

RESPIRATORY REHABILITATION IMPROVES QUALITY OF LIFE AND FUNCTIONALITY OF COVID 19 PATIENTS

Vladan Markovic^{1, 2*}, Aleksandra Jurisic-Skevin^{3, 4}, Vesna Grbovic^{3, 4}, Stefan Simovic^{5, 6}, Zeljko Todorovic^{5, 7},
Nebojsa Zdravkovic⁸, Jelena Dimitrijevic⁸ and Natasa Zdravkovic-Petrovic^{5, 9}

¹Department of Radiology, Faculty of Medical Sciences, University of Kragujevac, Serbia

²Department for Radiology, Clinical Center Kragujevac, Serbia

³Department of Physical Medicine, Faculty of Medical Sciences, University of Kragujevac, Serbia

⁴Center for Physical Medicine and Rehabilitation, Clinical Center Kragujevac, Serbia

⁵Department of Internal Medicine, Faculty of Medical Sciences, University of Kragujevac, Serbia

⁶Clinic for Cardiology, Clinical Center Kragujevac, Serbia

⁷Clinic for Hematology, Clinical Center Kragujevac, Serbia

⁸Department of Medical Statistics and Informatics, Faculty of Medical Sciences, University of Kragujevac, Serbia

⁹Clinic for Gastroenterohepatology, Clinical Center Kragujevac, Serbia

Received: 14.05.2023.

Accepted: 26.06.2023.

Corresponding author:

Vladan Markovic

Stevana Visokog 20b, 34000 Kragujevac, Serbia

Phone: +381 603019417

E-mail: drjack.vm@gmail.com

ABSTRACT

Respiratory rehabilitation leads to reduction of symptoms, strengthens extremity musculature and improves emotional state and management of daily activities in patients with respiratory diseases. Aim of our study was to determine quality of life and functionality of COVID 19 patients before and after respiratory rehabilitation program. The study was conducted at the Clinical Center, Kragujevac, from June to July 2020. The study was a prospective clinical trial and included 62 patients with the acute-phase of COVID-19. Respiratory rehabilitation program started at hospital and continued at home for three months overall. Quality of life was measured by the EQ-5D-5L and patient's functionality by The FIM score. All five dimension of EQ-5D-5L were higher after respiratory rehabilitation program as well as EQ-5D index score and VAS score (0.8516 ± 0.202 and 53.31 ± 17.129 before rehabilitation, 0.9147 ± 0.074 and 64.53 ± 8.368 after rehabilitation). Respiratory exercise showed significantly improvement in FIM total score from 104.48 ± 12.880 to 106.21 ± 9.791 , as well as in FIM motor and cognitive subscores. Respiratory rehabilitation program improves quality of life and functionality of COVID 19 patients.

Keywords: COVID 19, EQ-5D-5L, FIM, respiratory rehabilitation.



UDK: 616.24:615.8

616.98:578.834

Eabr 2025; 26(2):153-160

DOI: 10.2478/eabr-2023-0002

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (*SARS-CoV-2*) pneumonia significantly impairs the quality of life and functional status of patients. Even few months after onset of the SARS-CoV-2 infection, many patients are still affected with chronic, clinically relevant sequelae. The most frequently reported health issues are fatigue (53–87%), breathlessness (43–71%) and neuropsychological impairments (47%), with a high prevalence of psychological disorders such as increased levels of stress, anxiety and depression (1–4). The place and role of rehabilitation treatment is important not only in improving respiratory status but also in improving the quality of life and functionality after treatment of SARS-CoV-2 pneumonia(5).

The goal of respiratory rehabilitation in hospitalized Covid-19 patients is to improve dyspnea, relieve anxiety and depression, prevent complications, reduce morbidity, preserve functionality and improve quality of life. Early respiratory rehabilitation is not recommended for severe and critically ill patients if their condition remains unstable or progressively worsens, but for all other patients it is crucial. Individual approach to each patient is mandatory especially for elderly patients, obese patients and patients with multiple comorbidities. Evaluation and monitoring of the patient is carried out all the time during the rehabilitation (5).

It is well known that respiratory rehabilitation leads to reduction of symptoms, strengthens extremity musculature and improves emotional state and management of daily activities in patients with respiratory diseases (6). Aim of our study was to determine impact of Covid-19 infection on patient's quality of life and functionality and to investigate the efficacy of respiratory rehabilitation in improving them.

