

## Reduction in life activities after hospitalization for COVID-19 in intensive care units

*Redução das atividades de vida após internação por COVID-19 em unidades de terapia intensiva*  
*Reducción de las actividades de vida tras la hospitalización por COVID-19 en unidades de cuidados intensivos*

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### Abstract

**Objective:** To verify the factors associated with reduction in life activities in patients 12 months after discharge from the COVID-19 ICU. **Methods:** This is a cross-sectional, analytical study with a quantitative approach, based on primary data from patients at the Hospital Universitário Regional dos Campos Gerais, Paraná, Brazil. The final sample consisted of 32 patients discharged from the ICU between March 2020 and March 2021. **Results:** There was statistical evidence of a difference between the means of the groups in the domains Life Activities ( $p=0.0001$ ) and Disability ( $p<0.0001$ ), confirming that the disabled group has a worse indicator of disability in this domain; as also occurs between the geometric means of the groups. **Conclusion:** The most prevalent factors associated with reduction in life activities were those involving the physical and psychological domains, directly influencing their recovery. In addition, future research could focus on specific intervention strategies to minimize the impact of these sequelae and improve rehabilitation in COVID-19 patients.

**Descriptors:** Intensive Care Units; Activities of Daily Living; SARS-CoV-2; COVID-19.

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### What is already known on this?

A previous review showed that this is one of the first studies to use the activities of daily living marker in COVID-19 survivors.

### What this study adds?

The study has made a strong contribution to the scientific community, highlighting the difference in the means of the groups in relation to the post-COVID-19 syndrome and the Activities of Life and Disability domains, noting that the disabled group has worse indicators.



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### Resumo

**Objetivo:** Verificar os fatores associados à redução das atividades de vida em pacientes 12 meses após alta em UTI COVID-19. **Métodos:** Trata-se de um estudo transversal e analítico com abordagem quantitativa, desenvolvido com base em dados primários de pacientes do Hospital Universitário Regional dos Campos Gerais, Paraná, Brasil. A amostra final foi composta por 32 pacientes egressos da UTI no período de março de 2020 a março de 2021. **Resultados:** Observa-se evidência estatística de diferença de média dos grupos nos domínios Atividades de Vida ( $p= 0,0001$ ) e Incapacidade ( $p< 0,0001$ ) confirmando que o grupo incapacitado apresenta pior indicador de deficiência nesse domínio; como também ocorre entre a média geométrica entre os grupos. **Conclusão:** Os fatores associados à redução das atividades de vida mais prevalentes foram os que envolveram os domínios físico e psicológico, influenciando diretamente na recuperação dos mesmos. Além disso, pesquisas futuras podem focar em estratégias de intervenção específicas para minimizar o impacto dessas sequelas e melhorar a reabilitação em pacientes com COVID-19.

**Descritores:** Unidade de Terapia Intensiva; Atividades Cotidianas; SARS-CoV-2; COVID-19.

### Resumen

**Objetivo:** Verificar los factores asociados a la reducción de las actividades de vida en pacientes 12 meses después del alta de la UCI COVID-19. **Métodos:** Se trata de un estudio transversal, analítico, con abordaje cuantitativo, basado en datos primarios de pacientes del Hospital Universitario Regional dos Campos Gerais, Paraná, Brasil. La muestra final consistió en 32 pacientes dados de alta de la UCI entre marzo de 2020 y marzo de 2021. **Resultados:** Hubo evidencia estadística de diferencia entre las medias de los grupos en los dominios Actividades de Vida ( $p= 0,0001$ ) y Discapacidad ( $p< 0,0001$ ), confirmando que el grupo discapacitado presentó peor indicador de discapacidad en este dominio; como también ocurre entre la media geométrica entre los grupos. **Conclusión:** Los factores más prevalentes asociados a la reducción de las actividades de vida fueron los que involucran los dominios físico y psicológico, influyendo directamente en su recuperación. Además, futuras investigaciones podrían centrarse en estrategias de intervención específicas para minimizar el impacto de estas secuelas y mejorar la rehabilitación en pacientes con COVID-19.

