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Long-term functional outcomes after intensive care treatment for severe COVID-19

Dugotrajne funkcionalne posljedice nakon liječenja teškog COVID-19 u jedinici intenzivnog liječenja

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Summary

Patients treated for severe COVID-19 in intensive care units (ICUs) frequently experience persistent symptoms after hospital discharge, affecting physical, cognitive, and mental functioning. The aim of this study was to assess long-term difficulties after ICU treatment for severe COVID-19.

A cross-sectional survey was conducted at the University Hospital for Infectious Diseases "Dr. Fran Mihaljević", Zagreb. Adult patients treated in the ICU for severe COVID-19 between March 2020 and August 2021 were contacted at least six months after discharge. Quality of life was assessed using a telephone questionnaire adapted from the 15D instrument, comparing post-discharge status with the pre-hospitalization condition.

Eighty-eight patients were included, predominantly male (71.6%), with a mean age of 57 ± 13 years. Persistent difficulties were reported by 80.7% of respondents. The most frequently affected domains were breathing (59.1%), mobility (43.2%), mental function (36.4%), and daily activities (27.3%). Respiratory symptoms were reported both by mechanically ventilated and non-ventilated patients. Cognitive difficulties were mostly mild, although a small proportion of patients reported impairment affecting work ability.

Persistent functional limitations are common after ICU treatment for severe COVID-19. These findings suggest the potential benefit of structured post-ICU follow-up and multidisciplinary rehabilitation to improve long-term outcomes and quality of life.

Sažetak

Bolesnici liječeni u jedinicama intenzivnog liječenja (JIL) zbog teškog COVID-19 često imaju perzistentne tegobe nakon otpusta iz bolnice, koje zahvaćaju tjelesno, kognitivno i mentalno funkcioniranje. Cilj rada bio je ispitati dugotrajne poteškoće nakon otpusta iz JIL-a u bolesnika liječenih zbog teškog COVID-19.

Provedeno je presječno istraživanje u Klinici za infektivne bolesti „Dr. Fran Mihaljević“ u Zagrebu. U istraživanje su uključeni odrasli bolesnici liječeni u JIL-u zbog teškog COVID-19 u razdoblju od ožujka 2020. do kolovoza 2021., najmanje šest mjeseci nakon otpusta. Kvaliteta života procijenjena je telefonskim upitnikom prilagođenim 15D upitniku, uz usporedbu trenutnog stanja s razdobljem prije hospitalizacije.

U istraživanje je uključeno 88 bolesnika, većinom muškaraca (71,6%), prosječne dobi 57 ± 13 godina. Dugotrajne poteškoće navelo je 80,7% ispitanika. Najčešće zahvaćene dimenzije bile su disanje (59,1%), pokretljivost (43,2%), mentalno funkcioniranje (36,4%) i svakodnevne aktivnosti (27,3%). Kognitivne poteškoće uglavnom su bile blage, ali je kod manjeg broja bolesnika zabilježen utjecaj na radnu sposobnost.

Dugotrajne posljedice nakon liječenja teškog COVID-19 u JIL-u česte su te upućuju na potrebu za sustavnim praćenjem i rehabilitacijom bolesnika nakon otpusta.

Introduction

COVID-19, caused by the SARS-CoV-2 virus, was first identified in December 2019 in China^[1]. The disease manifests in a spectrum from asymptomatic to critical illness^[2, 3], with approximately 5% of cases developing a critical illness characterized by the

development of acute respiratory distress syndrome (ARDS), shock, coagulopathy, encephalopathy, heart failure, or acute renal failure^[2, 3]. Critical illness requires monitoring and treatment in intensive care units (ICUs)^[2].

Beyond acute illness and its complications, it is estimated that around 10% of individuals infected with SARS-CoV-2 develop some form of post-acute sequelae of SARS-CoV-2 infection (PASC), either pulmonary or extrapulmonary^[6, 7]. One year after discharge from the ICU, as many as 50% of patients experience newly developed physical, cognitive, or mental difficulties, with those recovering from ARDS showing impairments across nearly all post-intensive care syndrome (PICS) domains. Common physical issues include muscle weakness, weight loss, and fatigue. It is estimated that these difficulties are less severe, less frequent, and resolve more quickly in patients treated for COVID-19 compared to those treated in ICU for other conditions^[8].

It is estimated that the true mortality rate associated with COVID-19 is around 0.5% to 1% in unvaccinated individuals, with variability among risk groups^[9].

The aim of this study was to examine the persisting long-term difficulties after ICU discharge in patients who were treated for COVID-19.

Methods

The study was conducted at the “Dr. Fran Mihaljević” University Hospital for Infectious Diseases from February 24 to March 24, 2022. During this period, retrospective data were collected on patients treated in the ICU for severe COVID-19 from March 11, 2020, to August 31, 2021, who were discharged to further home care or other institutions.

