EFFECTIVENESS OF UPPER LIMB EXERCISE ALONG DIAPHRAGMTIC BREATHING WITH OR WITHOUT LOWER LIMB EXERCISE IN COVID19 SURVIVORS

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Abstract- SARS-related illnesses, such as COVID-19, were extremely contagious. Since the outbreak of SARS, quality of life and ability to exercise were negatively affected by a patient's illness severity. COVID patients were frequently discharged with a poor quality of life and significant physical and psychological impairment. Therefore, an immediate and effective treatment program was needed to address this issue. So, a randomized controlled study was conducted at Khawaja Farid Hospital Multan to see the effect of diaphragmatic breathing, and upper and lower limb exercise training on respiratory function, exertion, and the quality of life in COVID-19 survivors. The study duration was from November 2021 to March 2022. Those who had recovered from COVID-19 were included in this single-blinded, randomized study, which included 176 participants ranging in age from 35 to 60 years. Spirometry, a 6-minute walk test, the borg scale, and the SF8 questionnaire were all used to assess outcome measures. Two groups were created for the subjects. Treatment was done five days per week for four weeks in both groups. SPSS V 23 was used to analyze the data. Histograms of age for both groups were plotted as well as a pie chart for gender distribution. Independent samples t-test was applied to find the comparison between the groups. FEV1 (forced expiratory volume) mean difference was - 12.56159. FVC (forced vital capacity) mean difference was - 15.63636. Post FEV1/FVC mean difference was - 14.92045. PCS (physical component score) mean difference was 4.63636. MCS (mental component score) mean difference was 8.22727. Between the groups, results showed that group 2 showed better improvement as compared to group 1 with a p-value of 0.000 which was highly significant. This study concluded that diaphragmatic breathing, upper limb exercise training along with lower limb exercise training was highly effective for improving respiratory function, exertion, and quality of life as compared to diaphragmatic breathing with upper limb exercise training.

Index Terms- Coronavirus, Respiratory system, Breathing exercise, Exercise training.

I. Introduction

SARS-related illnesses, such as COVID-19, are extremely contagious. People in the Chinese province of Guangdong were infected with the virus that causes Severe Acute Respiratory Syndrome (SARS) (1). Acute respiratory distress syndrome was developed in infected patients with pneumonia and widespread alveolar damage (ARDS), and flu-like symptoms (2). Droplet particles released during sneezing and coughing of an infected person are the primary means of transmission for this highly contagious disease. The number of people infected with coronavirus were on the rise as well, in Pakistan (3). When a virus enters the lungs, it is taken up by angiotensin-converting enzyme 2 (ACE2). Alveolar cells are damaged when viruses bind to ACE2. Consequently, respiratory problems, other systemic issues, and death are caused by alveolar cell damage (4). Morbidity, death, and the shifting of personal roles have all been a result of the current global pandemic of COVID-19 that has affected everyone on the planet. Pneumonia and respiratory failure necessitate the use of artificial ventilation and other techniques to improve respiratory function in COVID patients more frequently. Early chest physiotherapy can improve gas exchange and prevent the need for artificial ventilation in other respiratory conditions if given in the early stages of the illness (5). Lung damage from the virus's attack on the respiratory tract is present in those who recover from SARS-CoV-2 infection (6). COVID patients are frequently discharged with a poor quality of life and significant physical and psychological impairment. Therefore, pulmonary rehabilitation must be both safe and effective to be effective (7). Within six to eight weeks of being discharged from the hospital, between 6 and 20 percent of patients with severe acute respiratory syndrome developed mild or moderate restrictive lung function and weakened muscle (8). Because of their inactivity, people suffering from pulmonary diseases have lower levels of muscle mass and strength (9).

