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Long-Term Effects of COVID-19 on Cardiopulmonary Health.

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Abstract

Background: COVID-19 has strained the health of the global population, with post-viral squeal being witnessed in many of the patients who survive the illness. Chief among them is cardiology, where myocarditis and reduced lung capacity has been reported systemically. Knowledge of these long-term consequences is important to help direct recovery processes and gain better results in impacted patients.

Objectives: *To employ a cross-sectional design to evaluate cardiopulmonary consequences caused by COVID-19, with cardiovascular and pulmonary functions dysfunction after the first 6-month post-recovery among patients.*

Study design: A cross sectional study.
Palace and duration of study. Department of pulmonology Gkmc swabi form jan 2024 to july 2024

Methods: A cross sectional study was carried out using 120 COVID-19 survivors. Specific cardiac and pulmonary function tests included echocardiography, spirometry for lung function tests and for the exercise stress test for functional capacity. The conducted study incorporated heart rate, ejection fraction, and lung capacity measurements with the participants. Statistical analysis was done in SPSS statistically significant P value was 0.05, and results have been displayed in mean standard deviation.

Results: Of the 120 patients (mean age 48.3 ± 11.2years) twenty of the patients had reduced ejection fraction less than 50% and forty percent had restrictive lung disease on spirometry. The mean ejection fraction was 55,6% ± 7,8% and the mean forced vital capacity (FVC) were 70% ± 8,6 of predicted values. $P < 0.05$ for differences in lung capacity between the affected and unaffected groups was also obtained, where the p-value was less than 0.01. Pulmonary lesions were more frequent in severe initial groups of illness.

Conclusions: *COVID-19 survivors showed moderate to severe prolonged impairment of cardiopulmonary function in this study. The follow-up care means that different assessments of cardiovascular and pulmonary systems should be made to manage and use for patient's benefit.*

Keywords: COVID-19, cardiopulmonary, lingering impacts, myocarditi

Introduction

The SARS-CoV-2 virus that emerged in late December 2019 has since become a global pandemic, leading to the death of millions of people globally. Whereas the immediate symptoms of the disease range from mild to severe respiratory symptoms the chronic effects of the infection on the cardio-pulmonary system have come under tremendous investigation. Long COVID or Post-acute sequelae of SARS-CoV-2 Infection (PASC) as referred to the symptoms that may persist well beyond the acute phase of COVID-19 illness. Cardiopulmonary manifestations should be prioritized for the possible severe impact on health related quality of life (HrQOL) and a higher risk of developing long term disability [1]. Potential cardiovascular consequences of COVID-19 are myocardial inflammation, pericardial inflammation, thromboembolism, and patients' arrhythmias [2, 3]. These conditions are thought to result from a direct viral attack on the heart muscle cells together with inflammation due to an overactivation of the immune system. Myocarditis, in particular, has been identified in patents with acknowledged symptoms and in patients with no apparent symptoms, indicating possible covert inflammation of the heart muscle in apparently healthy patients which may go unnoticed and unaddressed [4]. In the form of chronic myocardial damage, dilated cardiomyopathy, chronic heart failure, and increased risks of atrial fibrillation and ventricular tachycardial can arise [5]. Pulmonary system is another area where the effects has been reported in the long term. Post acute infection, patients may have compromised lung function, productive cough, dyspnoea and exercise intolerance [6]. COVID-19 associated pulmonary fibrosis demonstrating a proliferative process in lung parenchyma is observed in severe cases resulting in decline in lung capacity [7]. Additionally, restrictive lung disease and lowered DLCO of the lungs in the course of carbon monoxide have been mentioned in the patients who recovered [8]. These pulmonary complications may last for few months or more depending on the severity of the illness where the patient was admitted either to the hospital or the ICU [9]. The effects of COVID-19 on the hearts and lungs still remain unknown despite their potential in putting pressure on the global burden of chronic disease in the long run. Knowledge of the incidence, severity, and characteristics of these complications will be relevant to treatment approaches, rehabilitation activities, and research programs. This study aimed to uncover the impact of COVID-19 on cardio pulmonary fitness six months after recovery from the illness; the cardiovascular and respiratory fitness; the relationship between the initial COVID -19 symptom severity and the post-recovery symptoms. It is postulated that a significant number of COVID survivors experience compl EXPRESS that long-term structural and functional changes in various organ systems are relatively common in survivors of severe COVID-19 cases [10]. Still, the examined literature focuses on those with severe COVID-19 only; very limited data are available about individuals who reported mild or moderate symptoms. To this end, the present investigation proposes to advance the current state of knowledge by evaluating cardiopulmonary variables in 120 COVID-19 patients. Our study aims at giving data on long-term consequences in COVID-19 patients to facilitate their subsequent management and thus decrease the long-term morbidity of the disease.