MATERIALS AND METHODS

Study design and participants

The research was conducted as prospective study at Department of physical medicine and rehabilitation, Clinical Center of Kragujevac, Serbia in June and July 2020. Participants included in study were patients in the post-acute phase of mild, moderate, severe or critical COVID-19 as defined by the World Health Organization (7) and treated in Clinical Center of Kragujevac. Inclusion criteria for participants were age 18 and above. Patient with heart failure (New York Heart Association classes III and IV), patient with cognitive and conscious impairment (Mini-Mental State Examination score below 21, Glasgow Coma Score below 13), patient with serious sight and hearing impairment and febrile patients were excluded from study. All patients give written consent and study was approved by the ethics committee of the Clinical Center of Kragujevac (no. 01/20/485 from 24/04/2020).

Intervention

Respiratory rehabilitation was conducted once a day and involves patient positioning, postural drainage, and breathing exercises. Oxygen saturation (SpO_2) and heart rate via a pulse oximeter were measured before and after treatment.

Breathing exercises were performed in the supine position with the legs bent at the knees, in a semi-sitting or sitting position according to patient's respiratory status. After positioning, a physical treatment with breathing exercises was applied - training in diaphragmatic breathing to establish breathing control, reducing the consumption of energy needed for breathing, and improving lung ventilation. The patient was instructed to inhale the air through the nose and exhale lightly through the mouth in the position of pronouncing the letter "O" so that the expiration would be prolonged, two to three times longer than the inspiration. This way of breathing leads to a control and reduction of dyspnea and reduction of respiratory rate. During the implementation of the exercise program, accessory muscles of the shoulders and neck are relaxed. Attention is paid to the expansion of the lower part of the chest and the mobilization of the upper extremities. These exercises help eliminate secretions from the airways and increase vital capacity.

After breathing exercises postural drainage was then performed with manual chest percussion and followed with another course of exercises. The rehabilitation program lasted between 20 and 45 minutes and was performed once a day. Respiratory rehabilitation was ended if patients complained on dyspnea (modified Borg dyspnea scale (MBS) > of 3), chest tightness, shortness of breath, blurred vision, palpitations, increased sweating and dizziness and other serious symptoms that physician estimate as contraindication for further exercises.

Respiratory rehabilitation was performed during patients' hospitalization and was continued at home by patients themselves.

Outcome and measures

Oxygen saturation and heart rate measurement

Oxygen saturation and heart rate were measured via a pulse oximeter before and 15-30 minutes after respiratory exercise program, by nurse.

Measurement of dyspnea

Measurement of dyspnea is performed using a modified ten-degree Borg scale for the assessment of dyspnea. It consists of ten verbal descriptors to which numerical values have been added, ranging from 0 to 10 (0 - no breathlessness, 10 - maximum breathlessness).

Quality of life assessment

Quality of life was measured using the EuroQol 5-Dimension 5-Level (EQ-5D-5L) (8). The EQ-5D-5L essentially consists of 2 pages: the EQ-5D descriptive system and the EQ visual analogue scale (EQ VAS). The descriptive system consists of five dimensions. The question regarding mobility asks about problems in walking. Regarding self-care, the question asks about problems in walking or dressing oneself. Regarding usual activities, the question asks about problems in performing one's usual activities such as study, work, familial duties, housework, or leisure activities. Regarding pain/discomfort, the question asks about having pain or discomfort in one's usual life. Finally, the question regarding anxiety/depression asks about any feelings of anxiety/depression. Each dimension has 5 levels: no problems (1), slight problems (2), moderate problems (3), severe problems (4) and extreme problems (5). The digits for the five dimensions can be combined into a 5-digit number that describes the patient's health state. EQ-5D-5L Crosswalk Index Value Calculator was used to calculate index values for the EQ-5D-5L dimension scores.

The EQ VAS records the patient's self-rated health on a vertical visual analogue scale from 0 which stands for "The worst health you can imagine" to 100 which means "The best health you can imagine".

In our study we performed first EQ-5D-5L measurement at patients' admission and second three months later using telephone.

