

Effects of physiotherapy management on the percentage of lung involvement, performance, and anxiety level, between hospitalized male and female patients with COVID-19 Pneumonia, an interventional study

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Abstract

Background:

COVID-19-causing SARS-CoV-2 is global. respiratory distress. COVID-19 exhausts oxygen in the lungs. COVID-19 patients worry about their own and their family's health, being alone, losing their job, feeling helpless, and dying, which causes anxiety, depression, physiological stress, decreased physical performance, and decreased physical activity. Respiratory rehabilitation helps chronic pulmonary disease patients breathe. Rehabilitating COVID-19 patients is rare. Thus, this study compares the male and female effects of physiotherapy management on performance, anxiety, and stress in hospitalized COVID-19 pneumonia patients.

Methodology:

The study included 30 male and 30 female COVID-19 pneumonia patients (18–65 years old) from different centers in Al-Nassiriya province/Al-Hussein teaching hospital, Iraq. Patients' age, weights, heights, and BMI were recorded. at admission and before discharge; baseline CT and lung involvement

percentages were recorded. Anxiety was rated. The dynamic distance 6-minute walk test measured (exercise endurance).

COVID-19 pulmonary rehabilitation guided physiotherapy. at admission and post-Rehabilitation evaluations were done.

Result

At the RCU/Al-Hussein teaching hospital, we studied 60 COVID-19 pneumonia hospitalizations. Men and women are numbered equally. Patients were 22 to 65 years old, with a mean age of 43.52 +12.54. At discharge, anxiety and CT score (% lung involvement) decreased significantly (p0.0001).

Discharge exercise endurance (6-minute walk test) and oxygenation (10.22% and 125.96%, respectively) were significantly higher (p0.0001) than baseline. Both genders were affected.

Conclusion

Physiotherapy improved COVID-19 patients' oxygenation, and exercise endurance while decreasing lung involvement and anxiety.

Breathing exercises, early mobilization, and positioning can help COVID-19 patients, both men and women.

Keywords: COVID-19, SARS-CoV-2, physiotherapy, stress, lung involvement.

Introduction

On March 11, 2020, the coronavirus disease 2019 (COVID-19) outbreak began in the People's Republic of China's Hubei Province ^[1,2]. Through its Emergency Committee, the World Health Organization (WHO) declared COVID-19 a pandemic ^[2]. COVID-19 is caused by SARS-CoV-2, a coronavirus of the coronavirus family.

A substantial percentage of COVID-19 patients do not require hospitalization because they have a mild form of the disease with a good prognosis. On the other hand, patients with advanced age, other chronic diseases, pregnant women, and immunocompromised patients develop severe COVID-19 complications such as acute respiratory disease syndrome (ARDS).

Other complications include sepsis, septic shock, kidney failure, and cardiac failure. These patients require intensive care unit (ICU) admission as well as

supportive care ^[3]. About 14% of COVID-19 patients develop severe symptoms and require hospitalization, with about 5% requiring ICU admission ^[4].

Pneumonia has been linked to a decrease in physical and mental function ^[5]. A six-week respiratory rehabilitation program improved respiratory function and anxiety in COVID-19 patients, according to a study.

A large proportion of COVID-19 patients experience acute respiratory failure requiring mechanical ventilation ^[6,7]. COVID-19-related long-term physical, psychological, and cognitive impairment in patients should be investigated ^[8]. Patients admitted to the hospital due to COVID-19 who had no history of motor limitation had a high prevalence of impaired physical performance and muscle weakness ^[9-11].

In patients admitted to intensive care units (ICUs), muscle weakness and impairment of physical performance can be associated with systemic inflammation, mechanical ventilation, and prolonged bed rest ^[12].

A recent study found that pulmonary rehabilitation effectively improved physical performance in COVID-19 patients ^[13]. Stressors like constant worry about their own and their family members' health, isolation, loss of livelihood, sense of helplessness, and mortality risk cause anxiety and depression in COVID-19 patients ^[14,15].