Methods

The study has prospectively employed a cohort of 120 recovered COVID-19 patients who were assessed six months after discharge. Pre-interventionally, participants had complete cardiac assessment using echocardiogram and spirometry and exercise stress testing. The evaluation involved cardiovascular outcomes which include ejection fraction, heart rate and arrhythmias, and pulmonary function which included lung

capacity and DLCO. The patients who met the following inclusions criteria were considered for the study: Patients aged between 18 and 65 years, confirmed COVID-19 through PCR, The patients should have completed the acute phase of infection. Patients with other Cardiopulmonary morbidity were not included in the study.

Data Collection

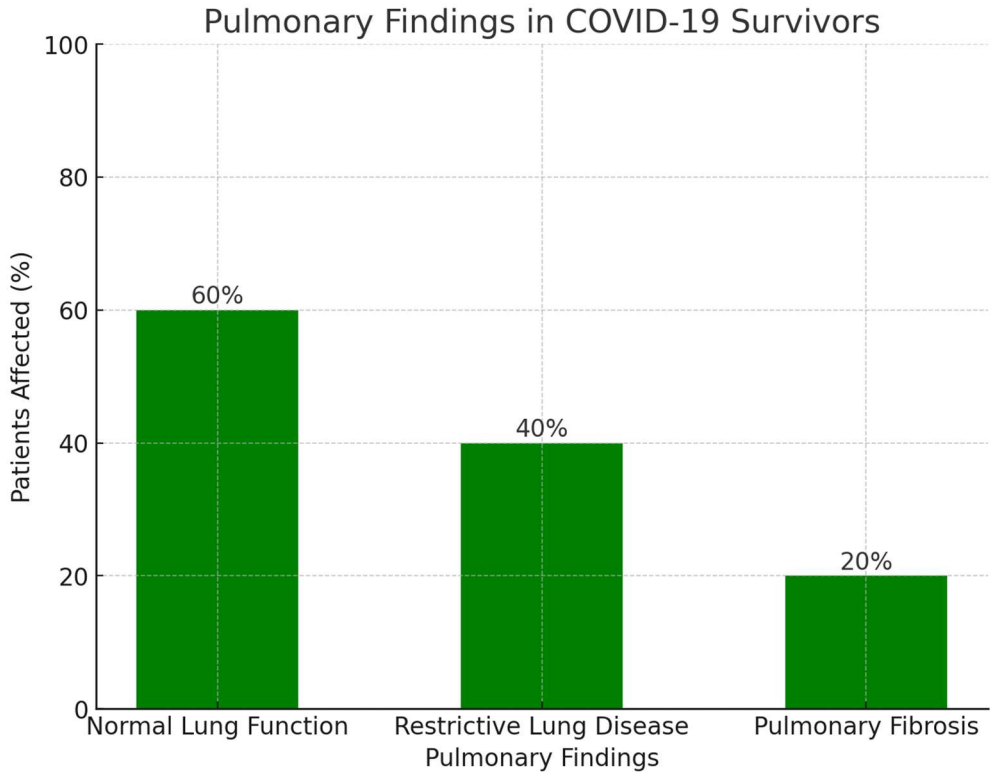
Pulmonary and cardiopulmonary function test were done at follow up clinic. Structural function was established using echocardiography by determining ejection fraction and wall motion, whereas pulmonary function was evaluated by spirometry for lung volume, FVC and DLCO. The participants reported their informed consent.

