Cogitare Enfermagem

ORIGINAL ARTICLE

Impact of COVID-19 on cognitive function of survivors after intensive care hospitalization: prospective cohort*

HIGHLIGHTS

1. Longitudinal behavior of cognitive dysfunction after the acute phase of COVID-19.
2. Worse cognitive trajectory among women.
3. Satisfactory cognitive recovery three months after ICU discharge.

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ABSTRACT

Objective: To analyze the impact of COVID-19 on cognition in adults at 14, 30, and 90 days after discharge from the Intensive Care Unit. **Method:** Prospective cohort study with 167 patients aged 18 years or older, assessed using Pfeiffer's Short Portable Mental Status Questionnaire, with data from hospitals in the Eastern region of the state of Paraná, Brazil, between 2021 and 2022. For data analysis, Friedman's Test was used to compare paired samples across the three collection points, and the Mann-Whitney Test was used to compare cognitive performance between men and women. **Results:** The mean age was 49.3 years, with the most frequent age group being 40–49 years; 52.7% were male, and the mean length of hospitalization was 16.6 days. Cognitive alterations persisted, and female participants showed a worse recovery profile. **Conclusion:** Recovery was satisfactory. Three months after ICU discharge, 4.1% of participants still presented mild impairments considering the limitations reported at the beginning of the study.

KEYWORDS: COVID-19; Intensive Care Units; Cognition; Cognitive Dysfunction; Mental Status and Dementia Tests.

HOW TO REFERENCE THIS ARTICLE:
Kmita LC, Corleto LV, Tiba MN, Ruggieri KCR, Moser ADL, Bernardelli RS. Impact of COVID-19 on cognitive function of survivors after intensive care hospitalization: prospective cohort. Cogitare Enferm [Internet]. 2025 [cited "insert year, month and day"];30:e96346en. Available from: https://doi.org/10.1590/ce.v30i.96346en

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INTRODUCTION

COVID-19 has become the fifth documented pandemic since the influenza pandemic of 1918 and spread rapidly worldwide1-2, with more than 522 million confirmed cases and over 6 million deaths reported globally by May 20223.

With the progression to more severe forms of the disease, characterized by lower oxygen saturation, hospitalization in Intensive Care Units becomes inevitable4-5. Survivors of severe critical illness following intensive care commonly develop a combination of cognitive dysfunction associated with fatigue, with up to 80% of patients experiencing new or worsened cognitive alterations after hospital discharge6. This condition is intensified in the context of COVID-19, where cognitive changes and delirium have been shown to result from the systemic inflammatory response to SARS-CoV-27.

Although most individuals infected with COVID-19 recover, a significant proportion continue to experience symptoms and complications beyond the acute illness. Patients with "long COVID" present a wide range of physical, mental, and psychological symptoms8-9, disturbances that had previously been associated with a different patient population than that observed during the pandemic10.

Thus, the world continues to face the diverse clinical manifestations of SARS-CoV-2 infection, with patients experiencing persistent symptoms that extend beyond four weeks after the initial episode, among which cognitive impairment is a frequent complaint11-12.

Cognitive assessment is essential to better guide care practices for populations subjected to sensory deprivation resulting from acute or chronic illness. In this context, Pfeiffer's Short Portable Mental Status Questionnaire (SPMSQ) stands out as a cognitive screening and diagnostic support tool that is easy to administer and demonstrates high validity and reliability, particularly in the prevention of dementia13. This instrument was used in the present study to analyze the impact of COVID-19 on cognition at 14, 30, and 90 days after discharge from the Intensive Care Unit (ICU).

METHOD

This was a quantitative, prospective cohort study that assessed cognitive impairment in patients recovering from COVID-19 who required admission to Intensive Care Units (ICUs). The study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cohort studies. The STROBE checklist items were considered to ensure transparency and quality in reporting, from study design and participant selection to data collection, analysis, presentation, and interpretation of results.

The initial approach to potential participants was carried out by telephone contact after ICU discharge. At that time, individuals were invited to participate in the study and were informed about its objectives, methods, and ethical implications. Data collection was conducted through telephone interviews administered by a trained research team, at three time points: 14, 30, and 90 days after ICU discharge.

Figure 1 presents the flowchart describing the screening, eligibility, inclusion, and follow-up stages of the patients who comprised the study sample.

