EARLY PHYSICAL REHABILITATION IN INTENSIVE CARE UNIT AND ITS IMPACT ON POST-COVID SYNDROME MANIFESTATIONS

Kovalenko V.

LLC "Treatment and Diagnostic Center "Dobrobut-Polyclinic", Kyiv, Ukraine
Bogomolets National Medical University, Kyiv, Ukraine

https://doi.org/10.35339/ic.11.3.kov

ABSTRACT

Background. The COVID-19 pandemic has caused a global health crisis, notably through long COVID, which significantly affects the quality of life of patients' post-discharge from hospital care. Long COVID is characterized by prolonged symptoms such as fatigue, cognitive impairments, depression, and anxiety. Early physical rehabilitation is a crucial component of patient recovery; however, the optimal frequency and intensity of rehabilitation interventions remain unclear.

Aim. To evaluate the effects of various physical rehabilitation regimens on functional status, cognitive functions, psychosocial state, and manifestations of post-COVID syndrome in patients who underwent severe COVID-19.

Materials and Methods. 102 patients with confirmed COVID-19 requiring treatment in an Intensive Care Unit (ICU) were included in the study. They were divided into groups based on the number of rehabilitation sessions per day: Group I received one session, while Group II received two. Physical rehabilitation included changing the body position in bed, verticalization and breathing exercises. We assessed average values for physical functional status, cognitive functions, and psychosocial condition at discharge, along with post-COVID symptom severity 5–7 days after discharge.

Results. Increasing the number of rehabilitation sessions led to better psychosocial outcomes and reduced manifestations of post-COVID syndrome. However, in the short-term, increasing session frequency did not yield statistically significant improvements in cognitive functions or physical status.

Conclusions. Early physical rehabilitation in ICU is vital for reducing manifestations of post-COVID syndrome in severe COVID-19 patients. Enhanced physical activity not only improves mental health but also helps alleviate physical symptoms. Future research should focus on the long-term effects of rehabilitation and a holistic approach to supporting patient recovery.

Keywords: *mobilization of patients, early activation of patient, COVID-19, ICU.*

Introduction

The COVID-19 pandemic has caused a global health crisis, particularly due to high mortality rates and severe consequences, especially among patients with severe disease progression. Post-COVID syndrome (Long COVID) has emerged as a significant issue faced by patients following COVID-19, particularly those who required hospitalization in the Intensive Care Unit (ICU) [1; 2]. This syndrome is characterized by long-lasting symptoms, such as fatigue, muscle weakness, cognitive impairments (commonly referred to as "brain fog"), depression, anxiety, and other psycho-emotional problems, which considerably diminish the quality of life for patients [3–5].

Physical rehabilitation is a critical component of the recovery process that can positively impact patients' overall health. It not only aids in physical recovery but also supports psychological well-being, as regular activities enhance motivation for rehabilitation [6–8]. However, questions regarding the optimal frequency and intensity of rehabilitation interventions remain unresolved.

Corresponding Author:
Kovalenko Viacheslav – MD, PhD student of the Department of Surgery, Anesthesiology and Intensive Care, Institute of Postgraduate Education Bogomolets National Medical University, Kyiv, Ukraine; LLC "TDC "Dobrobut-Polyclinic", Kyiv, Ukraine.
✉ Ukraine, 04116, Kyiv, Moldovska str., 3.
E-mail: viacheslav.kovalenko04@gmail.com

The **aim** of this study was to evaluate the impact of different physical rehabilitation regimes on functional status, cognitive functions, psychoemotional state, and manifestations of post-COVID syndrome in patients who experienced a severe form of COVID-19.

Materials and Methods

The study included 102 patients who were hospitalized in the ICU with a confirmed diagnosis of COVID-19 and required mechanical ventilation or oxygen therapy due to Acute Respiratory Distress Syndrome (ARDS).

Inclusion criteria for the study were: age over 18 years; confirmed by Polymerase Chain Reaction (PCR) COVID-19; hospitalization in the ICU due to respiratory failure related to ARDS.