According to research, a program of exercise training, education, pulmonary rehabilitation, and behavioral support can improve people's functional exercise capacity and quality of life (10). Upper limb training is thought to improve respiratory muscle coordination and reduce dyspnea (11). Due to the resulting dyspnea and chest discomfort, some patients had difficulty working out. Breathing techniques can be used in conjunction with other techniques to reduce the symptoms patients experience after training. As part of a COVID-19 treatment plan, upper body training must also be included (12). Weakened muscles, reduced endurance, and an increase in muscle fatigue are all possible outcomes of limb muscle dysfunction (13). As a person's ability to walk and engage in physical activity declines, as well as the amount of time spent in medical facilities, mortality and morbidity increase (14). Lower-limb endurance training's effects on variables are influenced by thoracoabdominal motion. Diaphragmatic breathing is another technique that has shown promise in reducing stress and anxiety in the self-perceived sense(15). People with COVID-19 may be able to improve their functional exercise capacity through the use of diaphragmatic breathing exercises after transplantation because it is non-invasive and has the potential to improve a wide range of diseases (16). It is estimated that COVID has been the leading cause of death in the world for the past two years. Research-based evidence for the use of physical therapy in the treatment of COVID has been lacking, especially when the patient was on mechanical ventilation and in critical condition. Improved pulmonary function, endurance, and overall quality of life can be achieved through physiotherapy. During this study, COVID survivors were given diaphragmatic breathing and upper and lower limb exercise training, and the results were studied. COVID survivor's respiratory performance was the primary goal of the study, which included upper and lower limb exercise training and diaphragmatic breathing exercise.

II. Materials and methods

A randomized controlled study was conducted. Khawaja Farid Hospital in Multan served as the source of the data. Data was collected after approval from the institutional ethics review committee. Non-probability consecutive sampling was used for data collection. With a 5% level of significance, the sample size was computed using the Burkoff sample formula: $n=2\sigma 2\ (Z1\text{-}\alpha+Z1\text{-}\beta)\ 2\ /\ (\mu o\text{-}\mu\alpha)\ 2$. A total of 176 participants were randomly divided into two groups by the lottery method. 176 participants were divided into two equal groups. Each group consisted of 88 participants. After consent was taken, participants were included according to the inclusion criteria. Inclusion Criteria: Between the ages of 35 and 60 (17). Gender (male and female). COVID-19 survivors were discharged from the hospital six weeks ago (diagnosed with COVID.-19, had a respiratory illness, and were unconfined six weeks ago) (18). Exclusion Criteria: In the last 14 days, if patient had any of the following: fever; new or worsening respiratory symptoms > 38.2 degrees Celsius (e.g., cough, dyspnea) (19). Pregnant Females (20). Refusal to give consent approval. Data Collection Procedure: A medical history of the participants was taken, and respiratory function was assessed by using spirometry. A 6- minute walk test was performed. Their level of fatigue was assessed by the borg scale and a questionnaire about their quality of life was fulfilled. Outcome measures were measured before the start of the treatment regimen and after the end of the treatment regimen of 4 weeks. Pre and post-values were taken to see if any improvement occurred within variables. Exercises for the upper limbs included shoulder presses, bicep curls, and wall presses; exercises for the lower limbs included knee extensions in sitting squats, stair climbing, and sit-to-stand. Diaphragmatic Breathing Technique: They supported their legs with a pillow beneath their knees while resting on their back on a flat surface or in bed, knees bent and head supported. One hand was on their upper chest, the other slightly below their rib cage. This allowed them to feel the diaphragm move as they breathed. They inhaled slowly through their nose, causing their stomach to move out against their hand. The hand on the chest was as still as possible. They clenched their stomach muscles, allowing them to fall inward while exhaling through pursed lips. Upper chest hand remained as still as possible. Participants in both groups received five sessions per week during the 4 weeks. Participants of Group A performed upper limb exercise training along with diaphragmatic breathing exercises at each session. Participants of Group B performed upper and lower limb exercise training along with diaphragmatic breathing exercises in each session. All participants received a total of 20 rehabilitation sessions (5 sessions per week for 4-

week periods). Data Analysis Procedure: SPSS V 23 was used to analyze the data. Kolmogorov-Smirnov test for normality of data was applied. Independent samples t-test was applied to find the difference between the groups for spirometry parameters (FEV1, FVC & FEV1/FVC ratio), rating of perceived exertion, and mental and physical component of the SF8 questionnaire. Paired samples t-test was applied for finding differences within group. A significant value was set at p=0.05. Among data, group 1 presented diaphragmatic breathing and upper limb exercises without lower limb exercises, while group 2 represented diaphragmatic breathing, upper limb exercises, and lower limb exercises.

III. Results

The average mean age of participants in group 1 was 43.8295±5.61038 years. The average mean age of participants in group 2 was 50.9886 ± 4.79342.

