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# "ROLE OF PULMONARY REHABILITATION IN POST COVID PATIENTS WITH RESPECT TO EXERCISE CAPACITY AND HEALTH RELATED QUALITY OF LIFE"

**Respiratory Medicine**

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## ABSTRACT

In December 2019, Wuhan, China, reported the identification of a novel coronavirus, which infects the respiratory system. The many studies revealed pulmonary impairment, which lowered survivors of COVID-19's activities of daily living (ADL), quality of life (QoL) by contributing to restricted breathing disorders, limited diffusion capabilities, and impaired lung function. Thus, this study aimed the effect of pulmonary rehabilitation on exercise capacity and health related quality of life in post covid-19 patients. 60 patients of SARS COV 2 POSITIVE patient's demographics data, Co- morbidities & Medications, radiological severity, clinical course and complications, signs and symptoms of long COVID, 6MWT, PCFS scale, mMRCscale, Changes in fatigue Assessment Scale, HRQoL were studied. The maximum patients were in the age group of 51 – 60 years with 31.67 %, with male dominance of 53.33 %. Majority of 58.33 % patients where overweight and were under medication of antihypertensive, oral antidiabetics, supplements & thyroxine. In the radiological severity study maximum 41.67 % were severe, 33.33 % had moderate symptoms, 25 % had mild symptoms, 6MWT, PCFS scale, mMRC scale, Changes in fatigue Assessment Scale, HRQoL all the parameter were statistically significant. Our study concludes that the significance of post-acute rehabilitation for COVID-19 recovery and provides evidence that comprehensive post-acute pulmonary rehabilitation is associated with significant clinical and functional improvements in patients who experienced severe COVID-19. Long term effects of rehabilitation will definitely prove in improvement of pulmonary function but has to be addressed in future trials.

## KEYWORDS

COVID-19, quality of life, rehabilitation, pulmonary function, mechanical ventilation, 6 MWT.

## INTRODUCTION

In December 2019, Wuhan, China, reported the identification of a novel coronavirus, which infects the respiratory system. 2019-nCoV is a kind of beta-coronavirus connected to human severe acute respiratory syndrome (SARS) and Middle East respirator syndrome ( MERS) , based on full-genome sequencing and phylogenetic research. It was eventually given the name Covid-19.[1] The WHO coronavirus in 2019 (COVID-19) Dashboard at the end of December 2021 stated that the global cumulative cases and deaths of COVID-19 reached over 300 million and 5.4 million, respectively. [2]

According to available data, the lung appears to be the organ most severely impacted by COVID-19, exhibiting a variety of pathophysiological symptoms such as pulmonary consolidation, hyaline membrane development, capillary injury and bleeding, and extensive alveolar epithelial degradation.[3,4] Respiratory failure, non-pulmonary consequences such acute cardiac injury, renal failure or thromboembolic events, septic shock, and multiple organ failure are the most common complications of this illness.

As a result, many patients with severe COVID-19 experience functional physical and occasionally psychological problems. [5,6] The majority of studies revealed pulmonary impairment, which could lower survivors of COVID-19's activities of daily living (ADL) and quality of life (QoL) by contributing to restricted breathing disorders, limited diffusion capabilities, and persistent impaired lung function.[7] For patients with severe COVID-19, mechanical ventilation (MV) is the most prominent form of life-saving treatment in the intensive care unit (ICU). However, MV can reduce diaphragm muscle motion and accelerate the progression of respiratory muscle dysfunction.[8,9]

In their joint statement on pulmonary rehabilitation (PR), the American Thoracic Society (ATS) and the European Respiratory Society (ERS) came to the conclusion that PR can improve QoL, decrease dyspnea, and increase exercise capacity in people with chronic obstructive pulmonary disease (COPD). It may also have significant short-term benefits in people with interstitial lung diseases (ILD).[10,11] Following the covid 19 infection, many patients require pulmonary rehabilitation (PR) based on the functional deficits previously described. According to the severity of the impairment brought on by the infection, the activity limitations, and the participation issues, these patients require a step-by-step concept of a comprehensive multimodal and interdisciplinary PR.[12]

Thus, focusing the above complication, we decided to study the effect of pulmonary rehabilitation on exercise capacity and health related quality of life in post covid-19 patients at tertiary care center.

## METHODOLOGY

A systemic and observational review was performed to study the effect of pulmonary rehabilitation on exercise capacity and health related quality of life in post covid-19 patients.

### Study Design

All consecutive adult patients visited between March 2021 and March 2022 to an outpatient pulmonary rehabilitation center, with persistent or progressive symptoms like dry cough, dyspnea, impaired physical function, generalized weakness and poor quality of life, after laboratory-confirmed COVID-19 in a single-center prospective study.