These stressors could result in the development of new symptoms or a worsening of current ones. These stressors, along with other factors like ventilation support, environmental factors (hospital conditions), and frequent medication, have been observed to contribute to sleep difficulties in COVID-19 patients ^[14].

It is advised that all COVID-19 patients be kept under close observation for any neuropsychiatric emergencies and receive basic mental health and psychosocial support. Physiotherapy can be used to rehabilitate COVID-19 patients who have decreased physical activity and muscle weakness. Depending on the infection's severity, patients may experience mild to severe muscle weakness ^[16]. Throughout the hospital stay and recovery of patients, physical therapy is crucial.

According to Baricich et al., 32% of COVID-19 patients still showed signs of physical impairment 3 to 6 months after being discharged ^[17]. These results demonstrate the value of physical therapy even after a patient leaves the hospital, also to increase the rate of functional recovery in COVID-19 patients, it is advised to start physical rehabilitation as soon as possible ^[18,19]. Recent research suggests using physiotherapy to treat COVID-19 patients.

Personalized rehabilitation physiotherapy improves the quality of life, physical performance, fatigue, respiratory function, and depression, according to several studies, case reports, and expert opinions ^[20,21].

Critically ill and ARDS patients with prolonged ICU stays benefit from early rehabilitation. ARDS patients who undergo early rehabilitation in the ICU recover faster and perform better in walking tests after discharge ^[22-24].

Chest physiotherapy assists with respiratory conditions. Early chest physiotherapy improves gas exchange, slows pathological progression, and eliminates mechanical ventilation ^[25,26].

COVID-19's high infectiousness makes chest physiotherapy aerosolization a concern ^[27]. In influenza patients, chest physiotherapy produced non-respirable droplets >10 m ^[28-30]. SARS, like COVID-19, also requires chest physiotherapy ^[31].

In COVID-19 patients, the goal of chest physiotherapy is to provide short-term relief from dyspnea, anxiety, and depression, and in the long run, the goal of chest physiotherapy in COVID-19 patients is to improve physical functions, which improves the quality of life ^[32,33].

Aim

This study aimed to assess the impact of physiotherapy management on lung involvement, performance, and anxiety levels, and also to compare the outcomes for male and female hospitalized patients with COVID-19 pneumonia.

Subjects and methods:

This is a pre-post interventional study in which 60 hospitalized patients (both males and females) with COVID-19 pneumonia diagnosed by an emergency or cardiopulmonary physician were recruited from the ICU department in Al-Nassiriya province/Al-Hussein teaching hospital. The patients were divided into two equal groups for interventions based on their gender (30 males and 30 females).

The study included patients of both genders ranging in age from 25 to 65 years. With hospitalization periods of at least two weeks. The study excluded those with orthopedic, systemic, and neurological disorders, as well as pregnant women.

G power calculations were used to estimate sample size. The sample size was calculated using Zampogna et al's study (effect size of 6-meter walking outcome

measure = 0.98)^[34]. G power calculations yielded a sample size of 30 participants in each group, for a total sample size of 60.

The demographic characteristics of the patients such as age, gender, weight, height, and BMI were collected in an excel sheet.

CT scan and lung involvement were recorded at baseline and before discharge. All images were taken using an Aquilion, 64-slice Toshiba CT system with patients supine during a single inspiratory breath-hold to reduce motion artifacts when possible, a standard low-dose chest CT protocol has been used with the following scanning parameters: tube voltage = 120 kV, automatic tube current modulation (30-70 mAs), matrix = 512 512, slice thickness = 1 mm, field of view = 350 mm. All images were then reconstructed with a slice thickness of 0.625-2 mm with the same increment^[35].

On a 5-point scale ranging from 1 (not at all anxious) to 5 (very anxious), anxiety levels were measured^[36,37].

