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Effect of Respiratory Training on Recovered COVID-19 Patients; a Randomized Controlled Study

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Abstract

The COVID-19 survivors may have decreased respiratory capacity, which leads to poor quality of life. It is believed that respiratory training has a good impact on all respiratory functions. This study aimed to determine the effect of respiratory training in recovered COVID-19 patients. Forty patients recovered from COVID-19 (22 men and 18 women) were randomly assigned to two groups; Group A, who received respiratory training program and group B as a control group with no intervention. Hold breath test, Borg dyspnea scale, and O2 saturation were assessed and compared pre-study and immediately after six weeks of training program. The results of hold breath/sec and Borg dyspnea scale was improved in-group A by (13.97 and 57.29%, respectively) versus 0.90 and 51.58%, respectively in-group B; However, there were no significant differences in O2 saturation between before and after training in both groups. It could be concluded that respiratory training can improve respiration in recovered COVID 19.

Keywords: COVID-19, Respiratory training, Hold breath test, Borg dyspnea scale

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1. Introduction

Syndrome Coronavirus 2 (SARS-CoV-2) is considered an infectious disease. World Health Organization (WHO) [1] declared COVID-19 as a pandemic on 11 March 2020. The most common COVID-19 symptoms were nonspecific, with fever, cough, and myalgia. Sore throat, headache, chills, nausea or vomiting, diarrhea, ageusia, and conjunctival congestion were considered among mild symptoms. The COVID-19 was divided into three categories: mild to moderate disease (non-pneumonia and pneumonia), severe disease (dyspnea, respiratory frequency greater than 30/min, oxygen saturation less than 93 percent. PaO_2/FiO_2 ratio less than 300, and/or lung infiltrates covering more than 50% of the lung field within 24–48 hours), and critical disease (respiratory failure, septic shock, and/or multi-organ dysfunction/fail [2]. Long-term respiratory, physical and psychological dysfunctions can be caused by the Corona Virus Infection Disease (COVID-19. COVID-19 can lead to a number of lasting symptoms such as breathlessness, fatigue and reduced ability to engage in activities of daily living. It became apparent that a recovery or rehabilitation program would be necessary to support those to return to normal following infection [3]. A supervised protocol of breathing exercises by physical therapist is recommended for patients with mild to severe COVID-19 patients, as results in SpO_2, demand of oxygen, respiratory rate, and heart rate. As, the breathing exercise improves respiratory muscle function, ribcage flexibility, gas exchange, and may decrease blood pressure, respiratory rate, and stress physiologically, consequently, helping patients with COVID-19 to manage their respiratory symptoms [4]. A respiratory rehabilitation program can improve respiratory function, quality of life (QoL) and anxiety in elderly patients with COVID-19 [5].

2. Materials and Methods

Forty participants of both sexes (22 men and 18 women). They were recovered from COVID-19 infection. They were selected from Nasr city police authority hospital from outpatient clinic for chest who came for regular follow up. They were randomly assigned into 2 equal groups. The ethical committee of Cairo University's Faculty of Physical Therapy has authorized the current research. An informed consent has been signed by the participants was also acquired to initiate the study process. All participants were divided into 2 equal groups for randomization. Group A received respiratory training program in addition to multivitamins supplements and Group B received no

exercises but only multivitamins supplements. They participants who met the inclusion criteria of adults aged >25 and < 45 years old, temperature between 36 and 37.5, blood oxygen saturation ≥95% and negative COVID-19 test for at least 2 weeks. Meanwhile, the exclusion criteria were subjects who had comorbidities from screening and on preliminary examination; the vital signs were unstable before giving exercise (breathing exercises). The subjects who failed the criteria were subjects with unstable hemodynamic during the implementation, fainting, and experienced chest pain or shortness of breath or coughing during breathing exercises.

2.1. Evaluation methods

All patients in both groups undertook the same evaluation procedures with the same sequence, before the study and after 6 weeks (the study period).

2.2. Borg dyspnea scale (BDS)

The BDS examines breathlessness under exertion, with higher scores indicating more intense perceptions of dyspnea. This is a vertical scale quantified from 0 to 10, in which 0 represents no symptoms and 10 represents maximum symptoms.

