Correlation Of Respiratory Muscle Weakness with Dyspnea and Fatigue in Long Term Post Covid Survivors

Anjali Linge[1], Dr Gloria Naik[2], Dr Archana Methe[3]
[1,2,3] *D.Y.Patil College Of Physiotherapy Kolhapur India*

***Abstract*—Background- Respiratory muscle weakness has emerged as a potential underlying factor contributing to various post-covid symptoms, yet its specific relationship with dyspnoea and fatigue in long-term post-COVID survivors remains poorly understood. Among the various sequelae observed in long-term post-COVID survivors, respiratory symptoms such as dyspnoea and fatigue are commonly reported. These symptoms can significantly impair the quality of life of affected individuals and pose challenges for healthcare providers in managing their care. Weakness in these muscles can compromise respiratory function, resulting in dyspnoea (shortness of breath) and fatigue, even after the resolution of acute illness. Methodology-A cross-sectional study was conducted with 77 participants aged between 35 to 50. Each participant had taken part in a single session of assessment for respiratory muscle weakness, dyspnoea, and fatigue. For assessing respiratory muscle weakness participants performed pulmonary function test. For assessing dyspnoea and fatigue Modified Medical Research Council scale and fatigue severity scale was used respectively. All the outcome measures were assessed on same day for each participants by the same examiner. Result- There was no correlation between respiratory muscle weakness and fatigue. Whereas there is no association between dyspnoea and fatigue as well. Where P is more than 0.05 (P<0.05) was considered statistical significant for dyspnoea and fatigue. Conclusion- Respiratory muscle weakness persist in post COVID-19 survivors.**

***Index Terms*—Post COVID-19 survivors, Respiratory muscle weakness, pulmonary function, Fatigue, Dyspnoea, Fatigue severity scale, Modified Medical Research scale.**

I. INTRODUCTION

In December 2019, the COVID-19 virus first appeared in China. By late February 2020, COVID-19 had spread quickly to become a pandemic. According to an international report on coronavirus illness, it has had a major impact on 210 countries and regions worldwide, as well as second international conveyances. In the meantime, the global average case death rate of COVID-19 is 14%. [1] Because of its strong similarity (~80%) to SARS-CoV, which caused acute respiratory distress syndrome (ARDS) and high mortality during 2002–2003, the novel coronavirus was called the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV). [1,2,3] SARS-CoV-2 is the virus that causes COVID-19, a virus that mostly affects the respiratory system. Fever and dyspnoea are common early symptoms. As of May 28, 2020, more than 5.5 million COVID-19 instances had been confirmed worldwide; of those, more than 353,000 cases have expired. [4,5,6]

The original case series from Wuhan, China described fever, dry cough, and dyspnoea as symptoms associated with lower respiratory tract infections. Furthermore, there were reports of headache, vertigo, widespread weakness, vomiting, and diarrhoea. The respiratory symptoms of COVID-19 are now well known to be highly variable, ranging from minor symptoms to severe hypoxia with ARDS. The Wuhan research described that the respiratory symptoms could proceed quickly because there was only a 9-day period between the onset of symptoms and the development of ARDS. [4] Weariness is a frequently reported COVID-19 symptom, and anecdotal information indicates that some individuals may continue to have severe, lasting weariness even after recovering from the infection. One of the most prevalent presenting problems in people infected with SARS-CoV-2, the virus that is causing the current COVID-19 pandemic, is fatigue. [4,6,7] An initial study on the clinical features of the infected individuals stated that 44%–69. 6%, 7 of them had fatigue as a presenting complaint. Although not as severe as in chronic fatigue syndrome, the degrees of physical and psychological exhaustion observed after COVID-19 are more than in the general population. Although SARS-CoV-2 infection's presenting characteristics

have been well-described, with symptoms ranging from moderate dyspnoea due to taste and smell disturbance as well as respiratory collapse, the media, and the long-term effects of a SARS-CoV-2 infection are still unknown. Specifically, there are worries that SARS-CoV-2 has the capacity to start a post-viral syndrome of weariness. [4,7,8,9]