Patient's functionality assessment

The Functional Independence Measure (FIM) is an 18-item instrument measuring a person's level of disability in terms of burden of care. FIM consist of 18 items, first 13 are forming motor subtotal score assessing independent performance in self-care, sphincter control, transfers, locomotion and last 5 are forming cognitive subtotal score assessing communication and social cognition. Each item is rated from 1 (requiring total assistance) to 7 (completely independent). After all items have been assessed, a total FIM score is calculated. Motor subtotal score can ranges between 13 and 91, while the cognitive component can range between 5 and 35, together forming total score from 18 to 126 (9).

In our study we performed first FIM score measurement at patients' admission and second three months later using telephone.

Statistics

Statistical analyses were performed using SPSS 26 (IBM, USA). Participant characteristics were reported as mean $\pm$ standard deviation (SD), or frequencies and percentages for categorical variables. The Chi-square goodness of fit test was used to determine the differences in the distribution of categorical variables. Continuous variables were compared between groups by the Mann-Whitney-U test. The Chi-square

test of independence was used to examine the relationship between participant characteristics and domains. For comparing pre- to post-respiratory rehabilitation quality of life and patient functionality (EQ-5D-5L and FIM score), a two-tailed Wilcoxon rank-sum test was applied. A p-value less than 0.05 was considered to be a measure of statistical significance for all statistical tests used.

RESULTS

Our study included 62 patients, 38 males (61.3%) and 24 females (38.7%). Most of the patients were older than 60 years ($n = 35$; 56.45%) and most of the patients had hypertension, other comorbidities were less presented. The basic characteristics of the patients are given in Table 1.

The patient's a mean EQ-5D index score and VAS score before respiratory rehabilitation were 0.8516 ± 0.202 and 53.31 ± 17.129 , respectively (Table 2).

The most frequently reported problem was anxiety/depression (80.6%) followed by pain/discomfort (79.1%). Self-care (21%) and usual activities were (21%) were the least frequently reported problems. Patients with previously diagnosed malignant diseases were more likely to report problem in mobility and self-care while patients with endocrinology diseases like Cushing disease, hipo- or hyperthyroidism diseases were more likely to report problem in self-care and usual activities. Sex, age, length of hospitalization and chronic diseases like hypertension, diabetes mellitus and hearth failure had no influence on five dimensions of EQ-5D before respiratory rehabilitation (Table 3).

After respiratory rehabilitation, both scores were higher, EQ-5D index score 0.9147 ± 0.074 and VAS score 64.53 ± 8.368 (Table 1). Still, most frequently reported problems were anxiety/depression (61.3%) and pain/discomfort (77.5%), but overall less percentage of patients reported those problems. Also patients reported fewer problems in mobility, self-care and usual activities (Table 4).

Comparing each dimension of EQ-5D, patients after respiratory rehabilitation showed significantly improvement in all five dimensions, mobility, self-care, usual activities, pain/discomfort and anxiety/depression (Table 2, Figure 1).

Respiratory rehabilitation showed improvement not only in quality of life but also in patient's functionality. FIM motor subtotal score showed significantly improvement from 70.90 ± 13.365 before to 74.97 ± 10.078 after respiratory rehabilitation. Similar findings were obtained in FIM cognitive subtotal score, respiratory rehabilitation improved score from 33.58 ± 2.551 to 34.06 ± 1.114 . Finally we calculated FIMI total score before (104.48 ± 12.880) and after (106.21 ± 9.791) respiratory rehabilitation and we found that respiratory rehabilitation significantly improved overall patient's functionality, motor and cognitive (Table 5).

Figure 1. Five dimensions of EQ-5D before and after respiratory rehabilitation.**Table 1.** Baseline demographic characteristics of the study population.

Characteristics		Results (%)	p-value
Gender	Male	38 (61.3 %)	p=0.075
	Female	24 (38.7%)	
Age	30-39	4 (6.45%)	p <0.001
	40-49	9 (14.52%)	
	50-59	13 (20.97%)	
	60+	35 (56.45%)	
Hypertension	Yes	31 (50%)	p=0.799
	No	31 (50%)	
Diabetes mellitus	Yes	16 (25.8%)	p <0.001
	No	46 (74.2%)	
COPD	Yes	6 (9.7%)	p <0.001
	No	56 (90.3%)	
Heart failure	Yes	5 (8.1%)	p <0.001
	No	57 (91.9%)	
Malignancy	Yes	10 (16.1%)	p <0.001
	No	52 (83.9%)	
Endocrine disorder	Yes	5 (8.1%)	p <0.001
	No	57 (91.9%)	

Table 2. Average value of all five dimensions of EQ-D before and after respiratory rehabilitation.