2.3. Breath hold test (BHT)

It is a test done to calculate how much time the patient can hold his breath as it helps the oxygen's diffusion to the alveoli.

2.4. O_2 saturation

Using a pulse oximeter, to measure the perfusion of the oxygen to the tissue.

2.5. Respiratory training

The respiratory training program was 6 weeks in duration; with three times per day supervised sessions and repeated 6 days per week, at first it was explained to the participant then, it may be done at home. The respiratory training program comprised of a) Diaphragmatic breathing exercises, 30 maximal voluntary diaphragmatic contractions in the supine position. It should be practiced three to four times and then rest, not to allow the patient to hyperventilate., b) Segmental breathing exercises, Patients were given 6 breaths per minute. Total were 18- 20 breaths of exercises in one session lasted for 10- 15 minutes. c) Postural correction while breathing exercises. d) Restricted breathing exercises. e) Incentive spirometer training, the participant was encouraged to achieve a certain volume receiving a visible feedback from the piston rising to the preset marker that set. The participant was instructed to hold his breath for at least 2 or 3 seconds at a minimum at full inspiration. While expiration is performed slowly and calmly with lips no longer sealed around the mouthpiece. After a series of 10 inhalations, coughing should be prompted to further clear the lungs. The participant should be shown how to expand the lower chest at maximal inspiration rather than using the accessory muscles of inhalation. The Borg breathlessness scale and rate of perceived exertion were used alongside self-reported symptoms (including fatigue) to determine progression of the exercises. The outcomes were Borg dyspnea scale (BDS), Breath hold test (BHT) and O_2 saturation.

2.6. Statistical analysis

The unpaired t-test was conducted for comparison of subject characteristics between groups. Chi- squared test was used for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects on hold breath, O2 saturation and borg dyspnea scale. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social sciences (SPSS) version 25 for windows (*IBM SPSS, Chicago, IL, USA*).

3. Results and discussion

In the current study, a total of 40 patients participated and they were randomly distributed into 2 groups (20 patients/group). No significant differences in age (P=0.71; P>0.05), weight (P=0.25; P>0.05), height (P=0.94; P>0.05), BMI (P=0.12; P>0.05), and gender (P=1.000; P>0.05) among groups A, and B. (Table 1). At the end of the study, the results revealed that there was no significant differences in age (P=0.71; P>0.05), weight (P=0. 25; P>0.05), height (P=0.94; P>0.05), BMI (P=0.12; P>0.05), and gender (P=1.000; P>0.05) among groups A, and B. There was a significant increase (P<0.05) in hold breath test within group A (P=0.001) after-treatment compared to before-treatment but there is no significant difference (P>0.05) within group B (P=0.69) between before- and after-treatment. While the Borg dyspnea scale before-treatment had significantly lower within group A (P=0.001), and group B (P=0.001) than before-treatment. Moreover, there is no significant differences (P>0.05) in O_2 saturation between before and after treatment within group A (P=0.48), and group B (P=0.64). This is confirmed by the work of Sinha and Geetanjali 2020, who demonstrated that short training of deep breathing exercises could improve the breath hold test and ventilatory functions. Either it showed a significant change in breath hold test in all subjects males or females with p value for both subjects < .05 after the short-term breathing exercise [6]. In addition, these results come in agreement with Tarigan 2022, who reported a significant improvement in dyspnea assessed by Borg scale after tele rehabilitation involving breathing exercises for 4 weeks that were monitored via videos sent by the subjects through WhatsApp. The borg scale showed this significant improvement, with p-value < 0.05 (3.05 ± 1.53 to 1.40 ± 1.42) [7]. This present study was consistent with the results of study by Djajalaksana 2022 reported that the respiratory exercises developed by Indonesian Society of Respirology (ISR), known as 'senam Asma' (asthma exercise) had no significant difference in the peripheral O2 saturation [8]. Gonzalez-Gerez etal., 2021 Found that completing one-

Table 1. Basic characteristics of participants

Characteristics	Group A	GroupB			
	Mean ± SD	Mean ± SD	MD	t- value	p-value
Age (years)	34.70 ± 3.33	34.35 ± 2.66	0.35	0.37	0.71
Weight (kg)	77.35 ± 9.58	74.25 ± 6.88	3.1	1.17	0.25
Height (cm)	169.25 ± 9.26	169.05 ± 8.20	0.2	0.07	0.94
BMI (kg/m²)	26.98 ± 2.39	25.98 ± 1.52	1	1.57	0.12
Gender, n (%)	-	-	-	-	-
Girls	9 (45%)	9 (45%)		($\chi^2 = 0$)	1
Boys	11 (55%)	11 (55%)			

SD, standard deviation; χ^2, Chi-square test; p-value, level of significance.