Weariness as "extreme and persistent tiredness, weakness or exhaustion that could be mental, physical, or both," which supports the notion that fatigue can have multiple dimensions. [10,11,12] The detrimental consequences of exhaustion include medical impairments that reduce productivity at work, workplace dangers, pharmaceutical errors that result in fatalities, and suicidal thoughts. Physicians were shown to be much more likely than working persons in the US to have symptoms of emotional, bodily, and mental weariness (37.9% vs. 27.8%) in a comparative study sample of 3442 adults. Certain specialty was also found to be at a higher relative risk of burnout. [10,13,14]

While most patients do not die from COVID-19, the illness does not have a time limit. The most typical symptoms include exhaustion, dyspnoea, and weak muscles. The care of acute patients during hospital stays has received the majority of attention in the literature on COVID-19. Given that SARS-CoV-2 has infected millions of people, individuals displaying post-COVID-19 symptoms may indicate a medical issue. According to a number of studies, 2–3 months after infection, between 55% and 85% of previously hospitalised COVID-19 survivors may still have post-infection symptoms. [15,16] A recent Meta study that was released as a preprint revealed that, overall, 80% of COVID-19 survivors showed at least one symptom of the disease, with fatigue accounting for 58% and dyspnoea for 24%. Between three weeks and three months following hospital release, fatigue and dyspnoea—which have a prevalence of 52% and 37%, respectively—are the most common respiratory post-COVID-19 symptoms in hospitalised patients. The meta-analysis found that 80% of COVID 19 survivors exhibited at least one post COVID-19 symptom, fatigue, headache, hair loss the most frequent. [15,16]

The above study was done to investigate and demonstrate the significant correlation between the above factors, highlighting the impact of respiratory muscle function on symptomatology in individuals recovering from COVID-19.

II. MATERIALS AND METHODOLOGY

The study was conducted after getting ethical approval from the Institutional ethical committee of D.Y. Patil Education Society, Kolhapur.77 participants fulfilling the inclusion and exclusion criteria were included in the study.

Inclusion criteria- COVID recovered patients with time span of at least 1 year belonging to the age group 35-50 years and both the genders.

Exclusion Criteria-Patients having history of cardiopulmonary surgeries, Pre-existing lung disease and history of smoking.

A written consent form was taken from the participants who were willing to participate in the study. Data collection sheet including their personal details, and study related measures were taken from the participants also the sheet involved about the interpretation of the scales taken. For assessment initially spirometer was used followed by the scales such as MMRC Scale and fatigue severity scale were also administered. After the collection of the whole sample size the master chart containing all the information of data sheet was formed and then the final result was obtained through the statistical analysis. Statistical analysis was done by using SPSS version 28, MS Excel 2016.

Modified Medical Research Scale:

Dyspnoea was assessed using Modified Medical Research Council scale. It uses a simple grading system based on a patient's perceived level of dyspnoea during daily activities.

Grade 0: The patient experiences dyspnoea only with strenuous exercise.

Grade 1: Dyspnoea occurs when walking uphill or hurrying on level ground.

Grade 2: The patient walks slower than people of the same age due to dyspnoea, or they need to stop for breath when walking at their own pace on level ground.

Grade 3: The patient stops for breath after walking approximately 100 meters or after a few minutes on level ground.

Grade 4: Dyspnoea is severe that the patient cannot leave the house or experiences dyspnoea when dressing or undressing.

Fatigue severity scale

The Fatigue Severity Scale (FSS) is a widely used self-report questionnaire designed to assess the severity of fatigue experienced by individuals across various contexts. The FSS questionnaire consists of nine statements or items that are directly related to the severity of fatigue experienced by the individual. Each statement reflects different aspects of fatigue, including physical exhaustion, cognitive fatigue, and the impact of fatigue on daily activities. Participants are instructed to rate their agreement with each statement based on their experiences of fatigue over a specified period, such as the past week or month. Responses are scored on a seven-point Likert scale, ranging from 1 (indicating "strongly disagree") to 7 (indicating "strongly agree"). Participants were asked to select the response that best reflects their level of agreement or disagreement with each statement. The total score on the FSS is obtained by summing the individual scores for each statement, with higher scores indicating greater perceived severity of fatigue. The interpretation for fatigue severity scale is a total score of less than 36 suggests that participant may not suffer from fatigue, and a total score of 36 or more suggests that you may need further evaluation by physician.