Exclusion criteria from the study included: pre-existing musculoskeletal disorders that limit mobility; neurological conditions that restrict mobility; presence of oncological diseases; patient death or transfer to another healthcare facility; refusal of the patient to participate in the study.

Two groups of patients were formed based on the number of rehabilitation sessions per day. Group 1 consisted of 51 patients who underwent 1 session per day, while Group 2 included 51 patients who had 2 sessions per day. It is important to note that a group of patients without rehabilitation was not formed for ethical reasons. The characteristics of the groups are presented in *Table 1*.

Physical rehabilitation sessions included: passive, active-passive, and active exercises, patient positioning in bed, sitting and standing verticalization, walking, and breathing exercises. The sessions were conducted by a physical therapist under the supervision of a nurse and an anesthesiologist. They began on the first day of hospitalization in the ICU, with each session lasting 15–20 minutes. During the session, the therapist aimed to achieve the highest possible intensity for the patient. Sessions were discontinued in the event of patient decompensation or if the patient refused to continue.

To assess physical functional status, the following scales were used:

1. Activity Measure for Post-Acute Care (AM-PAC) Activities of Daily Living (ADL) [9; 10]. This scale includes 6 parameters for assessing daily activities: the patient's ability to put on pants, bathe, use the toilet, put on a shirt, brush teeth, and eat. Each parameter can be scored on the scale from 1 to 4, where 1 indicates that the patient is unable to perform the task, 2 means significant assistance is required, 3 indicates minimal assistance, and 4 signifies that the task is performed independently. The maximum score on the scale is 24, while the minimum is 6.

2. Johns Hopkins: Highest Level of Mobility (JH-HLM) Scale [11]. This scale assesses patient mobility and consists of 8 levels of activity, ran-

Table 1. Comparative characteristics of the study groups

Characteristics, units (presentation)	Statistical data		Group (number of patients)	
	instrument	p value	1 (n=51)	2 (n=51)
Age, years (M±SD)	t-test	0.58	57.55±14.34	56.10±12.02
Sex (number, %):				
- males			35 (69)	34 (67)
- females			16 (31)	17 (33)
Body Mass Index, kg/m² (M±SD)	U-test	0.63	31.34±6.72	30.87±5.92
Comorbidities (number, %):				
- hypertension			31 (61)	33 (65)
- diabetes mellitus			22 (43)	15 (29)
- chronic kidney disease			13 (25)	8 (16)
- smoking			9 (18)	14 (27)
Severity of condition at admission:				
- computed tomography, % (M±SD)	U-test	0.63	51.33±19.80	46.62±19.0
- SpO_2, % (M±SD)	U-test	0.56	80.86±4.91	81.35±3.25
- respiratory rate, breaths per minute (M±SD)	t-test	0.09	24.20±1.51	23.69±1.52

Notes: (M±SD) – (Mean±Standard Deviation); SpO_2 – Oxygen saturation of hemoglobin as measured by pulse oximetry; U-test – Mann-Whitney U test; t-test – Student's t-test.

ging from the minimum level (1), where the patient is bed-bound, to the maximum level (8), where the patient is able to walk more than 100 meters.

To assess cognitive functions, the Mini-Mental State Examination (MMSE) scale [12; 13] was used. This standardized questionnaire consists of 22 questions and tasks, allowing for the evaluation of a patient's cognitive abilities in 5 dimensions: orientation in time and space, registration, attention and calculation, memory, and language. Scores range from 0 to 30 points, with a score of 27 or higher considered within the normal range. A key advantage of this questionnaire is its ease of use.

To assess mental status, the Hospital Anxiety and Depression Scale (HADS) [14] were used. This subjective method is designed for the screening of anxiety and depression in hospitalized patients. HADS is noted for its simplicity of application and analysis, as completing the questionnaire does not require significant time and does not pose complications for the patient. The scale consists of 14 statements divided into 2 subscales: subscale A for 'anxiety' and subscale D for 'depression.' Each statement in the questionnaire has 4 response options reflecting the severity of symptoms, ranging from 0 to 3.