All included patients provided with written informed consent for study participation.

This is a 12-month prospective observational cohort study conducted in the department of Respiratory Medicine at tertiary care center.

### Study Population

Following the inclusion and exclusion criteria, 60 consecutive patients of SARS COV 2 POSITIVE after discharge from hospital of both genders who visited the outpatient pulmonary rehabilitation center at department of Respiratory medicine during the study period were chosen.

Persistent symptoms (breathlessness, dry cough, chest pain, generalized weakness) after COVID-19, patients giving informed consent were taken as inclusion criteria.

Patients had a blood oxygenation level below 90% (at rest and maximal exertion), Patients not giving informed consent & age <18 years were excluded from the study.

**Study Protocol**
All study participants were asked to give their informed consent, and those who agreed were recruited in the study.

Data on patient demographics (i.e., age, sex, body mass index, education level, cigarette smoking), comorbidities, medications, and COVID-related information (date of positive RT PCR test, radiological severity, clinical course and complications, signs and symptoms of long COVID) were collected in a face-to-face interview.

The clinical severity of COVID-19 was categorized into 3 categories:
**Mild to Moderate**: outpatients with flu-like illness or suspected pneumonia,

**Severe:** hospitalized patients treated in a general ward,

**Critical:** hospitalized patients treated in an intensive care unit At baseline, patients underwent a detailed and structured initial functional capacity by 6MWD, respiratory function, dyspnea as per mMRC, and quality of life assessment by Chronic Respiratory Disease Questionnaire (CRQ).

Thereafter, patients underwent a individualized rehabilitation according to the Austrian guidelines for outpatient pulmonary rehabilitation Participants were asked and trained to do exercise over a 6 weeks period, 3 times per week, under the telephonically supervision.

**Parameter Measured**
1] **The 6MWT** is tool to evaluate functional capacity, was performed according to the European Respiratory Society (ERS) guidelines. Based on the European Respiratory Society guidelines and a systematic review of patients with cardiopulmonary diseases, we predefined that an improvement of 30.5 m would be the minimal clinically important difference (MCID).[13]

**2] Post-COVID-19 functional status (PCFS) scale.**
- It ranges from 0 to 4,
- O: No functional limitation.
- 4: Severe functional limitations;
- a separate category of 5 is usually added for patients who expire. [14]

3] **The modified Medical Research Council (mMRC) scale at rest**.
- which ranges from 0 to 4,
- 0: representing no dyspnea.
- 4: maximal dyspnea,

**4] Changes in fatigue Assessment Scale (FAS)[15]**
- which ranges from 10 to 50,
- FAS >21 indicating substantial fatigue,
- MCID was defined as a change of ≥4

5] **Health-related quality of life (HRQoL)** measurement tool, the German version of the Chronic Respiratory Disease Questionnaire (CRQ) was used. The questionnaire measures eight dimensions of HRQoL and allows calculation of two summary scales of physical and mental experienced. [16]

**Statistical Analysis** – All the patient's data was collected in excel spreadsheet and the data was analyzed using SPSS software 25. The data was presented in the form of mean, percentage, standard deviation.

**RESULTS**
The present study of 60 patients of SARS COV 2 POSITIVE after discharge from hospital were observed for effect of pulmonary rehabilitation on exercise capacity and health related quality of life. The results observed are as under.

**Table 1 – Demographic study**

| Parameters | Frequency (N) | Percentage (%) |
|---|---|---|
| Demographic study | | |
| Age Distribution | | |
| 18 -30 | 8 | 13.33 |
| 31 -40 | 10 | 16.67 |
| 41- 50 | 16 | 26.67 |
| 51 -60 | 19 | 31.67 |
| 61 - 70 | 7 | 11.67 |
| Gender Distribution | | |
| Male | 32 | 53.33 |
| Female | 28 | 46.67 |
| Body mass Index | | |
| Normal | 15 | 25 |
| Under weight | 10 | 16.67 |
| Overweight | 35 | 58.33 |
| Education level | | |
| Primary | 12 | 20.00 |
| Secondary | 28 | 46.67 |
| Graduate & PG | 20 | 33.33 |
| Smoking habits | | |
| Current | 5 | 8.33 |
| Former | 25 | 41.67 |
| Never | 30 | 50.00 |

**Table 1** represent the demographic data of the patients of SARS COV 2 POSITIVE. The maximum patients were observed in the age group of 51 – 60 years with 31.67 %, with male dominance of 53.33 %. Majority of 58.33 % patients were overweight. 46.67 % of patients had their secondary education done and maximum of 50 % patients had never smoked.