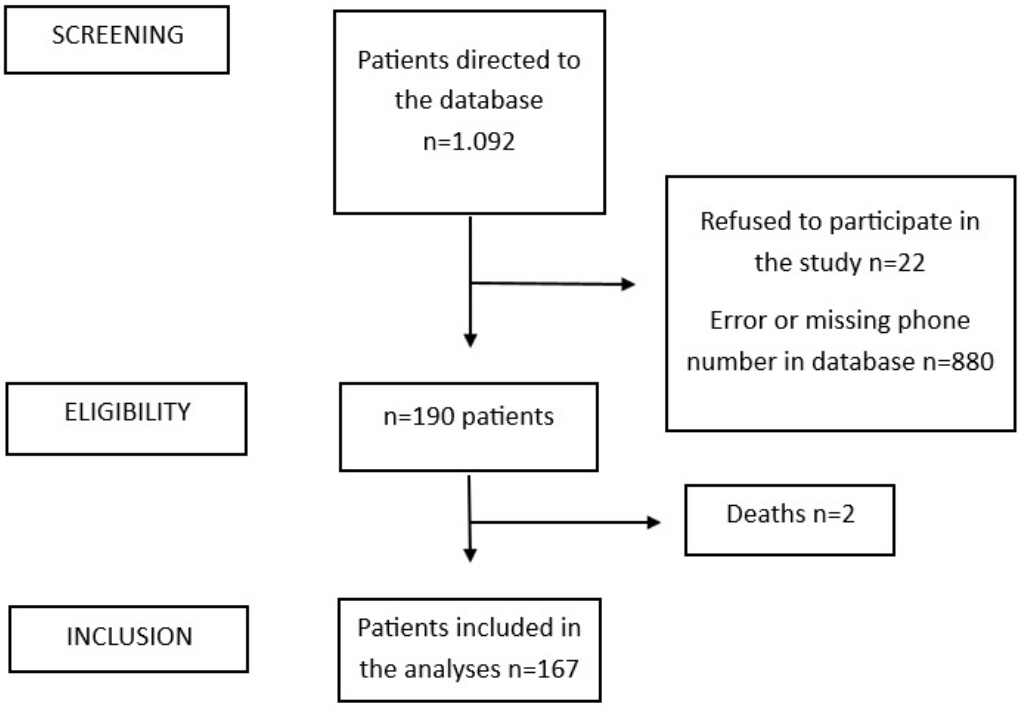

Figure 1. Data collection flowchart.
Source: The authors (2025).

Initially, patients admitted to ICUs were identified after authorization from all hospitals involved in the research, following the signing of the Cooperation Agreement. Subsequently, the principal investigator accessed hospital databases and clinical records from each institution, from which patients' telephone contacts and clinical-epidemiological information were obtained to characterize the health profile during their ICU stay.

The interviews were conducted using a validated instrument, the SPMSQ, composed of 10 questions. This instrument serves as a screening and monitoring tool for therapeutic measures and the progression or persistence of cognitive deficits[13-14]. The questionnaire assesses short- and long-term memory, orientation, and concentration through simple questions such as: date (day, month, and year), day of the week, current location, telephone number, age, place of birth, name of the current and previous presidents, mother's maiden name, and performing a countdown[13-14]. This instrument allows classification into preserved cognitive capacity (0–2 errors), mild cognitive impairment (3–4 errors), moderate (5–7 errors), or severe (8 or more errors), considering the participant's educational level[13,15].

For the construction of the study, data were obtained from the Center for Studies and Research in Intensive Care (CEPETI), which holds the records of patients discharged after ICU hospitalization for COVID-19 treatment in six public and private hospitals located in Curitiba, Paraná, Brazil. The participating hospitals were: Hospital Marcelino Champagnat, Hospital das Nações, Hospital Santa Casa de Curitiba, Centro Hospitalar do Trabalhador, Instituto de Neurologia de Curitiba (INC), and Hospital Vita Batel. The sample consisted of 167 patients of both sexes, assessed between January 2021 and March 2022, all of whom were discharged from the hospital following post-COVID-19 ICU admission.

Inclusion criteria were patients aged 18 years or older, admitted to an ICU due to COVID-19 infection in one of the participating hospitals, who survived to hospital discharge, were available for telephone contact at the stipulated times, and agreed to participate in the study by providing informed consent (ICF) during the telephone contact.

Patients who, after hospital discharge, remained tracheostomized, hindering verbal communication, or who presented other impairments preventing participation at the initial contact (D14 segment)—since the questionnaire must be answered by the patient—were contacted later within the pre-established timeframe for the D14 segment or, alternatively, at the next follow-up point (D30 segment).