**Descritores:** Unidades de Cuidados Intensivos; Actividades Cotidianas; SARS-CoV-2; COVID-19.

## INTRODUCTION

The infection caused by the SARS-CoV-2 virus, detected in Wuhan, China, in December 2019, triggered one of the biggest global epidemics of recent times. In January 2020, the world was already facing the impact of COVID-19, generated by a panorama of high demand for hospitalizations and a significant increase in deaths caused by the disease.<sup>(1)</sup>

It is now known that COVID-19 can lead to a delayed recovery of symptoms, lasting up to seven weeks after discharge from hospital, which is referred to as post-COVID-19 syndrome.<sup>(2)</sup>

After discharge, patients often have physical dysfunctions that impact on their functionality and ability to perform activities of daily living, which reduces their quality of life and raises the alarm about the increased mortality rate after discharge from the Intensive Care Unit.<sup>(2-3)</sup> Activities of daily living are those that individuals perform in their daily lives, such as bathing, cooking, personal hygiene, eating, among others.<sup>(4)</sup>

It is known that one of the factors related to impaired functionality in patients with COVID-19 is the systemic inflammation caused by the virus affecting the immune system, causing a dysfunction in circulation and the release of inflammatory oxytocins that result in edema and cause oxygen not to be distributed correctly throughout the body and muscle tissue.<sup>(5)</sup>

The sequelae predominantly affect the respiratory, renal, neurological and cardiovascular systems, and can also lead to the appearance of persistent symptoms, such as fatigue, cough, dyspnea, myalgia, headache, among others.<sup>(5-6)</sup> These symptoms make up the so-called post-COVID-19 syndrome and directly impact patients' lives, as well as their daily life activities.<sup>(6-7)</sup>

Thus, understanding the factors underlying the decrease in life activities in patients who have been admitted to the ICU due to COVID-19 is extremely important in the provision of health care. This in-depth understanding of the impacts on the physical, cognitive and psychological needs of these patients reveals the need to develop rehabilitation therapies involving all the biopsychosocial aspects of these individuals. Knowledge of the factors that impact on the reduction of life activities supports the need to implement therapies that provide for the general well-being of recovering patients, aiming to improve their quality of life, and allowing for a complete recovery and smoother reintegration into everyday life. Therefore, the aim of this study was to verify the factors associated with reduced activities of living in patients 12 months after discharge from COVID-19 Intensive Care Units (ICUs) at a University Hospital in southern Brazil.

## METHODS

This is a cross-sectional, analytical study with a quantitative approach, carried out using non-probabilistic convenience sampling. Primary and secondary data were collected from patients in the ICUs

of the Hospital Universitário Regional dos Campos Gerais (HURCG), in Ponta Grossa, Paraná, Brazil – a hospital that has become a reference in COVID-19 care in the region. The work was carried out in the hospital's five ICUs, each with 10 beds per unit.

The data collection process was carried out using evolutions and information from both the telephone interview and the patient's medical records. This study initially involved 93 patients who met the research criteria. Of these, 35 did not respond to any of the three attempts to contact them by telephone, 13 had incorrect or non-existent telephone numbers, four patients chose not to take part in the study and nine died in the first year after being discharged from hospital. Therefore, a total of 32 patients discharged from ICUs between March 2020 and March 2021 took part in the study.

The inclusion criteria were: having been admitted to the hospital's ICU for COVID-19; having been discharged from the hospital at least 365 days before the interview took place; being over 18 years old; and having a length of stay of more than eight days, based on the average length of stay of patients admitted to the General ICU in 2019.

The exclusion criteria were: patients with cognitive impairment; uncorrected hearing loss, which prevented them from understanding the questions; speech impairment; functional changes prior to COVID-19 hospitalization; and patients who did not answer the phone after three attempts on different days and at different times.

Primary data was obtained through recorded telephone interviews from July 2021 to April 2022, respecting the inclusion criterion of 365 days after discharge. Patients' telephone contact details were obtained from their hospitalization records. This interview was carried out with the patient themselves, using an unprecedented structured instrument containing sociodemographic questions, clinical questions, self-perceived health and the Whodas 2.0 scale (World Health Organization Disability Assessment Schedule) – a generic assessment instrument developed by the World Health Organization (WHO) to provide a standardized method of measuring health and disability in the population or clinical sphere. The Whodas 2.0, in its 12-item version, assesses activity limitations and participation restrictions in six domains: cognition; mobility; self-care; interpersonal relationships; and life activities and participation during the 30 days preceding the interview, applying a five-point scale to all items, where 1 indicates “no difficulty” and 5 indicates “extreme difficulty or inability to do the activity”.