In group 1, 31(35.2%) females and 57(64.2%) males were included while in group 2, 34(38.6%) females and 54(61.4%) males were included. Quality of life was measured by asking mental and physical conditions of participants. PCS (physical component score) and MCS (mental component score). Comparison between groups was assessed by finding the difference between post-treatment means values of variables. The mean value of Forced Expiratory Volume in 1 second (FEV1) of both groups was compared. Post FEV1 mean value of group 1 was 45.4094±1.37412 while Post FEV1 mean value of group 2 was 57.9710±1.08323 with a mean difference of -12.56159 between the groups which showed that the FEV1 mean value of group 2 showed better improvement as compared to FEV1 mean value of group 1 with p-values 0.000 that was highly significant. The mean value of Forced vital capacity (FVC) of both groups was compared. Post FVC mean value of group 1 was 61.5909±.76769 while Post FVC mean value of group 2 was 77.2273±2.37674 with a mean difference of -15.63636 between the groups which showed that the FVC mean value of group 2 showed better improvement as compared to FVC mean value of group 1 with p-values 0.000 that was highly significant. The mean value of FEV1/FVC of both groups was compared. Post FEV1/FVC mean value of group 1 was 71.5227±.50235 while Post FEV1/FVC mean value of group 2 was 86.4432±1.84987 with a mean difference of -14.92045 between the groups which showed that Post FEV1/FVC mean value of group 2 showed better improvement as compared to Post FEV1/FVC mean value of group 1 with p-value 0.000 that was highly significant. The mean value of Post RPE of both groups was compared. Post Rate of perceived exertion (RPE) mean value of group 1 was 7.4886±.71107 while Post RPE mean value of group 2 was 1.8068±.65842 with a mean difference of 5.68182 between the groups which showed that the RPE mean value of group 2 showed better improvement as compared to RPE mean value of group 1 with p-value 0.000 that was highly significant. The mean value of Post PCS of both groups was compared. Post PCS mean value of group 1 was 7.3636±.48380 while Post PCS mean value of group 2 was 2.7273±.47288 with a mean difference of 4.63636 between the groups which showed that the PCS mean value of group 2 showed better improvement as compared to PCS mean value of group 1 with p-value 0.000 that was highly significant. The mean value of Post MCS of both groups was compared. Post MCS mean value of group 1 was 11.3977±.49223 while Post MCS mean value of group 2 was 3.1705±.61066 with a mean difference of 8.22727 between the groups which showed that the MCS mean value of group 2 showed better improvement as compared to MCS mean value of group 1 with p-value 0.000 that was highly significant. Between the groups, the result showed that group 2 showed better improvement as compared to group 1 with a p-value of 0.000 which was highly significant.

TABLE 1: COMPARISON OF VARIABLES WITHIN GROUP 1

Variables of Group 1		Mean±SD	Sig. (2-tailed)
Pair 1	PRE FEV1	42.0110±.76299	0.04
	POST FEV1	45.4094±1.37412	
Pair 2	PRE FVC	58.4205±.89342	0.03
	POST FVC	61.5909±.76769	
Pair 3	PRE FEV1.PREFVC	68.8523±1.12995	0.04
	POST FEV1.POSTFVC	71.5227±.50235	
Pair 4	PRE RPE	8.4886±.71107	0.03
	POST RPE	7.4885±.71106	
Pair 5	PRE PCS	9.6477±.48042	0.03
	POST PCS	7.3636±.48380	
Pair 6	PRE MCS	13.6818±.46844	0.03
	POST MCS	11.3977±.49223	

TABLE 2: COMPARISON OF VARIABLES WITHIN GROUP 2

Variables of Group 2		Mean±SD	Sig. (2-tailed)
Pair 1	PRE FEV1	43.1461±1.53680	0.000
	POST FEV1	57.9710±1.08323	
Pair 2	PRE FVC	55.5909±2.18478	0.000
	POST FVC	77.2273±2.37674	
Pair 3	PRE FEV1.PRE FVC	63.6477±1.55393	0.000
	POSTFEV1.POST FVC	86.4432±1.84987	
Pair 4	PRE RPE	9.2614±.87749	0.000
	POST RPE	1.8068±.65842	
Pair 5	PRE PCS	14.9545±1.38886	0.000
	POST PCS	2.7273±.47288	
Pair 6	PRE MCS	15.9545±.70969	0.000
	POST MCS	3.1705±.61066	