III. RESULTS

Table-1- Descriptive statistics of gender

Gender	No. of Participants	Percentage
Female	35	45%
Male	42	55%
Total	77	100%

Among 77 participants considered for the study, 35 were females (45%) and remaining 42 were males (55%) respectively.

Table.2. Descriptive statistics (mean and SD) of age.

	N	Minimum	Maximum	Mean	SD
Age	77	35	50	42.51	4.87

Among 77 participants considered for study, the mean age (in years) of the study participants was 42.51 years with SD of 4.87 years. The minimum and the maximum age was 35 and 50 respectively.

Table.3. Descriptive statistics (Mean, SD) of height (cm), weight (kg) and BMI

	N	Minimum	Maximum	Mean	SD
Height (cm)	77	156 cm	163 cm	159 cm	± 2.5
Weight (kg)	77	64 kg	89 kg	77 kg	± 3.8
BMI	77	23	31	-	-

Among 77 participants considered for the study, the mean height (cm) was 159 cm with SD of ± 2.5, the mean weight (kg) was 77 kg with SD of ±3.8 respectively.

Table.4. MIP and MEP of study participants in mean and SD

Variable	Mean	SD
MIP in cmH2O	106.79	11.91
MEP in cmH2O	113.99	17.12

The mean of MIP was 106.79 with SD of 11.91 (cm) and mean of MEP was 113.99 with SD of 17.12 (cm).

Table.5. dyspnoea and fatigue distribution of study participants depending on presences or absences of dyspnoea and fatigue respectively.

Dyspnoea	Fatigue		Total	P value
	Fatigue Present	Fatigue Absent		

Dyspnoea Present	62(80.51%)	3(3.90%)	65(84.41%)	0.499
Dyspnoea Absent	11(14.29%)	1(1.30%)	12(15.59%)	
Total	73(94.80%)	4(5.20%)	77(100%)	

Dyspnoea along with fatigue was seen in 62 (80.51%) and without fatigue were 3(3.90%) which sums to 65(84.41%). Participants without dyspnoea along with fatigue were 11 (14.29%) and without fatigue were 1(1.3%) which sums to 12(15.59%).

Table.6. correlation between MIP and MEP

Correlation between		Correlation Coefficient (r)	P Value
MIP	MEP	0.9126	1.90E-42

High degree positive correlation exists between MIP and MEP and correlation was found to be statistically very highly significant (P-value<0.0001).