To assess the severity of post-COVID symptoms, the Post-COVID-19 Functional Status (PCFS) scale [15] was used. The PCFS evaluation was conducted during the first visit to the physician or during a phone contact with the physician. The survey was performed, on average, 5–7 days after discharge from the hospital. A sample survey algorithm is presented in the *Figure.*

Results and Discussion

The physical functional status of patients is presented in *Tables 2* and *3.*

The assessment using the AM-PAC (ADL) scale showed a slight difference between the groups. The average score in Group 1 was 22.55± ±2.96, while in Group 2 it was 23.22±2.29. However, the difference between these groups was not statistically significant (p=0.24). The findings were similar for the JH-HLM scale. This indicates that an increase in the frequency of rehabilitation sessions does not have a significant impact on patient mobility levels and their ability to perform daily tasks in the short term.

Our results differ from the study by Mayer K.P. et al. (2024), which involved approximately 2000 COVID-19 patients and found that early initiation of physical rehabilitation in the ICU, along with increased session intensity, significantly improved the patients' physical condition at the time

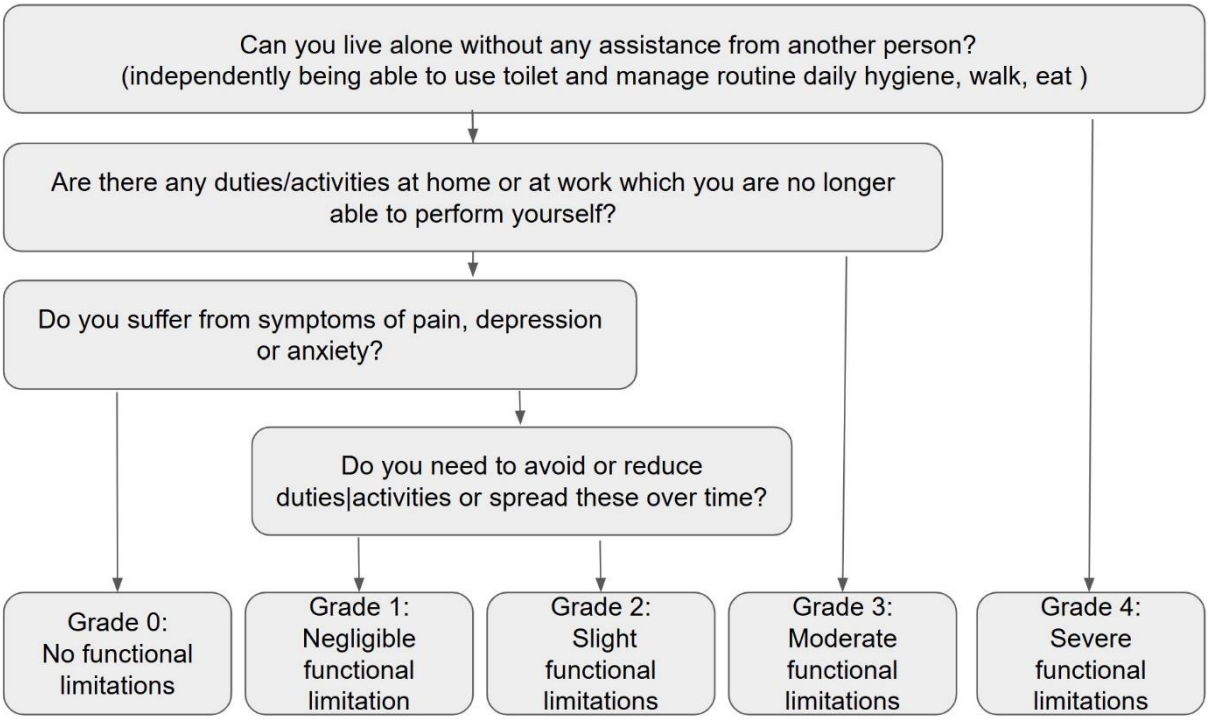

Fig. Post-COVID-19 Functional Status (PCFS) Tool [15].