Table 2. Mean hold breath, O_2 saturation and Borg dyspnea scale pre and post treatment of group A and B

	Group A	Group B		
	Mean ± SD	Mean ± SD	MD (95% CI)	p-value
Hold breath/sec				
Pre treatment	11.45 ± 1.43	11.10 ± 0.91	0.35(-0.42:1.12)	0.36
Post treatment	13.05 ± 1.19	11.20 ± 0.62	1.85 (1.24:2.45)	0.001
MD (95% CI)	-1.6 (-2.11: -1.08)	-0.1 (-0.61: 0.41)		
% of change	13.97	0.90		
	p = 0.001	***p = 0.69***		
O2 saturation (%)				
Pre treatment	97.80 ± 0.70	98.10 ± 0.64	-0.3 (-0.73:0.13)	0.16
Post treatment	97.95 ± 0.76	98.20 ± 0.77	-0.25 (-0.74:0.24)	0.31
MD (95% CI)	-0.15 (-0.58: 0.28)	-0.1 (-0.53:0.33)		
% of change	0.15	0.10		
	p = 0.48	***p = 0.64***		
Borg dyspnea scale				
Pre treatment	4.80 ± 0.83	4.75 ± 0.72	0.05 (-0.45:0.55)	0.84
Post treatment	2.05 ± 0.76	2.30 ± 0.66	-0.25 (-0.70:0.20)	0.27
MD (95% CI)	2.75 (2.37: 3.13)	2.45 (2.07:2.83)		
% of change	57.29	51.58		
	p = 0.001	***p = 0.001***		

SD, Standard deviation; **MD,** Mean difference; **CI,** Confidence interval; **p-value,** Level of significance

week of tele rehabilitation program based on respiratory exercises and supervised and monitored by physical therapists had a significant improvement on Borg scale compared with pre intervention in patients with mild to moderate symptoms than those who receive no intervention and these results came with accordance with our study that showed significant improvement of Borg scale in intervention group than control group [9]. However, it is noteworthy that Alahmri et al., 2020 didn't match with our study as they reported that there is significant improvement in oxygen saturation after pulmonary rehabilitation, but we found that there was no significant changes in the oxygen saturation post respiratory exercises in compare with non-interventional group [1]. Moreover, Djajalaksana et al., 2022 found that there is no significant differences in Borg scale after respiratory training program known as 'senam Asma' (asthma exercise), that was developed by Indonesian Society of Respirology (ISR) [8].

3.1. Effect of treatment on hold breath, O_2 saturation and borg dyspnea scale

There was a significant interaction of treatment and time ($F = 5.94$, $p = 0.002$, Partial eta squared = 0.33). There was a significant main effect of time ($F = 132.85$, $p = 0.001$, Partial eta squared = 0.92). There was a significant main effect of treatment ($F = 6.68$, $p = 0.001$, Partial eta squared = 0.36). There was a significant increase in hold breath and a significant decrease in borg dyspnea scale of group A post treatment compared with that pretreatment ($p > 0.001$). There was a significant decrease in borg dyspnea scale of group B post treatment compared with that pretreatment ($p > 0.001$), while there was no significant change in hold breath in group B ($p > 0.05$). There was no significant change in O_2 saturation in both groups ($p > 0.05$). (Table 2). Comparison between groups post treatment revealed a significant increase in hold breath of group A compared with that of group B ($p < 0.001$). There was no significant difference in O_2 saturation and borg dyspnea scale between groups post treatment ($p < 0.05$). (Table 2).

4. Conclusions

It can be concluded that respiratory training can increase respiration as it improves hold breath test and Borg dyspnea scale. Future studies are needed to establish the optimal protocol, duration, and long-term benefits as well as cost-effectiveness of rehabilitation.

Author contributions

All authors equally contributed in this research.

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Conflicts of Interest

"The authors declare no conflict of interest."

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