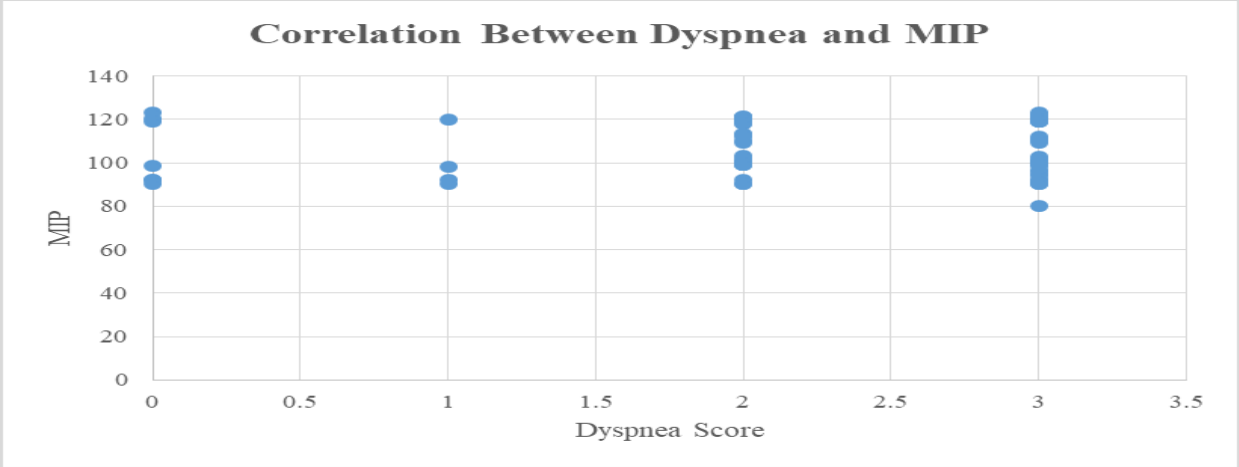

Figure.1 Correlation between dyspnoea and MIP

There was no significant correlation between dyspnoea and MIP. Also, correlation coefficient was 0.034 having P value (0.77) which indicates there is no significant correlation between dyspnoea and MIP.

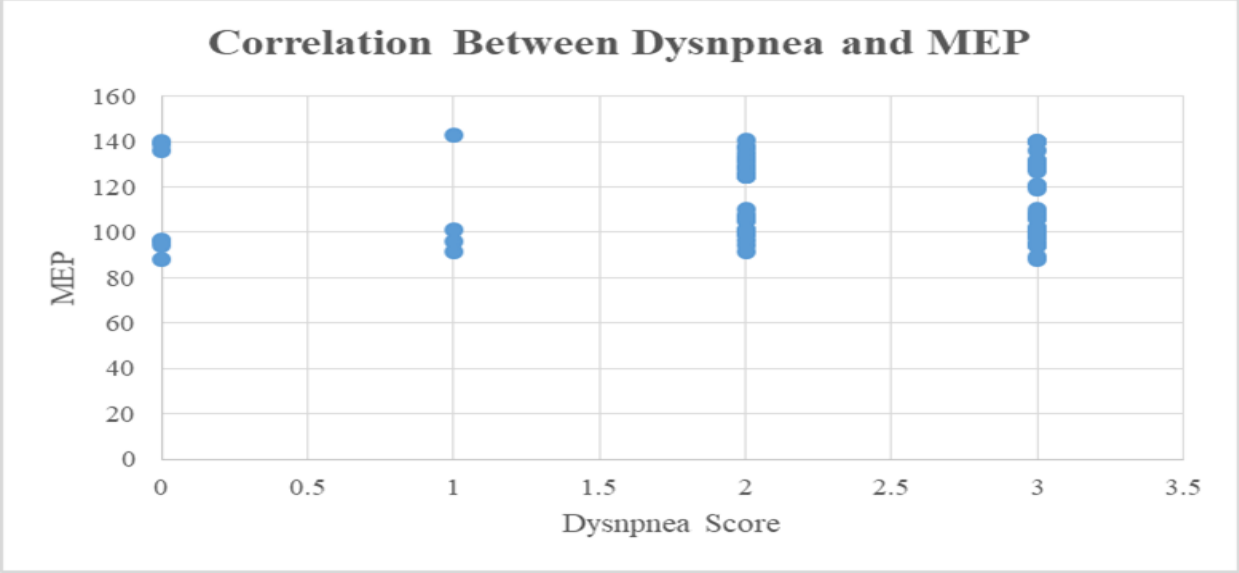

Figure.2. Correlation between dyspnoea and MEP

Correlation coefficient is -0.001 having P value (0.99) which indicates there is no significant correlation between dyspnoea and MEP.