TABLE 3: COMPARISON OF VARIABLES BETWEEN GROUPS

Variable	Group	Mean	Std.Deviation	Mean difference	T	Sig. (2-tailed)
Post FEV1	group 1	45.4094	1.37412	-12.56159	-67.346	.000
	group 2	57.9710	1.08323			
Post FVC	group 1	61.5909	.76769	-15.63636	-58.728	.000
	group 2	77.2273	2.37674			
Post FEV1/FVC	group 1	71.5227	.50235	-14.92045	-73.018	.000
	group 2	86.4432	1.84987			
Post RPE	group 1	7.4886	.71107	5.68182	55.000	.000
	group 2	1.8068	.65842			
Post PCS	group 1	7.3636	.48380	4.63636	64.289	.000
	group 2	2.7273	.47288			
Post MCS	group 1	11.3977	.49223	8.22727	98.398	.000
	group 2	3.1705	.61066			

IV. Discussion

The results of this study showed that diaphragmatic breathing, upper limb exercise training along with lower limb exercise training were highly effective for improving respiratory function, exertion, and quality of life as compared to diaphragmatic breathing with upper limb exercise training. Our study demonstrated that combined use of upper and lower limb exercise along with diaphragmatic breathing exercise was found to be more effective in improving respiratory function and patient's quality of life in COVID-19 survivors. Our results were similar to previous studies conducted comparing the effects of upper limb and breathing exercises on the six-minute walking distance among patients with chronic obstructive pulmonary disease (21). COVID-19 can cause a decrease in respiratory function and quality of life. Numerous studies and papers have been published in the last few decades on the treatment of respiratory problems in COVID-19 survivors. Researchers conducted a previous study to learn more about the effects of upper-limb training on dyspnea and quality of life in people with chronic obstructive pulmonary disease. According to this study, upper limb exercise training reduced pulmonary symptoms and improved breathlessness (22). The results of this study were in favor of my study that upper and lower limb exercise training along with diaphragmatic breathing reduced pulmonary symptoms. Another study showed the beneficial effect of pulmonary rehabilitation in COVID-19 for improving lung function, exercise performance, and quality of life. Pulmonary rehabilitation in the COVID-19 program was found to have a positive effect on improving lung function and exercise performance, as well as improving quality of life (23). Results of my study have also shown that respiratory rehabilitation improved respiratory function and quality of life. In patients with covid-19, aerobic exercise has also been shown to have a beneficial effect on the severity and progression of symptoms. COVID-19-related disorders were reduced after two weeks of moderate-intensity aerobic exercise. In addition, aerobic exercise increased leukocyte, lymphocyte, and immunoglobin A count in the bloodstream after two weeks of exercise (24). Similarly, the current study showed that exercise training was found to be effective in improving respiratory function. According to a different study, elderly patients with COVID-19 disease benefitted from respiratory rehabilitation. Six-week respiratory rehabilitation improved elderly COVID-19 patient's respiratory function and quality of life, but little improvement in elderly COVID-19 patients' depression was seen (25). Another study found that lower-limb endurance training improved dyspnea and lung function in patients with COPD. Endurance training was proposed as a treatment for some of the patient's symptoms. The dyspnea and pulmonary function test results of patients with chronic obstructive pulmonary disease improved after one month of twice-weekly lower limb endurance training (26). In this study, lower limb exercise training was effective to improve respiratory function when it was performed with upper limb exercise training along with diaphragmatic breathing. Literature supported the effects of upper and lower limb exercise along with diaphragmatic breathing for improving pulmonary function and quality of life. No study highlighted their combined effect. In our study, upper and lower limb exercise training was given to COVID-19 survivors. As COVID-19 is a contagious disease, it reduced quality of life and pulmonary function. Upper and lower limb exercise training both improved exercise tolerance and quality of life while breathing exercises helped to improve pulmonary functions.

V. Conclusion

This study concluded that diaphragmatic breathing, upper limb exercise training along with lower limb exercise training was highly effective for improving respiratory function, exertion, and quality of life as compared to diaphragmatic breathing with upper limb exercise training.

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