The 6-minute walk test (6MWT) was used to measure exercise endurance; it is the distance covered in 6 minutes (also known as the dynamic distance)^[38].

In accordance with the recommendations for patients diagnosed with COVID-19 included in the guidelines for pulmonary rehabilitation, a customized exercise plan was developed for the patients.

The following were components of the exercise program:

A: Breathing exercises such as diaphragmatic breathing, segmental breathing, breathing with pursed lips, and an effective cough are recommended.

B: Early mobilization, sitting in bed, sitting up in bed, walking after sitting up in bed for a while.

C: In addition to receiving guidance on how they should position themselves, patients received instruction on how to perform simple exercises, such as range of motion exercises and simple stretching^[39,40].

The outcome measures were assessed both during the initial session at the Rehabilitation Center and shortly after the rehabilitation was completed (before discharge from the hospital).

For the statistical analysis, SPSS version 26 software was used. The Kolmogorov-Smirnov (k-s) test was used to ensure that the data was normal. Continuous variables were presented as mean, SD, minimum and maximum, and frequency (%), while categorical variables were presented as frequency (%). The student t-test was used to compare the means of males and females. The baseline means were compared to the discharge means using a paired sample t-test. To

compare more than two groups, a one-way ANOVA was used. P values of less than 0.05 were considered significant.

Results:

Kolmogorov-Smirnov (k-s) test verified data normality (Table-1). Except for the baseline CT score (percent lung involvement), post-discharge CT score, and baseline and post-discharge 6-minute walk, all variables had a normal distribution ($p>0.05$). We applied parametric tests because the majority of variables were normally distributed.

Table (1): Test for normality. The Kolmogorov-Smirnov test was performed to check the distribution of data. Data distribution was considered Normal if the significance was more than 0.05.

Variables	Kolmogorov-Smirnov ^a		
	Statistic	Difference	Significance
Age (years)	0.07	60	0.20
Weight (kgs)	0.06	60	0.20
Height (cm)	0.19	60	0.40
BMI (Kg/m ²)	0.12	60	0.05
CT Baseline (%)	0.13	60	0.02
CT After discharge (%)	0.13	60	0.01
Anxiety Baseline	0.15	60	0.10
Anxiety After discharge	0.10	60	0.18
6 min walk Baseline (meters)	0.18	60	0.000
6 min walk after discharge (meters)	0.14	60	0.004

Table (2) shows baseline patient characteristics (2). Sixty severe COVID-19 pneumonia patients were included in the RCU at Al-Hussein teaching hospital, male to female ratio was 1:1. the patients averaged 43.52 ± 12.54 years (Min=22, Max=65). The mean weight and height were 76.87 ± 15.96 kgs (Min=45, Max=130) and 163.67 ± 10.06 (Min=145, Max=190). The patients' mean BMI was 28.88 ± 6.55 kg/m² (Min=18.73, Max=45.52). Baseline CT score (% lung involvement) was 38.34 ± 16.62 (Min=0.40, Max=75). Baseline anxiety was 11.73 ± 2.86 (Min=6, Max=19). Baseline exercise endurance (6 min walk) was 172.17 ± 120.28 (Min=5, Max=600).

Table (2): Baseline characteristics of the patients (n=60).

Baseline Characteristics (n=60)	Mean \pm SD	Minimum	Maximum
Age (Years)	43.52 ± 12.54	22.0	65.0
Weight (Kg)	76.87 ± 15.96	45.0	130.0

Height (cm)	163.67±10.06	145.0	190.0
BMI (Kg/m ²)	28.88±6.55	18.73	45.52
Baseline CT score (% lung involvement)	38.34±16.62	0.40	75.00
Baseline Anxiety	11.73±2.86	6.0	19.0
Exercise endurance (6 min walk in meters)	172.17±120.28	5.0	600.0

Comparing male and female baseline features; besides height, which was significantly higher ($p < 0.0001$) in men (169.53 ± 8.54) cm than in females (157.80 ± 7.85) cm, other baseline data were not statistically different (Table 3).