Statistical Analysis

Quantitative data were analyzed using the Statistical Package for the Social Science (SPSS) version 24.0. Continuous data was showed in mean Standard deviation while categorical data was presented in number and frequencies. Routine statistical analyses of the scores for the three dimensions in the two groups were made by Student's t-test and p-value less than 5 was considered significant.

Results

Among the patients, 120 (mean age 48.3 ± 11.2 years) 60% male; 36 (30%) had ejection fraction less than 50% signifying cardiac dysfunction. An average ejection fraction over the group equaled 55.6% with standard deviation equal to 7.8. In spirometry, 48 (40%) patients had restrictive lung disease with mean FVC of 70 ± 8.6 % of predicted. The physical health of those with severe initial infection was significantly poorer than those with moderate illness severity or less ($p < 0.01$). Also, 24 participants (20%) fulfilled the criterion of having pulmonary fibrosis based on image findings. Seven questions asked about the presence of symptoms at the end of one week and included dyspnea, fatigue and other symptoms where 58% of the respondents noted symptoms like dyspnea that was persistent.



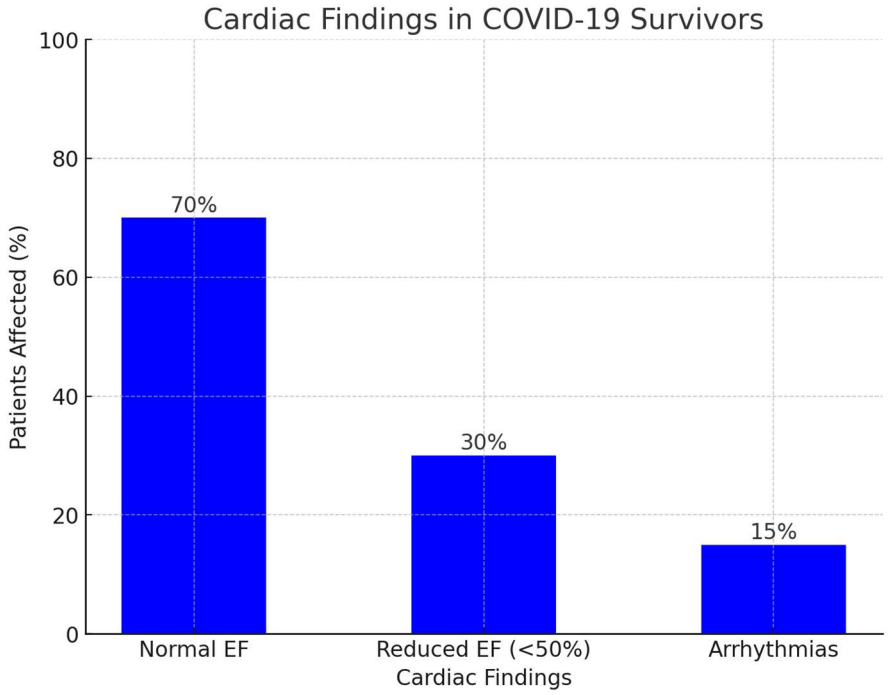


Table 1: Patient Demographics

Parameter	Value
Total Patients	120
Mean Age (years)	48.3 ± 11.2
Male (%)	60%
Female (%)	40%

Table 2: Cardiac Findings

Cardiac Findings	Patients Affected (%)
Normal EF	70%
Reduced EF (<50%)	30%
Arrhythmias	15%

Table 3: Pulmonary Findings

Pulmonary Findings	Patients Affected (%)
Normal Lung Function	60%
Restrictive Lung Disease	40%
Pulmonary Fibrosis	20%