**Table 2 Co- morbidities & Medications study**

| Parameters | Frequency(N) | Percentage(%) |
|---|---|---|
| Co-morbidities | | |
| Diabetes mellitus | 25 | 41.67 |
| Hypertension | 42 | 70.00 |
| Cardiovascular disorders | 18 | 30.00 |
| Neurological disorders | 12 | 20.00 |
| Psychiatric disorders | 10 | 16.67 |
| Kidney diseases | 16 | 26.67 |
| Liver diseases | 14 | 23.33 |
| HIV | 3 | 5.00 |
| Respiratory illness | 11 | 18.33 |
| Pregnancy | 5 | 8.33 |
| Drug history (Immunosuppressive) | 3 | 5.00 |
| Alcohol use | 12 | 20.00 |
| Tobacco use (Smoking/Chewing) | 25 | 41.67 |
| Medication | | |
| Antithrombotic agents | 15 | 25.00 |
| Antihypertensive drugs | 42 | 70.00 |
| Corticosteroids | 17 | 28.33 |
| Antihistamines | 12 | 20.00 |
| Long acting β-agonists | 13 | 21.67 |
| Psychoactive agents | 12 | 20.00 |
| Oral antidiabetic | 25 | 41.67 |
| Supplements | 40 | 66.67 |
| Thyroxine | 23 | 38.33 |

**Table 2** represents the Co- morbidities & Medications study of the patients of SARS COV 2 POSITIVE. In the co-morbidities study majority of 70 % patients were having hypertension followed by 41.67 % patients with DM, 30 % patients had cardiovascular diseases & other comorbidities.

Majority of patients were under antihypertensive drugs, oral antidiabetics drug, supplements for vitamins calcium etc, thyroxine.

**Table 3 - COVID-related information of the patients**

| Parameters | Frequency (N) | Percentage (%) |
|---|---|---|
| Radiological Severity | | |
| Mild | 15 | 25.00 |
| Moderate | 20 | 33.33 |
| Severe | 25 | 41.67 |
| Clinical course and complications | | |
| Mild | 12 | 20.00 |
| Moderate | 28 | 46.67 |
| Severe | 20 | 33.33 |
| Signs and symptoms of long COVID | | |
| Mild | 20 | 33.33 |
| Moderate | 25 | 41.67 |
| Severe | 15 | 25.00 |

**Table 3** represents the COVID-related information of the patients of the patients of SARS COV 2 POSITIVE. In the radiological severity study maximum 41.67 % were severe, 33.33 % had moderate symptoms, 25 % had mild symptoms.

In the study of clinical courses and complication majority of 46,67 % had moderate symptoms. 41.67 % had reported with moderate signs and symptoms of long COVID.

**Table - 4 Outcomes of parameter measured**

| Parameters | Pre - Rehabilitation | Post - Rehabilitation | P-value |
|---|---|---|---|
| 6MWT | 594.8 m | 698.2 m | <0.001 |
| PCES | 2 | 1 | <0.001 |
| mMRC | 2 | 1 | <0.001 |
| FAS | 26 | 18 | <0.001 |
| HRQoL- CRQ (Physical & Mental) | 30 | 36 | <0.001 |

**Table 4** represents the outcome of parameter measured. It was observed that in the 6 MWT before pulmonary rehabilitation was 594.8 m and post rehabilitation was 698.2 m. Post-COVID-19 functional status (PCFS) scale before pulmonary rehabilitation was 2 & post rehabilitation was 1.

The modified Medical Research Council (mMRC) scale at rest before pulmonary rehabilitation was 2 & post rehabilitation was 1. The Fatigue Assessment Scale (FAS) before pulmonary rehabilitation was 26 and post rehabilitation was 18. The health-related quality of life (HRQoL) before pulmonary rehabilitation was 30 and post rehabilitation was 36,