The dependent variable was the patient's functionality, measured by the difficulty presented in the Whodas 2.0 analysis domains with the response scale for “mild”, “moderate”, “severe” and “extreme”. The variables considered independent were sociodemographic (gender; age; schooling; marital status; family/social arrangement; occupation; own income; and monthly family income), clinical (chronic diseases; polypharmacy; depression; length of hospitalization; need for mechanical ventilation; need for pronation; cardiorespiratory arrest; need for antibiotics) and self-perception of general health.

The geometric mean was used in the study as a solution for the values obtained. It is useful when there is a need to calculate an average that is representative of all the dimensions or components of the data, preventing extreme values from dominating the final result. Therefore, in this study, the geometric mean was chosen as a statistical measure because it helps to avoid distortions caused by very high or very low values in different dimensions of the data, allowing for a more accurate and balanced analysis of the results.

The study used both supervised and unsupervised Data Mining (DM) techniques in the context of the Knowledge Discovery in Databases (KDD) process. Initially, in the data exploration phase, the Kolmogorov-Smirnov (KS) Normality Test was applied to guide the use of bivariate analyses using parametric and non-parametric analysis of variance tests. Next, in the DM pre-processing stage, 32 records containing 59 variables were subjected to data cleaning procedures, which included standardizing terminology, eliminating or correcting noise and dealing with missing values. Data exploration was carried out using Structured Query Language (SQL), with results presented in tables, graphs and infographics.

The database was enriched with the inclusion of 20 new variables corresponding to the indicators of the Whodas 2.0 domains, with numerical values ranging from zero to one and categories (low, medium and high). The Likert scale answers contained in the Whodas 2.0 instrument were converted into self-assessment indices using a specific formula. In addition, inversions were applied to the negative scales in one of the domains. In the Data Mining stage, clustering description, dimensionality reduction and classification techniques were used, employing well-established algorithms in the literature, such as K-means, Correlation-based Feature Selection (CFS) and J48, respectively.

To form the clusters, the Simple K-means algorithm was used with the definition of two centroids, making it possible to label the groups as “Disabled” and “Capable”, based on their predominant characteristics. Dimensionality reduction was carried out using the CFS algorithm, identifying the relevant independent variables to explain the outcome of the life activity domain. For the classification task in the context of KDD, the outcome classes were treated as dependent variables, using the J48 Decision Tree algorithm, trained and tested by cross-validating 10 folds to create classification models. Finally, the models were compared taking into account the characteristics of the input and output variables, their complexity and quality measures, allowing the identification of the variables that most influence the results of the target attributes.

After processing the data, the variables with the ability to explain the reduction in life activities were selected on the basis of class and index, with the class represented by the index intervals being named as categorical data. These were then divided into: low (values below 0.33); medium (values between  $< 0.33$  and  $< 0.66$ ); and high (values above 0.66). The unbalanced index of the outcome classes corresponds to a numerical interval ranging from zero to one, with one being ideal for the positive domains. Variables that appear in both the class column and the index column are more expressive than others that only appear in one situation.

This study complied with Resolution 466/2012 of the National Health Council and was approved by the Research Ethics Committee (No. 4.735.765/2021).

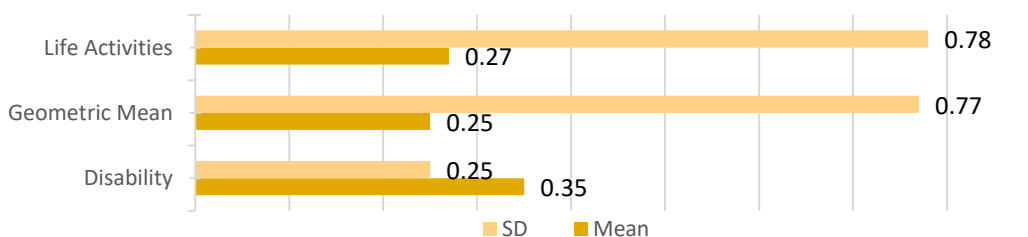
## RESULTS

Thirty-two people took part in the study, mostly women (56%), with an average age of 57 years (13.37). After analyzing the data, it was possible to group the individuals into two groups, with 25% of them falling into the group considered less independent (disabled) and 75% into the more independent (capable), according to the Simple K-means algorithm:

Regarding the disabled group, seven (87%) individuals required the use of antibiotics during hospitalization and, when asked about their living conditions after discharge, five (62%) individuals reported that they lived in communities, four (50%) were widowed, three (37%) married, one (12%) divorced, six (75%) had problems concentrating and seven (87%) had depressive symptoms, such as persistent dismay and low self-esteem, in the last 30 days. The average number of drugs used by these individuals was six a day.