Inclusion criteria for the study were:

- Age over 18 years.
- ICU admission due to severe COVID-19.
- Survival from the acute illness and discharge from ICU to home care or another institution (no mortality).
- Discharge from ICU at least six months before the survey.

Exclusion criteria included:

- Mortality within the first 30 days after discharge.
- Inability to contact the patient (e.g., unavailable phone number).
- Refusal to participate in the study.

Patients were contacted via phone and asked questions regarding their quality of life, which were adapted from the standardized 15D questionnaire (10). Respondents were requested to assess changes in specific dimensions of the 15D questionnaire compared to their condition prior to ICU hospitalization.

During the patient screening period (March 11, 2020 to August 31, 2021), a total of 450 adult patients were

hospitalized in the ICU, of whom 139 (30.9%) met the inclusion criteria. Altogether, 51 (36.7%) patients were excluded, 48 (94.1%) due to inability to contact and 3 (5.9%) due to death within the first 30 days post-discharge. Thus, a total of 88 patients were included in the study.

Results

The majority of respondents were male (N=63, 71.6%), with an average age of 57 (± 13) years at the time of hospitalization. Patients spent an average of 9.5 days (median 6-20) in the ICU. Mechanical ventilation was employed in 36 patients (40.1%), with an average duration of mechanical ventilation of 14.5 days (median 4.5-28.5). The Charlson Comorbidity Index (CCI) at the time of hospitalization was 2 (median 1-3).

Difficulty was reported by 71 (80.7%) respondents, equally distributed among women (N=21, 84%) and men (N=50, 79.4%). However, since the sample predominantly consists of men, those reporting difficulties also largely belong to this group (70.4%). Among mechanically ventilated patients, difficulties were reported by 28 respondents (77.8%), while 41 respondents (78.9%) not on mechanical ventilation reported similar issues.

Of all dimensions in the 15D questionnaire, the most frequently reported issues after hospitalization were in the breathing dimension (N=52, 59.1%), mobility (N=38, 43.2%), mental function (N=32, 36.4%), and daily activities (N=24, 27.3%).

Changes in the breathing dimension were reported by the highest number of respondents. Issues manifested as increased fatigue and shortness of breath during physical activities (N=10, 19.2%), during prolonged walking or climbing stairs (N=40, 76.9%), and for some, even during flat walking or daily tasks (N=2, 3.8%). Among patients who were mechanically ventilated, 19 (52.8%) reported breathing difficulties, while 34 (65.4%) non-ventilated patients also experienced similar issues.

Mobility issues reported by respondents ranged from those able to move independently within their home, requiring assistance with stairs (N=32, 84.2%), to those needing orthotic aids or assistance from others even at home (N=6, 15.8%).

In terms of cognitive function, the most frequently reported difficulties were mild memory problems and lack of concentration that did not affect normal functioning (N=30, 93.8%). However, 2 patients (6.2%) reported significant memory issues that required job changes.

In the daily activities dimension, 24 respondents (27.3%) indicated they could mostly complete tasks, albeit with minor difficulties and feeling different from their pre-hospitalization state. Additionally, 12 respondents (13.6%) reported sleep disturbances (dif-

ficulty initiating or maintaining sleep), of whom 6 (50.0%) used sleeping pills daily. Reduced mood was reported by 10 respondents (11.4%), and anxiety and irritability were noted by 14 (15.9%).

Detailed results are presented in Tables 1 and 2.

TABLE 1. DIFFICULTIES REPORTED BY PARTICIPANTS (REGARDLESS OF THE INTENSITY OF CHANGE) (N=88)

TABLICA 1. POTEŠKOĆE KOJE SU PRIJAVILI ISPITANICI (BEZ OBZIRA NA INTENZITET PROMJENE) (N=88)

Participants who reported at least one difficulty (N (%))	Male (N(%))	71 (80.7%)	50 (70.4%)
	Female (N(%))		
Participants on MV (N (% of all MV participants))	28 (77.8%)		
Participants without MV (N (% of all participants without MV))	41 (78.8%)		
Mobility (N (% of all participants))	38 (43.2%)		
Vision (N (% of all participants))	1 (1.1%)		
Hearing (N (% of all participants))	3 (3.4%)		
Breathing (N (% of all participants))	52 (59.1%)		
Sleep (N (% of all participants))	12 (13.6%)		
Eating (N (% of all participants))	2 (2.3%)		
Speech (N (% of all participants))	4 (4.5%)		
Excretion (N (% of all participants))	2 (2.3%)		
Daily activity (N (% of all participants))	24 (27.3%)		
Mental function (N (% of all participants))	32 (36.4%)		
Discomfort (N (% of all participants))	2 (2.3%)		
Depression (N (% of all participants))	10 (11.4%)		
Disturbance (N (% of all participants))	14 (15.9%)		
Vitality (N (% of all participants))	2 (2.3%)		
Sexual activity (N (% of all participants))	0 (0%)		

