

Assessment of Functional Capacity and Quality of Life in Post COVID-19 Patients Using 6MWT And SF-36

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ABSTRACT

Background: After the COVID-19 infection there are some changes in the lung parenchyma, cardiovascular structures and musculoskeletal units which can lead to complications and alter one's functional capacity and quality of life. However, there is a scarce amount of evidence on long term effects of COVID-19 on one's regular functional abilities. Therefore, this study aims to assess post-COVID-19 infected patient's functional capacity and Quality of life.

Methodology: This observational study assessed the functional capacity and quality of life of post-COVID-19 patients affected in past 1 to 6 months using 6 Minute Walk Test & SF-36 questionnaire respectively. 75 COVID-19 patients were segregated into mild, moderate and severe cases; with 25 patients in each category. 6 minute walk distance was measured and compared with the estimated 6 minute walk distance using the Indian population formula. SF-36 was measured under 8 specific dimensions of the questionnaire.

Results: The mean difference between the walked distance and the estimated distance was, 71.53 ± 36.01 in mildly affected patients, 117.52 ± 47.43 in moderately affected patients and, 203.819 ± 54.35 in severely affected patients. Therefore, severely infected COVID-19 patients had maximally affected functional capacity and quality of life, followed by moderately and mildly infected patients who had comparatively better functional capacity and quality of life.

Conclusion: The study clearly illustrated that both the functional capacity and quality of life of the patients are lowered after the COVID-19

infection, that is COVID-19 has long term effects on the human body. Moreover, there is an evident declination in 6 MWD and SF-36 scores from mild, moderate to severe, with severe having the least values.

Key Words: COVID-19, functional capacity, quality of life, 6 Minute Walk Test, SF-36.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious respiratory disease caused by novel coronavirus SARS-CoV-2 that emerged in China at the end of 2019, resulting in a worldwide pandemic

Signs and symptoms of COVID-19 patients : Signs and symptoms of COVID-19 patients includes fever, Cough, General weakness/fatigue, Headache, Myalgia, Sore throat, Coryza, Dyspnea, Anorexia /nausea /vomiting, Diarrhea , Altered mental status , severe acute respiratory illness: (SARI),Recent onset of Anosmia (loss of smell) or Ageusia (loss of taste) in the absence of any other identified cause. [1]

Long term effects/ post covid effects:

SARS-CoV2 infection can impact all organs structurally and functionally. Long-term cardiovascular effects under a broad clinical umbrella is referred as post-COVID-19 syndrome, also called long covid which includes heart failure, life-threatening arrhythmias, myocarditis, acute cardiac injury, coronary artery and aorta aneurysm

formation, hypertension, labile heart rate, accelerated atherosclerosis, both venous and arterial thromboembolic disease, dysautonomia. [3][4]

Common complications among hospitalized patients with COVID-19 include: Pneumonia (75%), acute respiratory distress syndrome (15%). Some patients who recover (stage 4) from the infection show a resilience phenotype. That is, these patients may never return to their original health state, thus establishing a new baseline for health. [21]

Functional capacity:

Functional capacity is the ability to perform activities of daily living that require sustained aerobic metabolism. The integrated efforts of the pulmonary, cardiovascular, and skeletal muscle systems dictate an individual's functional capacity. [5] [6]

6 MWT: The 6-min walk test (6 MWT) is a self-paced, submaximal exercise test that entails measurement of distance walked over a span of 6 minutes. Most patients do not achieve maximal exercise capacity during the 6MWT; instead, they choose their own intensity of exercise and are they can also stop and rest during the test. However, most activities of daily living are performed at submaximal levels of exertion, the 6MWD may better reflect the functional exercise level for daily physical activities. [14].

Quality of life:

Quality of life (QOL) is defined as an individual's perception of their position in life in the context of their culture and value systems, and also their satisfaction and views in relation to their goals, expectations, standards and concerns. [10]

The SF-36 stands for short-form health survey with 36 questions. It gives an eight-scale profile of scores with physical and mental health summary measures. It is a generic measure, unlike the one that targets a specific age, disease, or treatment group. The SF-36 scale has been useful in

comparing various populations and the relative burden of diseases, differentiating the health benefits produced by a wide range of different treatments, and screening individual patients. [32]

MATERIALS AND METHODS.