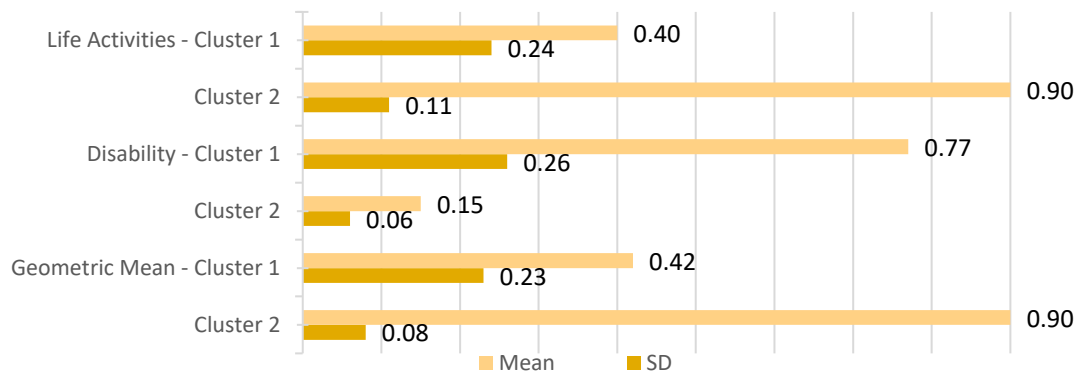
Thus, the geometric mean of the Health and Disability Assessment indicators was  $0.77 \pm 0.25$  and life activity had a high index ( $0.78 \pm 0.27$ ). Disability has a low index (0.25) and high relative variability ( $\pm 0.27$ ), as it is a negative domain, inverse to capability, and presents an ideal value, as shown in Figure 1.

**Figure 1** Disability index of the sample. Ponta Grossa, PR, Brazil, 2021.



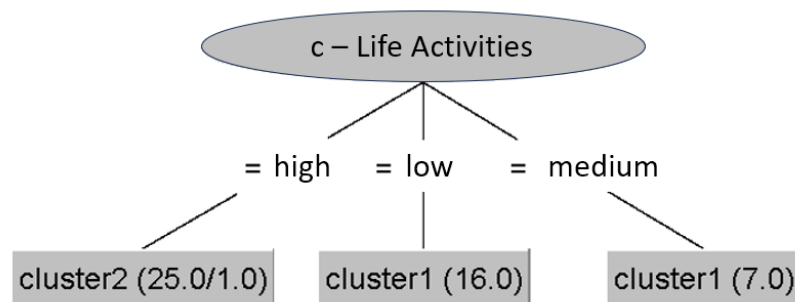
Source: own authorship, 2021.

Using the Mann-Whitney Test, there was statistical evidence of a difference between the means of the groups in the Life Activities ( $p= 0.0001$ ) and Disability ( $p< 0.0001$ ) domains, which means that the disabled group (cluster 1) has a worse disability indicator in this domain. The same is true for the geometric mean between the groups, observed using the Unpaired t test with Welch correction ( $p=0.0007$ ), as shown in Figure 2.

**Figure 2.** Disability index by cluster. Ponta Grossa, PR, Brazil, 2021.

Source: own authorship, 2021.

In this way, it presents a Decision Tree model with a high accuracy rate and quality measures of cluster classifications. The initial nodes are the most promising because they have the highest information gain and the lowest entropy. The Life Activities variable is allocated to this location, i.e., it strongly influences the outcome of the Decision Tree, as shown in Figure 3.

**Figure 3.** Decision Tree Model for Classifying Clusters by Domain Class: Life Activity. Ponta Grossa, PR, Brazil, 2021.

Source: own authorship, 2021.

The items that appear in both the class group and the index group show greater strength in relation to the impact caused on these individuals' activities of daily living. Thus, among the variables strongly capable of explaining the reduction in Life Activities, the following stand out: marital status; the conditions in which the individual lives at the time of the interview; the number of medications they use per day; the need for antibiotics during hospitalization; whether they had any depressive symptoms, such as sadness, persistent dismay and low self-esteem; and whether they had difficulty concentrating in the last 30 days prior to the telephone interview. The results are described in Chart 1.