Patients with preexisting language and/or cognitive disorders that rendered them unable to respond to the telephone interview were excluded. This information was provided by a family member or caregiver during the first telephone contact, 14 days after ICU discharge.

Data were entered into Microsoft Excel® spreadsheets and analyzed using the Statistical Package for the Social Sciences—SPSS® (IBM® SPSS®, Statistics v.25.0, SPSS Inc., Chicago, USA). Results were expressed as means, medians, minimum and maximum values, and standard deviations (quantitative variables) or as frequencies and percentages (qualitative variables).

To evaluate levels of cognitive impairment, McNemar's Test was applied. The Chi-square Test was used to compare cognitive impairment between the D30 and D90 segments, and Friedman's Test was used to compare paired samples at the three collection points. Ninety-five percent confidence intervals were calculated for parameters of interest. A p-value <0.05 was considered statistically significant.

The project was submitted to and approved by the Research Ethics Committee for Human Subjects at the Pontifical Catholic University of Paraná (approval no. 4.293.030). Informed consent was obtained either at the time of ICU discharge or by telephone.

RESULTS

When using cross-tabulation to evaluate the interaction between two segments of SPMSQ scores (D14/D30, D14/D90, and D30/D90) with McNemar's Test to assess paired levels of cognitive impairment, statistical significance was observed only between the D14/D90 segments ($p<0.05$). When applying the Chi-square Test to compare cognitive impairment between the D30 and D90 segments, statistical significance was observed ($p=0.00$). Inferential analysis across the three collection points indicated statistical significance ($p<0.05$).

Patients with a confirmed diagnosis of COVID-19 who were hospitalized had a mean age of 49.3 years ± 13.9. The minimum and maximum ages were 20 and 85 years, respectively. The most frequent age group was 40–49 years (24.7%), followed by 50–59 years (22%), 30–39 years (20.2%), and 60–69 years (18.6%).

The mean length of ICU stay was 16.6 days ± 16.5, with a minimum of 1 day and a maximum of 128 days (Table 1). Among the participants, 52.7% were male, and the most common level of education was high school completion (19.2%); 77.7% of participants had at least completed elementary school.

Seventy-five patients participated in all three follow-up segments. The mean SPMSQ score at D14 was 1.63 ± 1.91 (minimum = 0; maximum = 10). At D30, the mean score was 0.88 ± 1.28 (minimum = 0; maximum = 7). At D90, the mean score was 0.47 ± 0.97 (minimum = 0; maximum = 5).

Table 1 presents the number of participants in each isolated segment. At D14, 109 patients participated, with a mean of 1.72 ± 1.97 (minimum = 0; maximum = 10). At D30, 139 patients participated, with a mean of 1.12 ± 1.59 (minimum = 0; maximum = 8). At D90, 121 patients participated, with a mean of 0.46 ± 1.03 (minimum = 0; maximum = 6).

Table 1. Samples related to collection segments. Curitiba, PR, Brazil, 2022

Segment	N (isolated)	Mean	Standard Deviation	Minimum	Maximum	Percentiles		
						25°	50° (Median)	75°
D14	109	1.72	1.972	0	10	0	1	2
D30	139	1.12	1.59	0	8	0	1	2
D90	121	0.46	1.033	0	6	0	0	1
Segment	**N (in common)**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**p-value†**		
D14		1.63	1.916	0	10			
D30	75	0.88	1.284	0	7	0,00*		
D90		0.47	0.977	0	5			

Legend: Values expressed as frequency, mean, standard deviation, minimum, maximum, and quartiles (25th–75th).
†Friedman Test – Significance (p) (*significant p ≤ 0.05).
Source: Authors (2022).

When comparing SPMSQ scores by sex, a homogeneous pattern was observed between groups; however, female participants demonstrated a worse cognitive recovery profile, with statistically significant differences across all segments (Table 2).

Table 2 also shows cognitive outcomes in relation to ICU length of stay, using the data from Table 1 categorized as "ICU Stay Cluster," dichotomized into two groups: up to 11 days in the ICU and 12 days or more, to enable statistical comparison.

Analysis of the mean values across all segments showed that the sample, as a whole, evolved similarly over the follow-up period. Patients who remained in the ICU for 12 days or more had higher mean SPMSQ scores, reflecting greater cognitive impairment. However, statistical significance was not reached, suggesting that length of stay was not a determining factor for cognitive decline in this group. The results are summarized in Table 2.