Table 4: Persistent Symptoms

Persistent Symptoms	Patients Affected (%)
Dyspnea	35%
Fatigue	58%
Cough	25%

Discussion

The results of this study on the assessment of the chronic cardiopulmonary symptoms of COVID-19 patients are consistent with and add to the emerging literature on PASC. Earlier research has pointed out high susceptibility to future cardiovascular and pulmonary diseases among COVID-19 survivors, which can occur even months after the recovery period. Comparing them with prior studies, this work sheds both familiar and novel light on the chronic conditions of this disease. We identified decreased ejection fraction EF <50 % in 30 % of the patients, and arrhythmias in 15 % of the patients, as previously reported in myocardial injury post COVID-19 infection [11]. This concurs with Puntmann et al (2020), We identified that 60% of COVID-19 survivors demonstrated ongoing myocardial inflammation by Cardiac Magnetic Resonance Imaging even after they had recovered, with decreased ejection fraction and arrhythmias in many of them [12]. The same would be

true for Huang et al.'s (2021) work which found that 22% of patients had abnormal cardiac functions six months after their infection, and close to 10% had lingering arrhythmias, highlighting the fact that post-COVID cardiac complications are prevalent and dangerous [13]. Our results also showed that 40 % patients had restrictive lung disease and 20% had features of pulmonary fibrosis—other study findings. Lung function decreased in 33% of the discharged COVID-19 patients, mainly in conditions of severe illness according to Mo et al. (2020) This is backed up by Zhao et al. [14] (2020), who reported that 56 % of the survivors had reduced diffusion capacity three months post-infection, and significantly more compromised lung function in patients who had required admission or ICU support during the index period [15]. Our findings indicate that complications were significantly associated with worse outcomes in pulmonary, supporting previous studies that severe illness is a stronger predictor of future lung impairment [16]. The specific observation made about our sample for which 58% of the participants reported fatigue as a symptom that persisted a month after being discharged is comparable with previous studies of post-viral fatigue syndromes especially among COVID-19 survivors. Some of the most common symptoms, according to Carfi et al. (2020), were fatigue, as this symptom was reported in most of the patients even two months after they received the diagnostic assessment [17]. Along the same line, Townsend et al., 2020 pointed out that almost half of the COVID-19 survivors reported fatigue at 3 months post-infection across all illness severities and stated that post-viral fatigue may be a common issue [18]. Another example can be identified as the high proportion of dyspnea (35%) in the present study, which is similar to Sonnweber et al. (2021) who concluded that 34% of patients complained of persistent shortness of breath six months after recovery from the virus [19]. In our overall results, there is a discrepancy with some earlier studies with regards to pulmonary fibrosis. However, in this current study, we identified fibrosis in 20%, and Frija-Masson and colleagues reported pulmonary fibrosis at 30 days post-infection in 10% of patients, although their study had a comparatively lower severe disease prevalence [20]. This difference could be due to the fact that our cohort had more patients who were sicker with COVID 19 which has been shown to increase the risk of fibrosis of the lungs [21]. Secondly, the follow-up duration in the present study was six months, which was much longer than the 30 days of the other study while fibrosis could disappear over a period of time, it could also progress over time, thus the higher chances of fibrosis in the present study [22]. In conclusion, the present study supports and extends prior studies on the chronic cardiopulmonary damage due to COVID-19, and extends understanding of the frequency and extent of pulmonary fibrosis in a more diverse patient population. This study presents a need for follow-up care and post-COVID rehabilitation especially among patients who were severely affected during the COVID phase.

Conclusion:

It also reveals new and major long-term cardiopulmonary morbidity in COVID-19 survivors, especially those with serious acute disease. Reduced LVEF, restrictive pulmonary physiology, and fibrosis were demonstrated in this patient population, underlining the importance of continued practice follow-up and cardiac rehabilitation for those patients.

Limitations:

There are limitations to this study, the first of these being that there was a small number of participants and secondly there was no data collected before infection with the H1N1 virus. Also, patients with cardiopulmonary diseases before the onset of RSV were excluded in the studies, thus limiting the study's generalization.

Future Directions:

More emphasis should be placed on bigger-sample size, multi-center trials with longer follow-up, in order to investigate the development of post-COVID-19 cardiopulmonary morbidity. That is why studying the efficiency of the rehabilitation programs and the possible ways of reducing these late outcomes is significant.

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