Table 2. Physical functional status of patients in two groups at the time of hospital discharge

Characteristics, units (presentation)	Statistical data		Group (number of patients)	
	instrument	p value	1 (n=51)	2 (n=51)
AM-PAC (ADL) (M±SD)	U-test	0.24	22.55±2.96	23.22±2.29
JH-HLM (M±SD)	U-test	0.13	7.59±0.73	7.76±0.84

Notes: (M±SD) – (Mean±Standard Deviation); AM-PAC (ADL) – Activity Measure for Post-Acute Care (Activities of Daily Living); JH-HLM – Johns Hopkins: Highest Level of Mobility; U-test – Mann-Whitney U test.

Table 3. Cognitive and mental status of patients in two groups at the time of hospital discharge

Characteristics, units (presentation)	Statistical data		Group (number of patients)	
	instrument	p value	1 (n=51)	2 (n=51)
MMSE (M±SD)	U-test	0.24	26.45±4.37	27.35±3.58
HADS (A+D) (M±SD)	U-test	0.02	11.33±4.51	9.52±4.61

Notes: (M±SD) – (Mean±Standard Deviation); MMSE – Mini-Mental State Examination; HADS – Hospital Anxiety Depression Scale; U-test – Mann-Whitney U test.

of discharge [16]. According to other studies [17], the short-term effect of physical rehabilitation on functional status at discharge was negligible, while the long-term effect favored more intensive rehabilitation. This may indicate that the process of restoring physical activity requires more time and may depend on other factors, such as patients' baseline health status, the presence of comorbidities, or their previous level of physical activity.

Considering this, future studies should increase the sample size, measure and account for the intensity of each individual rehabilitation session, and extend the duration of patient follow-up.

Early physical rehabilitation is considered by researchers as one of the effective methods for improving cognitive functions in patients following their stay in the ICU [18]. The study conducted by Patel B.K. et al. (2023) found a positive effect of increasing the intensity of physical rehabilitation on cognitive functions, which became more pronounced over the long term [19].

In our study, the average MMSE score in Group 1 was [26.45±4.37] points, while in Group 2 it was [27.35±3.58] points. The difference in mean scores was not statistically significant. These results suggest that the recovery of cognitive functions after a severe form of COVID-19 may be a prolonged process and requires additional interventions beyond physical rehabilitation.

Regarding the mental component, patients who received two rehabilitation sessions per day exhibited a significant reduction in levels of anxiety and depression. The average score on the HADS (A+D) scale in Group 2 was 9.52±4.61, which is significantly lower than that in Group I, where the average score was 11.33±4.51 (p=0.02).

According to the literature [20], physical activity stimulates the production of endorphins (the 'happiness hormones'), which may contribute to reducing levels of anxiety and depression. Given the psycho-emotional consequences of COVID-19, intensive physical rehabilitation may be an important tool not only for physical but also for psychological recovery in patients.

One of the most significant findings of the study is the difference in PCFS scores, which assess the functional status of patients after discharge and serve as an important indicator of post-COVID syndrome manifestations. Patients who received two rehabilitation sessions per day had significantly better outcomes compared to those who underwent only one session (*Table 4*). The average score on the PCFS scale in Group 1 was 2.06±1.07, indicating a greater severity of post-COVID symptoms, such as weakness, pain, and fatigue, compared to Group 2, where the average score was 1.62±1.09. This highlights the potential of more intensive rehabilitation programs to reduce symptoms such as fatigue and weakness, which are common manifestations of post-COVID syndrome. The decline in physical strength and endurance may be related not only to the disease

Table 4. Manifestations of post-COVID syndrome in patients of both groups

Characteristics, units (presentation)	Statistical data		Group (number of patients)	
	instrument	p value	1 (n=51)	2 (n=51)
PCFS scale (M±SD)	U-test	0.02	2.06±1.07	1.62±1.09

Notes: (M±SD) – (Mean±Standard Deviation); PCFS – Post-COVID-19 Functional Status; U-test – Mann-Whitney U test.

itself but also to prolonged hospitalization; thus, maintaining a high level of physical activity plays a vital role in recovery.