Data regarding the classification of scores obtained with the Short Portable Mental Status Questionnaire (SPMSQ) were organized and presented in absolute (frequency) and relative (percentage) values, according to the instrument's criteria. This classification allowed for identifying the degree of cognitive impairment—preserved, mild, moderate, or severe—based on the number of errors, adjusted for educational level. Detailed information is presented in Table 3.

Table 2. Sex and length of ICU stay. Curitiba, PR, Brazil, 2022

Segment/Sex		N	Mean	Standard Deviation	p-value‡
D14	Male	59	1.32	1.58	0.045*
	Female	50	2.18	2.28	
D30	Male	71	0.68	0.82	0.013*
	Female	68	1.59	2.01	
D90	Male	60	0.18	0.59	0.001*
	Female	61	0.74	1.28	
Segment / ICU		**N**	**Mean**	**Standard Deviation**	**p-value‡**
D14	Up to 11 days	59	1.56	1.85	0.564**
	12 days or more	50	1.9	2.1	
D30	Up to 11 days	68	0.97	1.52	0.121**
	12 days or more	71	1.27	1.64	
D90	Up to 11 days	58	0.4	0.95	0.366**
	12 days or more	63	0.52	1.1	

Legend: Values expressed as frequency, mean, and standard deviation. Mann–Whitney Test – Significance (p) (*significant p ≤ 0.05; **not significant).
Source: Authors (2022).

Table 3. Cognitive impairment across all collection segments. Curitiba, PR, Brazil, 2022

		SPMSQ D14		SPMSQ D30		SPMSQ D90	
		N	%	N	%	N	%
Cognitive Status	Preserved Cognitive Capacity	83	76.1	121	87.1	116	95.9
	Mild Cognitive Impairment	15	13.8	12	8.6	3	2.5
	Moderate Cognitive	10	9.2	4	2.9	2	1.7
	Severe Cognitive	1	0.9	2	1.4	0	0
	Total	109	100	139	100	121	100

Source: Authors (2022).

At D14, 83 patients (76.1%) showed preserved cognitive capacity, 15 (13.8%) mild impairment, and 10 (9.2%) moderate impairment. Only one patient (0.9%) had severe cognitive impairment.

At D30, 121 patients (87.1%) had preserved cognitive capacity, 12 (8.6%) mild impairment, 4 (2.9%) moderate impairment, and 2 (1.4%) severe impairment.

At D90, 116 patients (95.9%) had preserved cognitive capacity, 3 (2.5%) mild impairment, and 2 (1.7%) moderate impairment. In this segment, no patient presented with severe impairment.

DISCUSSION

In this cohort study, patients were evaluated at three distinct time points, following a temporal evolution to assess and monitor cognitive deficits after ICU stays due to COVID-19. This objective aligns with other studies that have observed and reported changes in the cognitive status of patients recovering from this disease.[15-17] These findings are consistent with other reports describing mild, moderate, or severe cognitive impairment in patients with respiratory distress caused by COVID-19[18-19]. Scientific evidence indicates a possible association between the clinical variables of acute COVID-19 infection, including respiratory symptoms, and the cognitive and functional deficits that persist in the post-infection phase[20].

Similar to the present study, where the ICU setting is central, a cohort study involving 140 patients admitted to the ICU due to acute respiratory distress syndrome caused by SARS-CoV-2 concluded that 118 of them developed a combination of delirium (altered levels of consciousness) and cognitive disorders, secondary to the systemic inflammatory response triggered by the virus[4].

Of the 139 participants effectively included in the D30 segment, it was observed that 30 days after ICU discharge, 13% still presented some degree of impairment (mild, moderate, or severe). These findings are in line with other studies that also reported cognitive deficits 30 days after hospitalization[11].

Compared to the D30 results of this study, a cohort conducted in New York evaluated 45 critically ill COVID-19 patients admitted to the ICU. Of these, 30 participants underwent cognitive assessment 30 days after hospital discharge using another screening tool, the Telephone Montreal Cognitive Assessment (T-MoCA). Twenty percent scored below 19, indicating some level of cognitive impairment[21].

Another study assessing cognition at an average of 30–40 days after COVID-19 recovery evaluated 20 patients using the in-person Montreal Cognitive Assessment (MoCA). Seventy percent still showed cognitive deficits, corroborating findings related to impairment in the D30 segment[22].