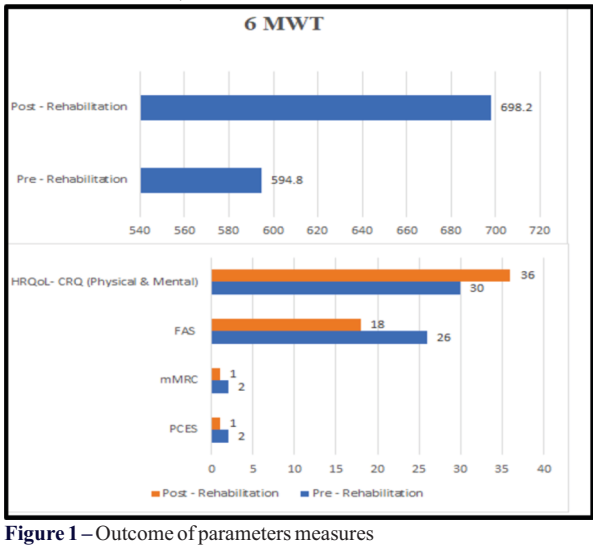


**Figure 1 –** Outcome of parameters measures

## DISCUSSION

The present study aimed to study the effect of pulmonary rehabilitation on exercise capacity and health related quality of life in post covid-19 patients at tertiary care center was observed on 60 patients. It is known that up to one third of COVID-19 patients experienced acute respiratory distress syndrome (ARDS) and severe pulmonary consequences, which resulted in long-lasting deficits in pulmonary function and physical performance.[17] The COVID symptoms are too complicated and patients effected are facing lot of difficulty so this study focused on the effect of pulmonary rehabilitation. This study conducted the detailed observation of all the modalities that are related with patients of SARS COV 2 POSITIVE.

In the demographic study the maximum patients were observed in the age group of 51 – 60 years with 31.67 %, with male dominance of 53.33 %. Majority of 58,33 % patients were overweight. 46.67 % of patients had their secondary education done and maximum of 50 % patients had never smoked. In the identical study conducted by Marc Spielmanns have reported similar observations.[18]

The Co- morbidities & Medications study of the patients of SARS COV 2 POSITIVE patients was studied and it was observed that maximum patients infected by COVID had hypertension, DM, cardiovascular dysfunction, kidney disease and other Co- morbidities, maximum patients were on antihypertensive, antidiabetic antihypertensive drugs, oral antidiabetics drug, supplements for vitamins calcium etc, thyroxine. The patients with some or the other co-morbidities were infected fast. Despite the obvious restrictions, we hypothesise that the significantly higher improvements were caused by post-COVID patients' greater probability of recovery compared to chronically ill patients, many of whom had long-standing pulmonary disease.[18]

The COVID related information of the patients like the radiological severity, clinical course and complications, signs and symptoms of long COVID were study and classified as mild, moderate & severe. In the radiological severity study maximum 41.67 % were severe, clinical courses and complication majority of 46,67 % had moderate symptoms, 41.67 % had reported with moderate signs and symptoms of long COVID. This observation cleared the condition of the patient when affected. No comparable study has been reported stating this parameter.

At baseline, patients underwent a detailed and structured initial functional capacity by 6MWD, respiratory function, dyspnea as per mMRC, and quality of life assessment by Chronic Respiratory Disease Questionnaire and were compared with the post rehabilitation results. All the results demonstrate that improvements during PR were significantly higher for the post rehabilitation patients. All the observation of 6MWD, respiratory function, dyspnea as per mMRC, and quality of life assessment by Chronic Respiratory Disease Questionnaire showed a significant improvement in the post PR patients. A study by Liu reported that distance of 6-MWT was significantly longer in experiment group than that in control group at 6 weeks from baseline in the same study it was also reported that patient-perceived dyspnea using mMRC dyspnea score.[19] A study by Abodonya reported the significant effect in the quality-of-life assessment which was identical with out study findings.[20]

Our findings, however, are consistent with a recent article describing notable improvements in pulmonary function and performance status of COVID-19 patients following a structured multidisciplinary rehabilitation programme. After participation in PR, more care of the patients was assessable in the home environment with the help of walking aids, home care, the help of relatives or oxygen supplementation. Patients in Switzerland were given the opportunity to move to an inpatient rehabilitation programme for post-acute care if they had a severe COVID 19 infection and ongoing, significant functional impairments. Fortunately, the Swiss healthcare system pays the expenditures associated with inpatient rehabilitation.[18] Thus this makes PR an essential component of the care chain throughout the post-acute phase of a severe COVID-19 infection.

## CONCLUSION

Our study highlights the significance of post-acute rehabilitation for COVID-19 recovery and provides evidence that comprehensive post-acute pulmonary rehabilitation is associated with significant clinical and functional improvements in patients who experienced severe COVID-19. As a result, healthcare facilities should create and put into action plans for offering interdisciplinary rehabilitation services in a variety of settings that improve functioning and prevent the progression of long-term COVID-19 disease effects. Our findings suggest that an integrated approach of care for patients with lengthy COVIDs should include personalized rehabilitation. Long term effects of rehabilitation will definitely prove in improvement of pulmonary function but has to be addressed in future trial.

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