MV: mechanical ventilation

TABLE 2. DETAILED DESCRIPTION OF CHANGES IN SPECIFIC DIMENSIONS ACCORDING TO REPORTED LEVELS OF DIFFICULTY (N=88)

TABLICA 2. DETALJAN OPIS PROMJENA U POJEDINIM DIMENZIJAMA PREMA PRIJAVLJENIM RAZINAMA POTEŠKOĆA (N=88)

BREATHING	
Participants on Mechanical Ventilation (MV) (N, (%))	19 (52.8%)
Participants without MV (N (%))	34 (65.4%)
Difficulty with sports activity (N (%))	10 (19.2%)
Difficulty climbing stairs (N (%))	40 (76.9%)
Difficulty walking on flat ground (N (%))	2 (3.8%)

MOBILITY	
Independent, requires help with climbing stairs (N (%))	32 (84.2%)
Requires help moving around the house (N (%))	6 (15.8%)
COGNITIVE FUNCTIONS	
Mild difficulties, normal functioning (N (%))	30 (93.8%)
Significant difficulties (N (%))	2 (6.2%)
SLEEP	
Difficulty falling or staying asleep, no medication used (N (%))	6 (50.0%)
Significant difficulties, with medication (N (%))	6 (50.0%)

Discussion

This study demonstrates that a substantial proportion of patients treated for severe COVID-19 in the intensive care unit experience persistent symptoms months after discharge. More than four-fifths of respondents (80.7%) reported at least one ongoing difficulty, indicating a high burden of post-acute morbidity in this population. These dimensions align with those observed in patients post-ARDS as a part of post-intensive care syndrome (PICS)^[11], as well as in patients hospitalized for COVID-19.^[7, 12, 13]

In a study by Huang et al., which followed patients hospitalized for COVID-19, 76% reported at least one symptom six months after discharge, with women reporting symptoms more frequently^[7]. In our study, the gender distribution of those reporting difficulties was equal, although the predominance of men in the sample may have influenced this outcome. Given the findings of Huang et al., it could be beneficial to investigate potential gender differences in future studies.

Respiratory symptoms were the most frequently reported long-term complaint, affecting 59.1% of respondents. Difficulties most commonly manifested during exertion, such as prolonged walking or climbing stairs, while only a small proportion experienced symptoms during basic daily activities. These findings are consistent with previous studies in post-COVID-19 and post-ARDS populations.^[14, 15, 16] Notably, breathing difficulties were reported both by patients who required mechanical ventilation and those who did not, suggesting that factors beyond ventilator-associated lung injury may contribute to long-term respiratory impairment.

Impairments in mobility were reported by 43.2% of patients, with most respondents remaining independent indoors but requiring assistance during more demanding activities. A smaller subset required orthotic

aids or assistance even within the home environment, highlighting the impact of prolonged ICU stay and critical illness-associated weakness. About half of post-COVID-19 patients had severe impairments in physical functioning and during activities of daily living at discharge home in similar study^[17] providing a clear rationale to study the safety and efficacy of rehabilitative interventions in these patients.

Cognitive difficulties were reported by approximately one-third of respondents, predominantly as mild memory impairment and reduced concentration. However, a small but clinically important proportion reported deficits severe enough to necessitate changes in employment, emphasizing the need for cognitive assessment and rehabilitation after ICU discharge. Cognitive deficits and psychological symptoms such as memory impairment, concentration difficulties, anxiety, and mood changes have also been described, significantly impacting daily functioning and quality of life.^[18]

Difficulties in daily activities were reported by over one-quarter of respondents and were frequently accompanied by sleep disturbances, mood changes, anxiety, or irritability. The coexistence of physical and psychological symptoms underscores the multidimensional nature of recovery after severe COVID-19.

Impairments in mobility and physical function after ICU discharge are well-recognized features of post-intensive care syndrome (PICS), affecting a substantial proportion of survivors and often persisting for months to years after discharge.^[19, 20]

Several limitations should be acknowledged, including the cross-sectional design, unicentric setting, and relatively small sample size. Nevertheless, this study provides valuable real-world insight into the long-term consequences of severe COVID-19 requiring intensive care.

Conclusion

Patients treated for severe COVID-19 in the intensive care unit frequently experience persistent symptoms months after discharge, most commonly involving respiratory function, mobility, and cognitive performance. These long-term difficulties substantially affect daily functioning and quality of life.

The results highlight the need for structured post-ICU follow-up, multidisciplinary rehabilitation programs, and early identification of patients at risk for prolonged recovery. Integrating physical, cognitive, and psychological support into post-discharge care may improve functional outcomes and facilitate reintegration into everyday and professional life.

Conflict of interest

The authors declare no conflict of interest.

Ethical considerations

The study was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all participants.

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