	Results (mean $\pm$ SD)	p-value
EQ-5D1 before	1.177 $\pm$ 0.425	0.010
EQ-5D1 after	1.370 $\pm$ 0.773	
EQ-5D2 before	1.145 $\pm$ 0.437	0.002
EQ-5D2 after	1.320 $\pm$ 0.672	
EQ-5D3 before	1.193 $\pm$ 0.437	0.05
EQ-5D3 after	1.310 $\pm$ 0.781	
EQ-5D4 before	1.790 $\pm$ 0.447	0.009
EQ-5D4 after	2.00 $\pm$ 0.747	
EQ-5D5 before	1.709 $\pm$ 0.662	0.000
EQ-5D5 after	2.020 $\pm$ 0.689	
EQ-5D VAS	53.31 $\pm$ 17.129	0.000
EQ-5D VAS	64.53 $\pm$ 8.368	
EQ-5D Index before	0.8516 $\pm$ 0.202	0.000
EQ-5D Index after	0.9147 $\pm$ 0.074	

Table 3. Percentage of reported any problem in 5 dimensions of EQ-5D before respiratory rehabilitation.

Characteristics		Mobility			Self-care			Usual Activities			Pain/discomfort			Anxiety/depression		
		No	Yes	p	No	Yes	p	No	Yes	p	No	Yes	p	No	Yes	p
Total		77.5	22.5		79	21		79	21		20.9	79.1		19.4	80.6	
Gender	Male	45.2	16.1	0.566	48.4	12.9	0.984	51.6	9.7	0.347	16.1	45.2	0.326	11.3	50.0	0.815
	Female	32.3	6.4		30.6	8.1		27.4	11.3		4.8	33.9		8.1	30.6	
Age	5.2	0.0	0.749	5.2	0.0	0.236	5.2	0.0	0.231	0.0	5.2	0.628	3.4	1.7	0.633	5.2
	10.3	3.4	5.2		0.0	1.7		0.0	1.7		8.6	8.6		6.9	13.8	
	19.0	1.7	1.7		0.0	0.0		1.7	1.7		17.2	17.2		13.8	17.2	
	50.0	10.3	15.5		12.1	20.7		17.2	19.0		46.6	48.3		39.7	44.8	
Lenght of hospitalization		13.94 $\pm$ 2.409	14.21 $\pm$ 1.805	0.868	14.00 $\pm$ 2.372	14.00 $\pm$ 1.958	0.761	14.04 $\pm$ 2.327	13.85 $\pm$ 2.154	0.584	13.85 $\pm$ 2.154	14.04 $\pm$ 2.327	0.667	13.25 $\pm$ 2.989	14.18 $\pm$ 2.68	0.494
Hypertension	Yes	35.5	14.5	0.224	38.7	11.3	0.755	37.1	12.9	0.349	9.7	40.3	0.755	8.1	41.9	0.520
	No	41.9	8.1		40.3	9.7		41.9	8.1		11.3	38.7		11.3	38.7	
Diabetes mellitus	Yes	17.7	8.1	0.538	21.0	4.8	0.800	19.4	6.5	0.646	8.1	17.7	0.241	4.8	21.0	0.943
	No	59.7	15.5		58.1	16.1		59.7	14.5		12.9	61.3		14.5	59.7	
COPD	Yes	6.5	3.2	0.610	6.5	3.2	0.597	0.0	9.7	0.328	1.6	8.1	0.861	6.5	1.6	0.884
	No	71.0	19.4		72.6	17.7		21.0	69.4		17.7	72.6		71.0	21.0	
Heart failure	Yes	6.5	1.6	0.886	8.1	0.0	0.352	8.1	0.0	0.352	3.2	4.8	0.280	1.6	6.5	0.970
	No	71.0	21.0		71.0	21.0		71.0	21.0		17.7	74.2		17.7	74.2	
Malignancy	Yes	8.1	8.1	0.024	8.1	8.1	0.041	9.7	6.5	0.196	3.2	12.9	0.934	3.2	12.9	0.955
	No	69.4	14.5		71.0	12.9		69.4	14.5		17.7	66.1		16.1	67.7	
Endocrine disorder	Yes	4.8	3.2	0.314	3.2	4.8	0.050	3.2	4.8	0.050	1.6	6.5	0.956	1.6	6.5	0.970
	No	72.6	19.4		75.8	16.1		75.8	16.1		19.4	72.6		17.7	74.2	