Consistent with the literature, cognitive performance in post-COVID-19 patients has been reported as below optimal. A narrative review covering two to seven months post-discharge identified deficits in attention, reduced information-processing speed, and short-term memory impairment, particularly among ICU survivors[9]. These temporal trends, as observed in the present study, highlight the prevalence of cognitive deficits among previously hospitalized patients[23].

Although hospitalized patients, especially those admitted to ICUs, are at greater risk of developing cognitive symptoms, these manifestations have also been reported in patients with mild COVID-19 and even in asymptomatic individuals[23]. Young patients with a positive COVID-19 diagnosis who were not hospitalized have also presented with these deficits[24,25]. Different levels of cognitive impairment in patients who experienced COVID-19, likely triggered by underlying inflammatory processes[9], may persist longer than other symptoms, with a distinctive course of progression[10].

Supporting the present study's findings, which identified women as having worse cognitive profiles across all follow-up segments, other studies have also described that women are twice as likely to develop cognitive impairment as a symptom of long COVID[26-27]. Female sex has been considered a risk factor in this context[28-29].

To some extent, these findings contribute to understanding the complex construct of cognitive alterations associated with COVID-19. One aspect that deserves attention, although not explored in this study but closely related to the hospital environment, particularly the sensory deprivation typical of ICUs, and with high potential to exacerbate COVID-19-related cognitive alterations, is the presence of cognitive impairment associated with complaints of depression, anxiety, and reduced functional capacity. This is a highly relevant theme that should be addressed in future studies[11-30].

Given the uncertainties surrounding treatment of cognitive deficits in unexpected contexts such as post-COVID-19 recovery, participation in cognitive stimulation centers has generally been recommended. However, any form of intervention will only be successful if it is based on a valid and reliable assessment of cognitive status.

It is important to emphasize the multidimensional nature of the cognitive domain and its repercussions on other areas of life, such as mobility, self-care, and emotional balance. These findings should be reflected upon to design interventions that mitigate the consequences of cognitive impairment.

One of the main limitations of this study was the large number of nonexistent or incorrect telephone contacts in patient records, which hindered participant recruitment. Partial participation in follow-up segments was also due to patients' inability to verbalize, hospitalization without telephone access, unavailability for scheduled contact, lack of time or interest in continuing participation, and deaths.

The research team attempted to conduct video call interviews, assuming this strategy could provide participants with greater security through visual contact with the interviewer. However, this approach did not succeed as expected. Only one patient accepted this option. The others declined, citing personal appearance concerns—especially at 14 days post-ICU discharge—or discomfort with the visibility of their physical environment. At D30 and D90 follow-ups, some participants had already returned to work and refused the option of video call interviews.

CONCLUSION

The evidence found in this study demonstrates the longitudinal behavior of a highly impactful disorder on global health after the acute phase of COVID-19: cognitive dysfunction.

The SPMSQ results revealed cognitive alterations in a portion of patients who remained in Intensive Care Units due to COVID-19; however, it was not possible to establish that ICU length of stay directly influenced their recovery trajectory. Female participants consistently exhibited higher mean scores across all follow-up segments, suggesting a worse cognitive recovery profile among women. Overall, cognitive recovery was satisfactory three months after ICU discharge, with only a small proportion of patients (4.1%) remaining symptomatic. Even among those who reported cognitive complaints, impairments were milder compared with those identified at the beginning of data collection.

FUNDING

This study is derived from a doctoral dissertation research project funded through the Call for Emerging and Consolidating Graduate Programs in Priority Areas in the States (PDPG) – Call No. 18/2020, Project No. 88887.568437/2020-00.

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***Article extracted from the doctoral thesis:** "Análise do impacto da COVID 19 sobre a funcionalidade e qualidade de vida após alta da Unidade de Terapia Intensiva", Pontifícia Universidade Católica do Paraná, Curitiba, PR, Brasil, 2021.

Received: 30/09/2024
Approved: 09/07/2025
Associate editor: Dra. Cremilde Aparecida Trindade Radovanovic

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Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - **Kmita LC, Corleto LV, Tiba MN, Ruggieri KCR, Moser ADL, Bernardelli RS.** Drafting the work or revising it critically for important intellectual content - **Kmita LC, Moser ADL, Bernardelli RS.** Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - **Moser ADL, Bernardelli RS.** All authors approved the final version of the text.

Conflicts of interest:
The authors have no conflicts of interest to declare.

Data availability:
The authors declare that the data are not available due to restrictions related to confidentiality, intellectual property rights and/or other legal impediments.

ISSN 2176-9133