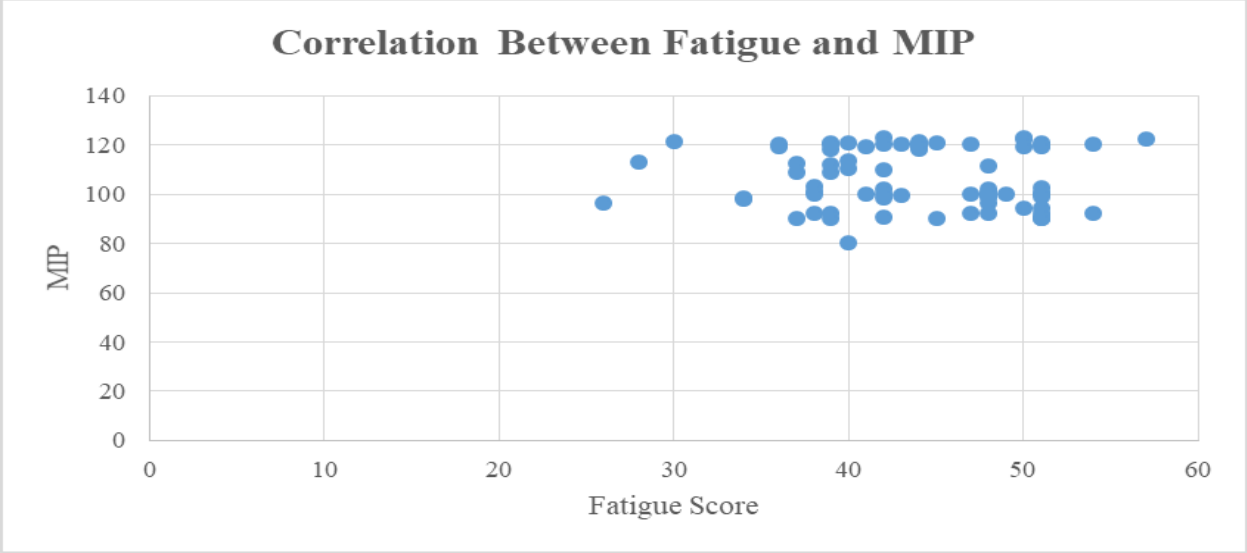

Figure.3 Correlation between fatigue and MIP

The above graph indicates that there is no significant correlation between fatigue and MIP. Also correlation coefficient is -0.061 having P value (0.60) which indicates there is no significant correlation between fatigue and MIP.