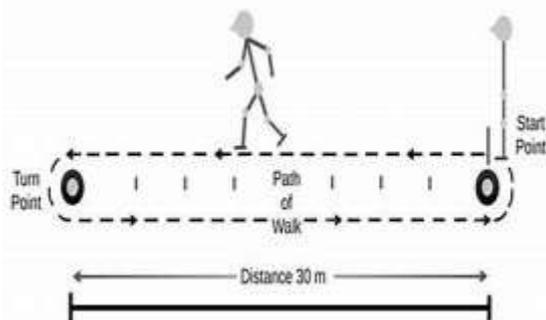
The materials used for this study involved an area with 100 m distance, two small cones to mark the turnaround points, sphygmomanometer, stethoscope, pulse oximeter, watch, countdown timer (or stopwatch), a chair that can be easily moved along the walking course, worksheets on a clipboard [13] [14], SF-36 questionnaire, pen/pencil and Modified Borgs dyspnea scale

This observational study, with conventional sampling, was carried out after obtaining a written informed consent from all the subjects of the study and the institution as well. Post 1-6 months of mild, moderate, and severe cases of COVID-19 between the ages of 35-45 years, were included in the study which was conducted in a metropolitan city. Only the patients who had reports of testing positive for COVID-19 were included in the study excluding-chronic smokers, industrial workers prone to pneumoconiosis, existing or prevailing cases of cardiopulmonary disorder (other than COVID-19), past history of cardiopulmonary disorder (other than COVID-19), systemic disorders, lung cancer, musculoskeletal disorders or psychological disorders

Screening of the subjects was done as per the aforementioned inclusion and exclusion criteria, from which 75 individuals who were willing to participate were included in this study. The subjects were divided and chosen to categorize equally amongst 3 groups that is 25 mild, 25 moderate and 25 severe. Subjects were explained about the procedure and purpose of the study in detail. Subjects were then questioned from the SF-36 questionnaire and reports were made. After answering the SF-36 questionnaire, the six minute walk test was conducted on each individual.

The patient rested in a chair, located near the starting position, for at least 10 minutes before the test started. During this time, the subject was checked for any contraindications. Pulse, respiratory rate, Oxygen saturation (SpO2) and blood pressure were measured and recorded. Moreover, the patient rated their baseline dyspnea using the Modified Borgs scale before starting the test. The patient was asked to walk as far as possible for 6 minutes back and forth around the cones. They were permitted to slow down, to stop, and to rest as necessary. They resumed walking as soon as they were able to. Each

time the participant returned to the starting line, a lap was counted. Furthermore, the extra distance travelled by the subject was measured. Post-test, the blood pressure, SpO2, respiratory rate and pulse rate were measured again. The post walk Borg dyspnea levels were also recorded. Finally, the collected data was compared to the estimated distance which was calculated using the 6 minute walk test formula that is, for males- $D = 561.022 - (2.507 * \text{age}) + (1.505 * \text{weight (kg)}) - (0.055 * \text{height (cm)})$ [33], for females- $D = 30.325 - (0.809 * \text{age}) - (2.074 * \text{weight (kg)}) + (4.235 * \text{height (cm)})$ [33]



Modified Borg Dyspnoea Scale

- 0 Nothing at all
- 0.5 Very, very slight (just noticeable)
- 1 Very slight
- 2 Slight
- 3 Moderate
- 4 Somewhat severe
- 5 Severe
- 6
- 7 Very severe
- 8
- 9 Very, very severe (almost maximal)
- 10 Maximal

SF-36 QUESTIONNAIRE

Name: _____ Ref. ID: _____ Date: _____
 Sex: _____ Age: _____ Gender: M / F

Please answer the 36 questions of the Health Survey completely, honestly, and without interruptions.

