing that respiratory rehabilitation and respiratory muscle training can improve lung function (including FVC/VC) and functional capacity in both post-COVID and long-COVID subjects [15].

The findings of this study align with previous research showing that a multimodal approach to post-COVID-19 pulmonary rehabilitation yields superior outcomes compared to single interventions. Rehabilitation programs that combine breathing exercises with methods to increase respiratory muscle strength have been shown to improve lung function, reduce shortness of breath, and increase activity tolerance and functional capacity in

post-COVID-19 patients [16,17,18].

The results of the study showing that Breathing Exercise has no effect on increasing vital capacity could be caused by several factors, such as the technique and duration of the exercise which may not be intensive enough to have a significant impact on lung capacity. Breathing exercises that focus on relaxation, without additional resistance or challenges for the respiratory muscles, tend to be less effective in increasing lung elasticity and respiratory muscle strength. In addition, participant characteristics, such as age, medical history, and initial lung capacity conditions also play a role, especially in individuals with optimal lung conditions or who have a history of respiratory disorders. Therefore, the ineffectiveness of Breathing Exercise in increasing vital capacity may be influenced by a combination of methodological aspects and individual characteristics of the participants.

This study has several limitations that should be considered. The relatively limited sample size and the varying clinical characteristics of post-COVID-19 patients, such as the severity of their previous illness and length of recovery, could potentially impact the generalizability of the results. Furthermore, the short duration of the intervention and follow-up period do not allow for evaluation of the long-term effects of the combination of Breathing Exercise and the Super Inductive System. This study also used only vital capacity as an indicator of lung function, thus not comprehensively describing changes in other respiratory parameters. Therefore, future research is recommended involving a larger sample size, a longer follow-up period, and a wider range of lung function and functional capacity parameters.

5. Conclusion

The combination of Breathing Exercise and Super Inductive System (SIS) is more effective than Breathing Exercise alone in increasing vital capacity in post-COVID-19 patients. In addition, there is a significant effect of the use of Breathing Exercise and SIS on increasing lung capacity in these patients. However, Breathing Exercise performed without SIS support did not show a significant effect on vital capacity.

6. Abbreviation

BE: Breathing Exercise; SIS: Super Inductive System; VC: vital capacity; FVC: forced vital capacity

7. Competing interest

The authors declare that they have no competing interest

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