It is important to note that one of the limitations of the study is its short time frame, as the assessment of results was conducted only at the time of discharge and a few days thereafter. There is a possibility that some effects, particularly in the cognitive domain, may manifest only after a longer period post-discharge.

Another significant limitation is the absence of a control group without rehabilitation. While this was justified by ethical considerations, it still restricts our conclusions regarding the absolute effectiveness of physical rehabilitation.

Future research should focus on examining the long-term effects of physical rehabilitation following severe COVID-19, specifically how changes in the intensity of physical exercises may influence patients' recovery in the long term. Studies should also take into account other aspects of recovery, such as social and psychological rehabilitation, which may contribute to the overall improvement in the quality of life for patients who have recovered from COVID-19.

Conclusion

The increase in the number of physical rehabilitation sessions for patients who have experienced severe COVID-19 demonstrates significant potential for reducing manifestations of post-COVID syndrome and improving patients' psycho-emotional state. Intensive rehabilitation programs may assist in alleviating symptoms such as fatigue and weakness, which are commonly observed in post-COVID patients. However, to achieve sustainable and long-lasting results, it is essential to consider other aspects of recovery, such as cognitive rehabilitation and social-psychological support, which play a crucial role in the recovery process following severe COVID-19.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the authors.

Funding Sources

There are no external sources of funding.

Consent for publication

All authors give their consent to publication.

References

1. Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ. Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLoS Med. 2021;18(9):e1003773. DOI: 10.1371/journal.pmed.1003773. PMID: 34582441.

2. Del Rio C, Collins LF, Malani P. Long-term Health Consequences of COVID-19. JAMA. 2020;324(17): 1723-4. DOI: 10.1001/jama.2020.19719. PMID: 33031513.

3. The Lancet. Facing up to long COVID. Lancet. 2020;396(10266):1861. DOI: 10.1016/S0140-6736(20) 32662-3. PMID: 33308453.

4. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. BMJ Glob Health. 2021:e005427. DOI: 10.1136/bmjgh-2021-005427. PMID: 34580069.

5. Neufeld KJ, Leoutsakos JS, Yan H, Lin S, Zabinski JS, Dinglas VD, et al. Fatigue Symptoms During the First Year Following ARDS. Chest. 2020;158(3):999-1007. DOI: 10.1016/j.chest.2020.03.059. PMID: 32304774.

6. Simpson R, Robinson L. Rehabilitation After Critical Illness in People with COVID-19 Infection. Am J Phys Med Rehabil. 2020;99(6):470-4. DOI: 10.1097/PHM.0000000000001443. PMID: 32282359.

7. Spada MS, Biffi AM, Belotti L, Cremaschi L, Palumbo C, Locatelli C, et al. Psychological impact of COVID-19 after hospital discharge: A follow-up study on Italian recovered patients. J Affect Disord. 2022;317:84-90. DOI: 10.1016/j.jad.2022.08.086. PMID: 36029882.

8. Rosa RG, Teixeira C, Piva S, Morandi A. Anticipating ICU discharge and long-term follow-up. Curr Opin Crit Care. 2024; 30(2):157-64. DOI: 10.1097/MCC.0000000000001136. PMID: 38441134.

9. Jette DU, Stilphen M, Ranganathan VK, Passek S, Frost FS, Jette AM. Interrater Reliability of AM-PAC "6-Clicks" Basic Mobility and Daily Activity Short Forms. Phys Ther. 2015;95(5):758-66. DOI: 10.2522/ptj.20140174. PMID: 25504489.