GENERAL HEALTH:
 In general, would you say your health is:
 Excellent Very Good Good Fair Poor

Compared to one year ago, how would you rate your health in general now?
 Much better now than one year ago
 Somewhat better now than one year ago
 About the same
 Somewhat worse now than one year ago
 Much worse than one year ago

LIMITATIONS OF ACTIVITIES:
 The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Moderate activities, such as walking a mile, pushing a vacuum cleaner, bowling, or playing golf
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Lifting or carrying groceries
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Climbing several flights of stairs
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Climbing one flight of stairs
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Bending, kneeling, or stooping
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Walking more than a mile
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Walking several blocks
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Walking one block
 Yes, Limited a lot Yes, Limited a little No, Not Limited at all

Lifting or dressing yourself
 Yes, Limited a lot Yes, Limited a little Yes, Not Limited at all

PHYSICAL HEALTH PROBLEMS:
 During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
Cut down the amount of time you spend on work or other activities
 Yes No

Accomplished less than you would like
 Yes No

Were limited in the kind of work or other activities
 Yes No

Had difficulty performing the work or other activities (for example, it took extra effort)
 Yes No

EMOTIONAL HEALTH PROBLEMS:
 During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?
Cut down the amount of time you spend on work or other activities
 Yes No

Accomplished less than you would like
 Yes No

Didn't do work or other activities as carefully as usual
 Yes No

SOCIAL ACTIVITIES:
 Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
 Not at all Slightly Moderately Often Very severely

PAIN:
 How much bodily pain have you had during the past 4 weeks?
 None Very mild Mild Moderate Severe Very severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?
 Not at all A little bit Moderately Quite a bit Extremely

The image shows a portion of the SF-36 questionnaire. It includes sections for 'ENERGY AND EMOTIONS', 'SOCIAL ACTIVITIES', and 'PHYSICAL FUNCTION'. Each section contains several questions with five response options: 'All of the time', 'Most of the time', 'A good bit of the time', 'Some of the time', and 'None of the time'. For example, under 'ENERGY AND EMOTIONS', questions include 'Did you feel full of pep?', 'Have you been a very nervous person?', 'Have you felt so down in the dumps that nothing could cheer you up?', 'Have you felt calm and peaceful?', and 'Did you have a lot of energy?'. Under 'SOCIAL ACTIVITIES', a question asks 'During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?'. Under 'PHYSICAL FUNCTION', questions include 'How often did you do things that were physically demanding?', 'How often did you do things that were physically tiring?', 'How often did you do things that were physically strenuous?', 'How often did you do things that were physically taxing?', and 'How often did you do things that were physically stressful?'.

RESULTS

Data was collected on a data sheet and encoded for computer analysis. Tables were made using Microsoft word and figures was plotted using Microsoft Excel. Computerized analysis of data was done.

Results

Demographic and Clinical

Characteristics of the patients:

Ninety COVID-19 patients were enrolled in this study. Among the 90 patients, 11 did

not show up and 4 of them were excluded to make the data comparable with equal number of participants. A total of 75 participants were included for analysis. Characteristics of the participants were collected (Table 1). The study participants included 50 men (66.66%) and 25 women (33.33%), with 25 mild cases, 25 moderate cases and 25 severe cases. The mean age (SD) was 40.08 years (± 4.07) and these patients were between ages 35 to 45 years.

Characteristics	Subtype	Number	Percentage (%)
Sex	Female	25	33.33
	Male	50	66.66
Subgroup	Mild	25	33.3
	Moderate	25	33.33
	Severe	25	33.3
Mean Age (years) \pm SD		40.08 \pm 4.08	
Heart rate	Pre	87.83 \pm 12.833	
	Post	89.35 \pm 11.56	
Respiratory rate	Pre	19.68 \pm 5.36	
	Post	20.83 \pm 5.54	
Systolic BP (mmHg)	Pre	131.19 \pm 17.15	
	Post	133.35 \pm 16.77	
Diastolic BP (mmHg)	Pre	84.69 \pm 10.89	
	Post	85.63 \pm 10.51	
RPE	Pre	0.96 \pm 0.023	
	Post	2.57 \pm 0.028	
Hospital Admission	Yes	34	45.33
	No	41	54.66

Table 1: Demographic and Clinical Characteristics of the patients

Assessment of functional capacity- Six minute walk distance in the Study

The 6 minute walk distance was measured and compared with the estimated 6 minute walk distance using the Indian population

formula. The distance travelled by them were significantly lower than the estimated distances. The mean estimated distance for the whole population was 550.61 \pm 29.62. Although, there were variations between

different severities (Table 2).The severe the disease the lower the value of distance walked, and the more the difference between estimated distances and the actual walked distances.