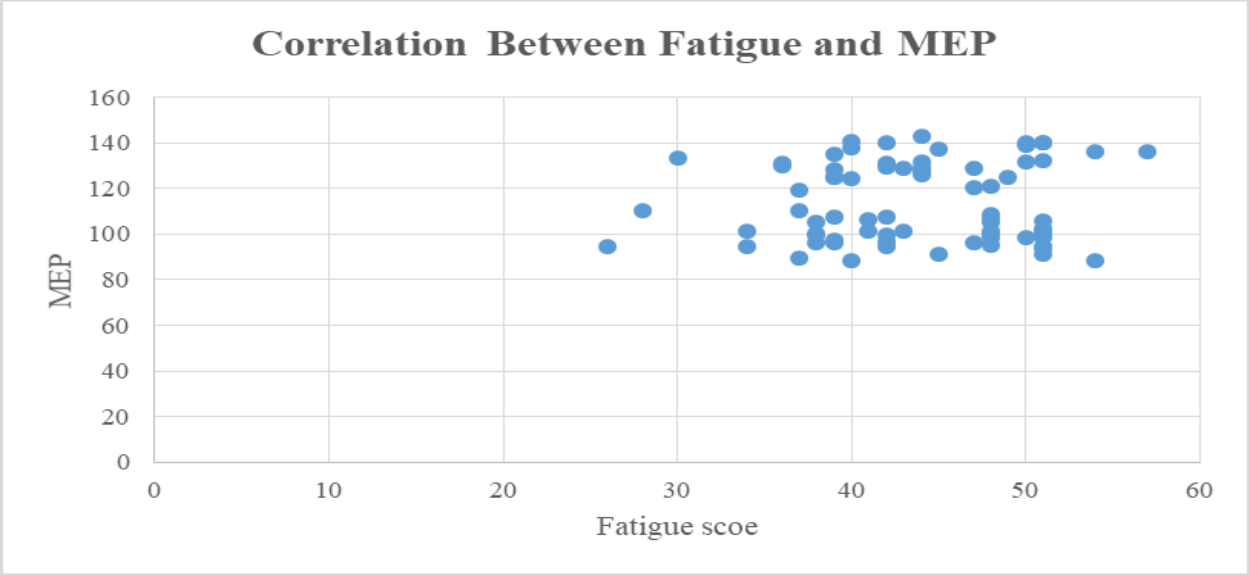

Figure.4 Correlation between Fatigue and MEP

The above graph indicates there is no significant correlation between fatigue and MEP. Also, correlation coefficient was 0.042 having P value (0.72) which indicates there is no significant correlation between fatigue and MEP.

IV. DISCUSSION

In the above study, both male and female subjects were included. The number of female participants in the study was lesser as compared to male participants. From the study conducted by Maria L Cuadrado et.al [17] suggest that the males were having more severity of the symptoms during the initial phase whereas the females had more persistent symptoms for longer duration she further concluded with the males having greater severity of COVID 19 symptoms. The observed differences in symptom severity between

males and females provide additional insights into the relationship between respiratory muscle weakness and symptomatology. While males may exhibit more severe symptoms during the acute phase of COVID-19, females may experience persistent symptoms over a longer duration, indicating potential differences in disease progression and recovery trajectories based on gender.

The data of height and weight of the participants were collected and from the collected data it was cleared that the majority of the participants were from overweight category. Previous studies have been proved that due to their sedentary lifestyle people are getting overweight affecting their health status.

The mean MIP was recorded as 106.79±11.91 centimetres, while the mean MEP was measured at 113.99±17.12 centimetres. These measurements serve as indicators of respiratory muscle weakness. The use of spirometry to measure Maximum Inspiratory Pressure (MIP) and Maximum Expiratory Pressure (MEP) provides objective assessments of respiratory muscle strength. A decrease in MIP and MEP values indicates weakness in the inspiratory and expiratory muscles, respectively, which aligns with symptoms of respiratory impairment.

Out of the 77 participants included in the above study, 65 individuals reported experiencing dyspnoea according to the Modified MRC dyspnoea scale. These participants exhibited varying degrees of respiratory discomfort or difficulty breathing. Conversely, 12 participants did not report any complaints related to dyspnoea, indicating a lack of respiratory symptoms. The majority of participants in the study reported experiencing dyspnoea, indicating respiratory discomfort or difficulty breathing.

The Fatigue Severity Scale is a rating scale used to assess the severity of fatigue experienced by individuals. Among the participants, 73 individuals were classified as experiencing fatigue (fatigue present), while 4 participants were categorized as not experiencing fatigue (fatigue absent). This categorization allowed researchers to analyse the impact of fatigue on various aspects of the participants' health and well-being.

Bickton et al. [18] in his case report suggested that fatigue is most frequent complication to be seen in a participants reported who had COVID in passed that can be considered reason behind respiratory muscle weakness and other symptoms.

Also Paneroni et al.[19] studied the patient post COVID with the complaint of pneumonia having no comorbidities from the results obtained he concluded that those who were recovering from pneumonia showed reduced muscular as well as physical performance indicating requirements of structured treatment plans.

Respiratory muscle weakness can directly impact the ability of individuals to breathe effectively. Weakness in the inspiratory and expiratory muscles can lead to reduced lung expansion, impaired ventilation, and increased effort required for breathing. This can result in symptoms such as dyspnoea (shortness of breath), which is a common complaint among individuals with respiratory muscle weakness.

V. CONCLUSION

The above study concludes that COVID 19 survivors has various complications including dyspnoea, fatigue, and reduced functional capacity. Respiratory muscle weakness in COVID 19 survivors should be considered with clinical importance. The current study suggests that there is no correlation between respiratory muscle weakness and the presence of dyspnea and fatigue in long-term post-COVID survivors. The findings underscore the importance of addressing respiratory muscle function as part of comprehensive rehabilitation strategies for individuals recovering from COVID-19. Targeted interventions aimed at improving respiratory muscle strength and endurance may help alleviate symptoms and enhance overall quality of life in this population.