Table (3): Comparison of the baseline characteristics between males (n=30) and females (n=30).

Baseline Characteristics	Male (n=30)	Female (n=30)	Mean difference	t statistics	Effect size	Power	P value
Age (Years)	43.73±12.5 2	43.30±12.77	0.43	0.13	0.04	0.05	0.90
Weight (Kg)	78.23±11.3 8	75.50±19.61	2.73	0.66	0.18	0.11	0.51
Height (cm)	169.53±8.5 4	157.80±7.85	11.73	5.54	1.56	0.99	<0.0001 *
BMI (Kg/m ²)	27.25±3.91	30.48±8.16	-3.23	-1.96	0.53	0.54	0.06
Baseline CT score (% lung involvement)	38.33±16.0 5	38.35±17.46	-0.01	-0.003	0.001	0.05	0.99
Baseline Anxiety	11.10±2.70	12.37±2.92	-1.23	-1.75	0.64	0.71	0.09
Exercise endurance (6 min walk in meters)	198.00±142 .06	146.33±88.7 3	51.67	1.69	0.44	0.41	0.10

Student t-test was performed and the values were represented as mean±SD. Cohen's d was calculated to determine the effect size. P values less than 0.05 was considered to be significant.

*=Highly significant statistically.

At discharge, the CT score (% lung involvement) reduced by 33.78% and anxiety decreased by 38.87% compared to baseline values ($p < 0.0001$). At discharge, there was a significant increase in both; oxygenation (10.22%) and exercise

endurance (6 min walk test) (125.96%) compared to baseline values ($p < 0.0001$), Table (4).

Table (4): Effect of physiotherapy management on CT score (% lung involvement), anxiety levels, and exercise endurance (6 min walk test) score.

Characteristics (n=60)	Baseline	At discharge	% Change	Mean difference	t statistics	Effect size	Power	P value
Baseline CT score (% lung involvement)	38.34±16.62	25.39±17.02	33.78	12.95	19.06	2.46	1	<0.0001*
Anxiety	11.73±2.86	7.17±2.51	38.87	4.57	21.04	2.72	1	<0.0001*
Exercise endurance (6 min walk-meter)	172.17±120.28	389.03±203.94	125.96	-216.87	-15.40	-1.99	1	<0.0001*

Paired t-test was performed and the values were represented as mean±SD. Cohen's *d* was calculated to determine the effect size. P values less than 0.05 was considered to be significant. *=Highly significant statistically.

The physiotherapy intervention had the same impact on both men and women. At discharge, there was a significant ($p < 0.0001$) decrease in the CT score (percent lung involvement) (34.74% in males vs. 32.88% in females) and anxiety levels (36.67% in males vs. 41.03% in females) compared to baseline values in both sexes. There was no significant difference between male and female baseline mean CT scores ($p = 0.70$). Also, there was no significant difference between males and females in the mean CT at discharge ($p = 0.87$) (Table 5).

At discharge, both men and females had a significant ($p < 0.0001$) increase in their 6-minute walk test (6MWT) scores compared to their baseline values (113.33% in males and 143.10% in females).

Males had significantly higher baseline exercise endurance (6 min walk test) scores than females ($p = 0.04$), while the mean exercise endurance (6 min walk test) scores after discharge were not statistically different ($p = 0.07$) (Table 5).

Table (5): Gender-wise comparison of the effect of physiotherapy management on CT score (% lung involvement), anxiety levels, and exercise endurance (6 min walk test) score.