Severity	Distance walked	Difference
Mild	466.425 ± 45.491	71.53 ± 36.01
Moderate	439.44 ± 47.856	117.52 ± 47.43
Severe	351.95 ± 66.6202	203.819 ± 54.35

Table 2: The above table shows the distance walked by the Covid-19 patients and the amount of difference compared to the estimated distance.

Severity	Affected functional capacity / total patients of particular severity	Not affected	% of affected patients
Severe	25/25	0	100
Moderate	24/25	1	96
Mild	10/25	15	40

Table 3: The above table shows highest affection of functional capacity in severe COVID-19 patients (25/25 patients were affected), followed by moderate (24/25 patients were affected) and least affection in Mild Covid-19 patients (10/25 patients were affected)

Assessment of Quality of Life -Scores of SF-36 in the Study

The SF-36 mean scores for eight specific dimensions was measured. (Table-4). In these eight dimensions, General Health, Vitality, and Mental health subgroup scores

According to the previous researches a difference more than 62.36 in males and more than 76.91 in females, denotes that these individuals have an affected functional capacity. (31)

Therefore the population that was affected and not affected divided in subgroups is demonstrated in Table 3.

were significantly lower in all these patients. However, the scores of Physical functioning, Role physical, Role emotional, Bodily pain and Social function were better, especially for the mild subgroup.

Severity	GH	PF	RP	RE	SF	BP	V	MH
Mild	53.4	81.4	80	81.33	74.5	92.4	56.8	68
Moderate	37.2	69.6	53	52	57	71.9	46.4	63.2
Severe	15	37.6	21	17.33	35.5	39.7	22.4	39.2

Table-4: SF-36 mean scores of eight specific dimensions.

[Where GH-general health, PF- physical functioning, RP-role physical, RE-role emotional, SF-social functioning, BP-bodily pain, V-vitality, MH-mental health.]

All the subgroups (mild, moderate and severe) had maximally affected general health and least affected bodily pain component amongst all the 8 domains.

Table 4 represents the mean scores of the affected individuals that is mild (n=25), moderate (n=25) and severe (n=25). Where GH-general health, PF- physical functioning, RP-role physical, RE-role emotional, SF-social functioning, BP-bodily pain, V-vitality, MH-mental health.

Table 4 also shows severely affected patients to have the poorest quality of life, moderately affected patients had an average quality of life and mildly affected patients had a better quality of life.

DISCUSSION

The COVID-19 pandemic is a significant physiological and psychological stressor for individuals, across social and economic communities worldwide. This study is the first to perform a comprehensive analysis of functional capacity and quality of life in Indian COVID-19 patients after 1 to 6 month of getting affected by COVID-19, aged between 35-45 years old.

In this study, we divided 75 COVID-19 patients into 25 mild, 25 moderate and 25 severe. Outcome measures like 6 MWT and SF-36 were used to analyse the functional capacity and quality of life respectively. We examined an absolute difference between COVID-19 patient's expected functional capacity and actual functional capacity (derived from the 6 MWT Indian population

formula using the estimated distance and the distance walked by the patient).

In patients affected with COVID-19 there are changes in the lung parenchyma, cardiovascular structures (with sequel of heart failure) and musculoskeletal bodies. [8] [9] this is further related to the quality of life. Therefore, these complications can continue for a longer time (that is even up to six months) after getting the corona virus disease and affect one's functional capacity and quality of life to a significant level. Furthermore, most of the studies have been concentrating on the needs and effects of multidisciplinary rehabilitation in COVID-19 patients, but there is barely any evidence on the functional capacity and quality of life of the patients post 1-6 months after the infection. [6] Whereas there is a clear-cut need of evaluation and assessment of the affected functional capacity and quality of life of the patients to work better and effectively on the same.

Severely affected COVID-19 patients.