Table 4. Percentage of reported any problem in 5 dimensions of EQ-5D before respiratory rehabilitation.

Characteristics		Mobility			Self-care			Usual Activities			Pain/discomfort			Anxiety/depression		
		No	Yes	p	No	Yes	p	No	Yes	p	No	Yes	p	No	Yes	p
Total		83.9	16.1		88.7	11.3		82.2	17.8		22.5	77.5		38.7	61.3	
Gender	Male	50.0	11.3	0.727	53.2	8.1	0.696	53.2	8.1	0.311	17.7	43.6	0.212	24.2	37.1	0.876
	Female	33.9	4.8		35.5	3.2		29.0	9.7		4.8	33.9		14.5	24.2	
Age	30-39	5.2	0.0	0.426	5.2	0.0	0.050	5.2	0.0	0.341	0.0	5.2	0.630	0.0	5.2	0.443
	40-49	8.6	5.2		12.1	1.7		12.1	1.7		5.2	8.6		0.0	13.8	
	50-59	19.0	1.7		20.7	0.0		19.0	1.7		3.4	17.2		3.4	17.2	
	60+	44.8	15.5		39.7	20.7		41.4	19.0		12.1	48.3		15.5	44.8	
Length of hospitalization		14.00±2.376	14.00±1.764	0.789	13.98±2.286	14.14±2.340	0.965	14.00±2.324	14.00±2.145	0.782	13.93±2.093	14.02±2.347	0.739	13.83±2.353	14.11±2.252	0.922
Hypertension	Yes	40.3	9.7	0.731	43.5	6.5	0.688	40.3	9.7	0.739	11.3	28.7	0.999	14.5	35.5	0.118
	No	43.5	6.5		45.2	4.8		41.9	8.1		11.3	38.7		24.2	25.8	
Diabetes mellitus	Yes	19.4	6.5	0.266	24.2	1.6	0.666	21.0	4.8	0.903	8.1	17.7	0.336	8.1	17.7	0.561
	No	64.5	9.7		64.5	9.7		61.3	12.9		14.5	59.7		30.6	43.5	
COPD	Yes	8.1	1.6	0.970	8.1	1.6	0.528	8.1	1.6	0.942	0.0	9.7	0.322	3.2	6.5	0.776
	No	75.8	14.5		80.6	9.7		74.2	16.1		22.6	67.7		35.5	54.8	
Heart failure	Yes	6.5	1.6	0.811	8.1	0.0	0.405	8.1	0.0	0.575	3.2	4.8	0.314	1.6	6.5	0.640
	No	77.4	14.5		80.6	11.3		74.2	17.7		19.4	72.6		37.1	54.8	
Malignancy	Yes	9.7	6.5	0.046	9.7	6.5	0.010	9.7	6.5	0.067	3.2	12.9	0.831	4.8	11.3	0.727
	No	74.2	9.7		79.0	4.8		72.6	11.3		19.4	64.5		33.9	50.0	
Endocrine disorder	Yes	6.5	1.6	0.806	3.2	4.8	0.008	3.2	4.8	0.035	1.6	6.5	0.886	1.6	6.5	0.640
	No	77.4	14.5		85.5	6.5		79.0	12.9		21.0	71.0		37.1	54.8	

Table 5. FIMI subtotal scores and total score before and after respiratory rehabilitation.