Parameters	Gender	Baseline	At discharge	P value	% Change
CT score (% lung involvement)	Male (n=30)	38.33±16.04	25.03±17.36	<0.0001	34.71
	Female (n=30)	38.35±17.46	25.74±16.97	<0.0001	32.88
	P value	0.71	0.87		
Anxiety	Male (n=30)	11.10±2.71	7.03±2.82	<0.0001	36.67
	Female (n=30)	12.38±2.92	7.30±2.21	<0.0001	41.03
	P value	0.53	0.12		
Exercise endurance (6 min walk in meter)	Male (n=30)	198.00±142.06	422.33±229.96	<0.0001	113.31
	Female (n=30)	146.33±88.73	355.73±171.60	<0.0001	143.10
	P value	0.04*	0.07		

Paired t-test was performed and the values were represented as mean±SD. P values less than 0.05 was considered to be significant. *=Highly significant statistically. One-way ANOVA with Bonferroni correction was performed (to compare more than 2 groups) and an independent sample t-test was performed to compare between 2 groups. Values were represented as mean±SD. P values less than 0.05 was considered to be significant. *=Highly significant statistically.

Discussion

The current study investigated the impact of physiotherapy management on lung involvement, performance, and anxiety level in hospitalized patients with COVID-19. 60 hospitalized patients with severe COVID-19 pneumonia were included with a male-to-female ratio of 1:1.

All patients had significantly different heights. The average age of men and women was around 44 years. The average weight for both sexes was greater than 75 kg, and there was no significant difference in BMI between men and women. The baseline CT scores of men and women were likewise comparable. The baseline anxiety level of females was somewhat greater, but the difference was not statistically significant. The baseline exercise endurance (6-minute walk) score for males was 198 and for females it was 146. (Table 1 and Table 2)

The term "ongoing symptomatic COVID-19" (OSC) refers to a constellation of symptoms that have persisted for 4 weeks to 3 months after they first appeared^[41].

This syndrome causes myalgias, muscular dysfunction, sleep disturbances, psychiatric and psychoemotional changes, pulmonary fibrosis, and lung capacity reduction ^[42,43].

The advantages of the respiratory physiotherapy strategy were highlighted by results from previous trials that revealed patients' post-COVID sequelae were reduced by at least 50% after completing the 12 sessions of physiotherapy ^[44].

In our study; the mean CT scores after inclusion were (38.33±16.04) among males, and (38.35±17.46) among female patients. Recent studies involving COVID-19 patients found that the CT score was significantly higher in the critical and severe stages compared to the mild stage (p 0.0001), as well as among patients in the late phase compared to those in the early phase (p 0.0001) [132]. CRP and D-dimer levels were strongly linked with CT score (p 0.0001, r = 0.6204 and p 0.0001, r = 0.6625).

In both univariate (HR, 8.33; 95% CI, 3.19-21.73; p 0.0001) and multivariate analytic (HR, 3.74; 95% CI, 1.10-12.77; p = 0.0348) analyses, a CT score of 18 was linked to an increased mortality risk. As a result, CT values may be used to predict the outcome ^[45].

Patients with COVID-19 may present with symptoms, including moderate (22%), mild (13%), and severe (23%) anxiety, as well as moderate (10%) and mild (22%) stress. These findings are consistent with prior research on COVID-19 patients ^[44,46,47].

According to a review, chest physiotherapy in the form of breathing exercises, coughing exercises, diaphragmatic training, stretching exercises, and at-home workouts has improved FEV1 (L), FVC (L), FEV1/FVC%, diffusing lung capacity for carbon monoxide (DLCO%), endurance, and a decreased level of anxiety and depressive symptoms in COVID-patients after discharge ^[48].

Respiratory physiotherapy, in particular, helps those who are unable to remove secretions on their own, whether or not there are concomitant comorbidities, leading to a good recovery ^[49].

All COVID-19 sufferers must have early therapy in order to increase the rate of rapid functional recovery ^[50]. According to a review, physical therapy interventions help COVID-19 patients recover and serve as a barrier of protection. Additional outcomes include a shorter period of stay in intensive care and lower treatment costs, as this outbreak has placed a heavy financial strain on several nations ^[49].

Early mobilization and chest physiotherapy are recommended as essential components of the ABCDEF bundle of care to assist lower morbidity and mortality^[51].