From the 75 patients, 25 patients were severely affected and all of them (n=25) that is, 100% had affected functional capacity. The mean distance walked by these patients was 351.95 ± 66.602 This may be due to three main histopathological changes, firstly seen in epithelial tissue that is, reactive epithelial changes and DAD (diffuse alveolar damage), secondly, the vascular changes involving microvascular damage, (micro) thrombi, and acute fibrinous changes and organizing pneumonia, and thirdly the fibrotic changes are noted which results in interstitial fibrosis. [30]

The cardiopulmonary system is majorly related to the functional capacity of the individuals, hence all the patients showed reduced functional capacity. This further affects the patient's endurance to perform ADLs. Therefore their quality of life is maximally affected with scores being GH-15, PF-37.6, RP-21, RE-17.33, SF-35.5, BP-39.7, V-22.4 and MH-39.2.

Moderately affected COVID-19 patients

From the 75 patients, 25 patients were moderately affected and 24 of them (n=25) that is, 96% had affected functional capacity. The mean distance walked by these patients was 439.94 ± 47.856 . This was again because of similar histopathological changes, that is epithelial, microvascular and fibrotic changes.

However, they were mild and hence were able to recover or were in the recovering stage within 6 months after being infected. Furthermore, the functional capacity and ability to perform ADLs is directly proportional and so is quality of life. Hence, quality of life of these patients came down to GH-37.2, PF-69.6, RP-53, RE-52, SF-57, BP-71.9, V-46.4 and MH-63.2 on a 100 point scale of SF-36, that is it was shown to be affected not only due to reduced endurance but also due to its psychological effects.

Mildly affected COVID-19 patients.

From the 75 patients, 25 patients were mildly affected and 10 of them (n=25) that is, 40% had affected functional capacity. The distance walked by these patients was 466.425 ± 45.49 these patients had very mild changes in the lung parenchyma, most of the changes which were present healed and recovered completely. Yet in some patients, there were changes which abided for a longer time hence some of them still had an affected functional capacity (one of the possible reasons can be a sedentary lifestyle). The quality of life was still seen to be affected as it valued with a mean of GH-53.4, PF-81.4, RP-80, RE-81.33, SF-74.5, BP-92.4, V-56.8 and MH-68 on a 100 point scale. Functional capacity may not be the only reason affecting quality of life but also due to quarantine a lot of patients had disturbed mental health.

To sum up, patients had higher RPE, higher body pain and vitality scores, but lower functional capacity, physiological function, social function and low quality of life scores. To our knowledge, the COVID-19 patients had uncommon symptoms,

including headache, abdominal pain, lower appetite and, quick fatigue especially in the severe group [25]. Therefore, the physiological changes caused by the virus may last for 1-6 months.

The differing values in functional capacity that is 100% affected, 96% affected and 40% affected in severe, moderate and mild cases respectively phenomenon demonstrated that the more severe the condition of patients, the more severe the impact on their lung's condition. It also affected the overall physical health as well as emotional and mental health which reflected in the reduced mean scores on SF-36, that is 28-severe, 57-moderate and 71.8-mild.

Furthermore, during the acute phase of the disease, severe and some moderate cases were quarantined in hospital wards and followed strict control measures [26]. They had to reduce their interaction with the community. Meanwhile, they focused more on themselves and less on the individuals around them, as well as social affairs, leading to lower SF-36 scores.

The results are not quite surprising because in addition to the physical and psychological impairment- the long period of isolation, fear of illness, and extreme uncertainty during the COVID-19 illness had tremendous psychological and mood disturbances. Recent studies observed that during the early stage of the COVID-19 outbreak, patients were at higher risk for mental health issues than the general population [27, 28].

Physical activity and exercise have been proven to be an effective method for directly improving both mental and physical health in general [29]. Thus, COVID-19 patients could benefit from exercises. Hence, to improve the lung's functional capacity and quality of life of the patient's affected by the corona virus, they require a multidimensional rehabilitation for a longer time to avoid the complications of long covid.

CONCLUSION

The study clearly demonstrates that both the functional capacity and quality of life of the patients affected with COVID-19 are reduced even as long as up to 1-6 months. Moreover, it shows a marked descent in 6 MWD and SF-36 scores from mild, moderate to severe, with severe having the least values in both functional capacity and quality of life (that is most deteriorated values for both the factors). Hence, there should be a follow up and a comprehensive program should be designed for the patient post COVID-19. Consequently, healthcare facilities should also develop and implement plans for providing multidisciplinary rehabilitation treatments in various departments to recover effectively and prevent the development of long-term consequences of the COVID-19 disease.

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