10. Jette DU, Stilphen M, Ranganathan VK, Passek SD, Frost FS, Jette AM. Validity of the AM-PAC "6-Clicks" inpatient daily activity and basic mobility short forms. Phys Ther. 2014;94(3):379-91. DOI: 10.2522/ptj.20130199. PMID: 24231229.

11. Hiser S, Chung CR, Toonstra A, Friedman LA, Colantuoni E, Hoyer E, Needham DM. Inter-rater reliability of the Johns Hopkins Highest Level of Mobility Scale (JH-HLM) in the intensive care unit. Braz J Phys Ther. 2021:352-5. DOI: 10.1016/j.bjpt.2020.07.010. PMID: 32811787.

12. Biagianti B, Di Liberto A, Nicolo Edoardo A, Lisi I, Nobilia L, de Ferrabonc GD, et al. Cognitive Assessment in SARS-CoV-2 Patients: A Systematic Review. Front Aging Neurosci. 2022;14:909661. DOI: 10.3389/fnagi.2022.909661. PMID: 35847679.

13. Aiello EN, Fiabane E, Manera MR, Radici A, Grossi F, Ottonello M, et al. Screening for cognitive sequelae of SARS-CoV-2 infection: a comparison between the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA). Neurol Sci. 2022;43(1):81-4. DOI: 10.1007/s10072-021-05630-3. PMID: 34668124.

14. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Res. 2002;52(2):69-77. DOI: 10.1016/s0022-3999(01)00296-3. PMID: 11832252.

15. Klok FA, Boon GJAM, Barco S, Endres M, Geelhoed JJM, Knauss S, et al. The Post-COVID-19 Functional Status scale: a tool to measure functional status over time after COVID-19. Eur Respir J. 2020;56(1):2001494. DOI: 10.1183/13993003.01494-2020. PMID: 32398306.

16. Mayer KP, Haezebrouck E, Ginoza LM, Martinez C, Jan M, Michener LA, et al. Early physical rehabilitation dosage in the intensive care unit associates with hospital outcomes after critical COVID-19. Crit Care. 2024;28(1):248. DOI: 10.1186/s13054-024-05035-6. PMID: 39026370.

17. Burtin C, Clerckx B, Robbeets C, Ferdinande P, Langer D, Troosters T, et al. Early exercise in critically ill patients enhances short-term functional recovery. Crit Care Med. 2009;37(9):2499-505. DOI: 10.1097/CCM.0b013e3181a38937. PMID: 19623052.

18. Honarmand K, Lalli RS, Priestap F, Chen JL, McIntyre CW, Owen AM, Slessarev M. Natural History of Cognitive Impairment in Critical Illness Survivors. A Systematic Review. Am J Respir Crit Care Med. 2020;202(2):193-201. DOI: 10.1164/rccm.201904-0816CI. PMID: 32078780.

19. Patel BK, Wolfe KS, Patel SB, Dugan KC, Esbrook CL, Pawlik AJ, et al. Effect of early mobilisation on long-term cognitive impairment in critical illness in the USA: a randomised controlled trial. Lancet Respir Med. 2023;11(6):563-72. DOI: 10.1016/S2213-2600(22)00489-1. PMID: 36693400.

20. Basso JC, Suzuki WA. The Effects of Acute Exercise on Mood, Cognition, Neurophysiology, and Neurochemical Pathways: A Review. Brain Plast. 2017;2(2):127-52. DOI: 10.3233/BPL-160040. PMID: 29765853.

Received: 23 Jul 2024
Accepted: 26 Sep 2024
Published: 30 Sep 2024

Cite in Vancouver style as: Kovalenko V. Early physical rehabilitation in intensive care unit and its impact on Post-COVID syndrome manifestations. Inter Collegas. 2024;11(3):17-22. https://doi.org/10.35339/ic.11.3.kov

Archived: https://doi.org/10.5281/zenodo.14250339