According to a review on incorporating aerobic activities among COVID-19 patients; increased aerobic capacity is advised since it may enhance immunological and pulmonary processes, which would aid in preventing COVID-19 complications and promoting functional activities^[52].

Pulmonary rehabilitation increases mobility, autonomy, and health-related quality of life, supporting recovery and community reintegration.

In patients receiving physiotherapy, we noticed that anxiety levels were decreased by 38.87% at discharge compared to baseline values (Table 3).

In a cohort analysis of covid-19 patients, it was observed that between 40% and 56% of the sample had changed psychological states, including PTSD, anxiety and depression, cognitive function impairment, and dyspnea^[53].

Other data from a case study of an 18-year-old boy who had lung transplantation due to complications from COVID-19 and on whom early Physiotherapy was started revealed that the patient's anxiety and depression decreased at 1 month and 3 months after discharge^[54].

A case series on early physical therapy treatments for Covid 19 patients in acute care hospitals found that early movement, respiratory management, and functional exercises improved lung function, dyspnoea, and anxiety^[55].

The exercise endurance (6MWT) was improved after six weeks of respiratory rehabilitation^[56]. The functional independence of these COVID-19 patients did not, however, improve with respiratory rehabilitation [106]. Similar findings in the COVID-19 patients were reported by Abodonya et al.^[57] (6MWT pre: 332.6 (34.5) m; post: 376.5 (39.4) m; p 0.001).

In symptomatic COVID-19 patients, aerobic exercise and breathing drills increased exercise capacity^[58]. With these physical interventions, the distance walked in 6 minutes increased (pre: 560.3 (11.3) m; post: 635.3 (11.6) m; p 0.001).

A different study found that COVID-19 patients' walking ability and muscle strength both improved after pulmonary rehabilitation (6MWT pre: 138.7 (144.4) m; post: 343.4 (139.6) m; p 0.05). Following 20 days of cardiopulmonary rehabilitation, exercise capacity increased (6MWT pre: 230.9 (153.6) m; post: 360.9 (134.6) m; p 0.05) in COVID-19 patients^[59].

Exercise capacity (6MWT pre: 176 (141) m; post: 357 (132) m; p 0.0001) and disability (FIM score pre: 100 (15.1); post: 111(15); p 0.0001) were both improved in COVID-19 patients after a two-week pulmonary rehabilitation program. Additionally, patients' 6MWT post-intervention walking distance showed improvement^[60].

According to a survey study conducted in China, performing physical activity in the right amounts and at the right intensities while in the hospital or at home may assist to reduce stress and attain psychological stability^[61].

The vital role of physiotherapy during Covid-19 was explained in a systematic review and concluded that physiotherapy can relax patients and help in relieving stress and anxiety^[49].

We found that both males and females responded similarly to the physiotherapy intervention. The CT score was lower in men than in women, coming in at 34.74% versus 32.88%. Similarly, anxiety levels upon discharge (36.67% in men vs. 41.03% in women). None of these values significantly differentiated between males and females. Additionally, we found no significant difference in the results for exercise endurance between men and women. (Table 5)

The impact of physiotherapy on Covid-19 patients has been the subject of a few recent systematic reviews^{[49] [62-65]}. The majority of these assessments, however, did not disclose gender-based subgroup analyses or data. Nevertheless, these evaluations discovered that physiotherapy improves the pulmonary, physical, and mental health of patients. Overall, it contributes to a higher quality of life.

Conclusion:

Clearly, physiotherapy contributes to COVID-19 management. This trial was done only on Covid-19 patients, and therapy was initiated as soon as patients were admitted to hospitals. Physiotherapy was found to be useful in reducing lung involvement in Covid-19 patients, according to our findings. Additionally, Physiotherapy dramatically decreased anxiety and boosted exercise endurance. Both sexes benefited equally from the Physiotherapy treatments.

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