REFERENCES

[1] Celik B, Dane S. The effects of COVID-19 pandemic outbreak on food consumption preferences and their causes. Journal of research in medical and dental science. 2020 May;8(3):169-73.

[2] Anyiwo CE, Adegboro B. A re-emerging coronavirus (2019-nCov): A review. Pacific Journal of Medical Sciences. 2020:7-16.

[3] https://www.worldometers.info/coronavirus/
Wang J, Sato T, Sakuraba A. Coronavirus disease 2019 (COVID-19) meets obesity: strong association between the global overweight

population and COVID-19 mortality. The Journal of Nutrition. 2021 Jan; 151(1):9.

[4] Priya S, Abhilash PV, Naik GM et.al. Impact of fatigue on quality of life among COVID-19 survivors. Int J Sci Healthc Res. 2021; 6:327-.

[5] Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun. 2020; 109:102433.

[6] Islam M, Cotler J, Jason L. Post-viral fatigue and COVID-19: lessons from past epidemics. Fatigue2020;8 (2):61-69.

[7] Del Rio C, Malani PN. COVID19 New insights on a rapidly changing epidemic.Jama.2020; 323(14):1339-1340.

[8] Townsend L, Dyer AH, Jones et.al.Persistent fatigue following SARS-CoV-2 infection is common and independent of severity of initial infection. Plos one.2020; 15(11):e024078

[9] Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020; 395(10223):497-506.

[10] Hashmi MF, Modi P, Basit H, et.al. Dyspnea. In Emergency Settings: Up-to-date Diagnosing and Management in the Emergency Department. Current Medical Issues. 2024 Jan 1;22(1):37-44.

[11] Wilson C. Concern coronavirus may trigger post-viral fatigue syndromes. New Scientist 2020; 246(3278):10.

[12] Hickie I, Davenport T, Wakefield D, et al.Post-infective and chronic fatigue syndromes precipitated by viral and non-viral pathogens: prospective cohort study. Bmj. 2006; 333(7568):575.

[13] Taboada M, Moreno E, Cariñena A, Rey T, Pita-Romero R, et al. Quality of life, functional status, and persistent symptoms after intensive care of COVID-19 patients. Br J Anaesth. 2021; 126(3):e110-e113.

[14] Sim, K. & Chua, HC. The psychological impact of SARS: a matter of heart and mind. Can. Med. Assoc J, 2004; 170(5), 811-812.

[15] Repišti S, Jovanović N, Kuzman M, et al. How to Measure the impact of the COVID-19 pandemic on quality of life: COV19-QoL-the development, reliability and validity of a new scale. Global Psychiatry. 2020; 1(0).

[16] Stephan Nopp, fl.orian moik , frederikus A klok , et.al outpatient pulmonary rehabilitation in patients with long covid improves exercise capacity , functional status, dyspnea, fatigue and quality of life. Karger AG, Basel. 2022; 101(6):593-601.

[17] 17.César Fernández-de-las-Peñas, Domingo Palacios-Ceña, Víctor Gómez-Mayordomo, Lidiane L Florencio, María L. Cuadrado, Gustavo Plaza-Manzano, Marcos Navarro-Santana, Prevalence of post-COVID-19 symptoms in hospitalized and non-hospitalized COVID-19 survivors: A systematic review and meta-analysis,European Journal of Internal Medicine,Volume 92,2021,Pages 55-70.

[18] Bickton, Fanuel Meckson BSc; Chisati, Enock MSc; Rylance, Jamie PhD; Morton, Ben PhD. An Improvised Pulmonary Telerehabilitation Program for Postacute COVID-19 Patients Would Be Feasible and Acceptable in a Low-Resource Setting. American Journal of Physical Medicine & Rehabilitation 100(3): P 209-212, March 2021.

[19] Carla Simonelli, Mara Paneroni, Michele Vitacca, Nicolino Ambrosino, Measures of physical performance in COVID-19 patients: a mapping review, Pulmonology, Volume 27, Issue 6, 2021,