	Mean ± SD	p-value
FIM motor subtotal score before	70.90±13.365	0.000
FIM motor subtotal score after	74.97±10.078	
FIM cognitive subtotal score before	33.58±2.551	0.027
FIM2 subtotal score after	34.06±1.114	
FIM total score before	104.48±12.880	0.000
FIM total score after	106.21±9.791	

DISCUSSION

Aim of present study was assessing EQ-5D score and FIM index before and after respiratory rehabilitation in patients with COVID 19 infection. The mean score for EQ-5D score and EQ-VAS scale before rehabilitation were 0.8516±0.202 and 53.31±17.129, respectively. When compared to EQ-5D values in patients with asthma (mean EQ-5D index: 0.77–0.88 and mean EQ-VAS: 57–67) (10,11), the current study demonstrate that quality of life is similarly effected in COVID-19 patients, even EQ-VAS values were better in asthma patients. The fact that majority of our patients had no pre-existing comorbidities, especially respiratory diseases, emphasizes the substantial persistent burden of COVID-19.

There are little data about long-term recovery from COVID 19 and quality of life of these patients. Previously studies showed that both non-hospitalized and hospitalized COVID 19 patients had lower quality of life (measured with EQ-5D) compared to general population three months after symptoms onset (12,13). These results clearly showed that COVID 19 patients had long-term problems that affected their everyday life. Our study demonstrated that respiratory rehabilitation could improve quality of life. EQ-5D index score and EQ-VAS score were higher after respiratory rehabilitation, 0.9147±0.074 and 64.53±8.368, respectively. These results are supported with previously studies that showed significantly improvement in respiratory parameters such as oxygen saturation, respiratory rate and need for oxygen therapy in COVID 19 patients after respiratory

rehabilitation (14,15). Comparing each dimension of EQ-5D, patients after respiratory rehabilitation showed significantly improvement in all five, mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The most common problems our patients reported were anxiety and pain. Generally, mental health complications of anxiety, depression and poor sleep are often in acute phase of COVID 19 and in recovery phase due to biological and psychosocial factor (16). Another very often post-COVID 19 symptom are pain, including musculoskeletal pain, chest pain, headache, testicular pain (17-19). Our patients showed significant improvement regarding both, anxiety and pain after respiratory rehabilitation.

Patient's impairments in body functions and structure such as weakness, dyspnea, fatigue, chronic pain limit the ability to perform both, basic activities of daily living (ADL) and instrumental ADL. Basic ADL are related to personal care and mobility, whereas instrumental ADL are associated with the person's ability to interact with his environment (20). Functional Independence Measure score which was used in our research is commonly used scale to assess functional status regarding both ADL in critically ill patients (21).

Previously studies clearly showed that respiratory rehabilitation improved ADL in COVID 19 patients (22-24). Our research accordingly demonstrated that respiratory rehabilitation started in the hospital and continued at home significantly improved overall patient's functionality, motor and cognitive and improved patient's ability to perform ADL.

ACKNOWLEDGMENT

Patients gave their written informed consent before the study enrollment.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Halpin SJ, McIvor C, Whyatt G, Adams A, Harvey O, McLean L, et al. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: A cross-sectional evaluation. *Journal of medical virology* 2021, 93(2), 1013–1022.
2. Carfi A, Bernabei R, Landi F & Gemelli Against COVID-19 Post-Acute Care Study Group. Persistent Symptoms in Patients After Acute COVID-19. *JAMA* 2020, 324(6), 603–605.
3. Goërtz YMJ, Van Herck M, Delbressine JM, Vaes AW, Meys R, Machado FVC, et al. Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome?. *ERJ open research* 2020, 6(4), 00542-2020.
4. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *International journal of environmental research and public health* 2020, 17(5), 1729.
5. Zhao HM, Xie YX, Wang C; Chinese Association of Rehabilitation Medicine; Respiratory Rehabilitation Committee of Chinese Association of Rehabilitation Medicine; Cardiopulmonary Rehabilitation Group of Chinese Society of Physical Medicine and Rehabilitation. Recommendations for respiratory rehabilitation in adults with coronavirus disease 2019. *Chinese medical journal* 2020, 133(13), 1595–1602.
6. Gordon CS, Waller JW, Cook RM, Cavalera SL, Lim WT, Osadnik CR. Effect of Pulmonary Rehabilitation on Symptoms of Anxiety and Depression in COPD: A Systematic Review and Meta-Analysis. *Chest* 2019, 156(1), 80-91.
7. World Health Organization. Living guidance for clinical management of COVID-19. 2011.
8. Herdman M, Gudex C, Lloyd A, Janssen MF, Kind P, Parkin D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation* 2011, 20(10), 1727–1736.
9. Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation. *Advances in clinical rehabilitation* 1987, 1, 6–18.
10. Hernandez G, Garin O, Dima AL, Pont A, Martí Pastor M, Alonso J, et al. EuroQol (EQ-5D-5L) Validity in Assessing the Quality of Life in Adults With Asthma: Cross-Sectional Study. *Journal of medical Internet research* 2019, 21(1), e10178.
11. Szentes BL, Schultz K, Nowak D, Schuler M, Schwarzkopf L. How does the EQ-5D-5L perform in asthma patients compared with an asthma-specific quality of life questionnaire?. *BMC pulmonary medicine* 2020, 20(1), 168.
12. Wong AW, Shah AS, Johnston JC, Carlsten C, Ryerson CJ. Patient-reported outcome measures after COVID-19: a prospective cohort study. *The European respiratory journal* 2020, 56(5), 2003276.
13. Van Herck M, Goërtz YMJ, Houben-Wilke S, Machado FVC, Meys R, Delbressine JM, et al. Severe Fatigue in Long COVID: Web-Based Quantitative Follow-up Study in Members of Online Long COVID Support Groups. *Journal of medical Internet research* 2021, 23(9), e30274.
14. Liu K, Zhang W, Yang Y, Zhang J, Li Y, Chen Y. Respiratory rehabilitation in elderly patients with COVID-19: A randomized controlled study. *Complementary therapies in clinical practice* 2020, 39, 101166.
15. Kader M, Hossain MA, Reddy V, Perera NKP, Rashid M. Effects of short-term breathing exercises on respiratory recovery in patients with COVID-19: a quasi-experimental study. *BMC sports science, medicine & rehabilitation* 2022, 14(1), 60.
16. Uzunova G, Pallanti S, Hollander E. Presentation and management of anxiety in individuals with acute

- symptomatic or asymptomatic COVID-19 infection, and in the post-COVID-19 recovery phase. *International journal of psychiatry in clinical practice* 2021, 25(2), 115–131.
17. Fiala K, Martens J, Abd-Elsayed A. Post-COVID Pain Syndromes. *Current pain and headache reports* 2022, 26(5), 379–383.
 18. Fernández-de-Las-Peñas C, Navarro-Santana M, Plaza-Manzano G, Palacios-Ceña D, Arendt-Nielsen L. Time course prevalence of post-COVID pain symptoms of musculoskeletal origin in patients who had survived severe acute respiratory syndrome coronavirus 2 infection: a systematic review and meta-analysis. *Pain* 2022, 163(7), 1220–1231.
 19. Janbazi L, Kazemian A, Mansouri K, Madani SP, Yousefi N, Vahedifard F, et al. The incidence and characteristics of chronic pain and fatigue after 12 months later admitting with COVID-19; The Post- COVID 19 syndrome. *Am J Phys Med Rehabil.* 2022. Epub ahead of print
 20. Edemekong PF, Bomgaars DL, Sukumaran S, Caroline S. Activities of Daily Living. [Updated 2022 Jul 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470404/>
 21. Elliott D, Denehy L, Berney S, Alison JA. Assessing physical function and activity for survivors of a critical illness: a review of instruments. *Australian critical care : official journal of the Confederation of Australian Critical Care Nurses* 2011, 24(3), 155–166.
 22. Belli S, Balbi B, Prince I, Cattaneo D, Masocco F, Zaccaria S, et al. Low physical functioning and impaired performance of activities of daily life in COVID-19 patients who survived hospitalisation. *The European respiratory journal* 2020, 56(4), 2002096.
 23. Curci C, Pisano F, Bonacci E, Camozzi DM, Ceravolo C, Bergonzi R, et al. Early rehabilitation in post-acute COVID-19 patients: data from an Italian COVID-19 Rehabilitation Unit and proposal of a treatment protocol. *European journal of physical and rehabilitation medicine* 2020, 56(5), 633–641.
 24. Sakai T, Hoshino C, Yamaguchi R, Hirao M, Nakahara R, Okawa A. Remote rehabilitation for patients with COVID-19. *Journal of rehabilitation medicine* 2020, 52(9), jrm00095.