**Chart 1.** Selected variables capable of explaining the reduction in the Life Activities variable. Ponta Grossa, PR, Brazil, 2021.

Target Attribute	Selected variables	
	Class	Index
Selected variable (p<0.05)	(100%) Current marital status (100%) Conditions in which you live at the time of the interview (100%) How many medicines do you take a day? (97%) Needed antibiotics during hospitalization for COVID-19 (97%) Had any depressive symptoms such as sadness, persistent dismay and low self-esteem in the last 30 days (91%) Had difficulty concentrating in the last 30 days	(100%) Living conditions at the time of the interview (100%) Had any depressive symptoms such as sadness, persistent dismay and low self-esteem in the last 30 days (97%) Current marital status (97%) Needed antibiotics during hospitalization for COVID-19 (97%) Had difficulty concentrating in the last 30 days (94%) How many medicines do you take a day?

Source: own authorship, 2021.

## DISCUSSION

In this study, the factors strongly associated with reduced activities of life in patients 12 months after discharge from the COVID-19 ICU were marital status, living conditions and the number of medications used per day, followed by the need to use antibiotics during hospitalization, the presence of depressive symptoms such as sadness, persistent dismay, low self-esteem and difficulty concentrating.

Long periods of hospitalization in intensive care units can result in a set of sequelae called post-intensive care syndrome (PICS). The PICS can last for months or even years after the illness. As a consequence, they have a direct impact on patients' quality of life, characterized by physical, cognitive and psychological changes, mainly affecting the performance of activities of daily living.<sup>(8)</sup>

Recent studies have shown that, in general, at least 40% of these patients also suffer significant neurological damage, such as fatigue and weakness, after being hospitalized.<sup>(9)</sup> This damage is linked to a combination of the clinical condition and physiological mechanisms, including metabolic and bioenergetic vascular alterations, the use of sedatives, neuromuscular blockade and immobilization for long periods, which result in muscle atrophy and loss of strength.<sup>(10-11)</sup>

In some cases, patients affected by COVID-19 can progress to the most severe stage of the disease, SARS (severe acute respiratory syndrome), characterized by acute respiratory failure, which often leads to the patient being admitted to an ICU bed and the need for invasive mechanical ventilation.<sup>(8)</sup> The recovery time of each patient varies according to the symptoms presented, the interventions suffered during the acute phase of the infection, their lifestyle before hospitalization and the presence or absence of comorbidities.<sup>(12)</sup>

Of the total of 32 patients who made up the final sample of this study, seven required antibiotics (87%), a similar result to that found in another study, where 91.4% of patients were taking antibiotics, and 79% were also taking a combination of antibiotics, ranging from two to five antibiotics during hospitalization.<sup>(13)</sup>

Still in the neurological domain, difficulty concentrating was identified, with 97% of patients impacted by this domain. COVID-19 is known to produce cognitive damage directly linked to difficulty concentrating and depressive symptoms, leading to difficulties sleeping, such as insomnia and sleep disorders, which are present in post-discharge patients.<sup>(14-15)</sup>

In addition, recent data shows the association between the impact of social isolation and socio-affective ties, since after discharge from hospital, individuals present: depressive symptoms, such as fear, loneliness; and sleep disorders, which can damage mental health and have a negative short- and long-term impact on the quality of life of these people.<sup>(16-17)</sup>

The most common symptoms reported by post-COVID-19 patients were sadness, anxiety and sleep disorders.<sup>(4)</sup> In another study, 23 patients had depressive symptoms and a lack of interest in carrying out everyday activities<sup>(18)</sup>, all of which are linked to the post-traumatic stress that long periods of hospitalization can cause these individuals.<sup>(19)</sup>

Another important factor observed was the age group over 60, associated with an increase in chronic non-communicable diseases, such as obesity, systemic arterial hypertension (SAH), diabetes

mellitus (DM) and depression, which generate the need for pharmacological treatment with various drugs, which would explain the use of four or more drugs, known by specialists as polypharmacy, which impacts on the quality of life of these individuals.<sup>(18)</sup>

As limitations of this study, it is important to note that some of the criteria used to assess health and disability, such as the use of the geometric mean, are not universally adopted, so comparisons with other studies should be made with caution.

The findings of this study aim to help understand the relationship between COVID-19 and the reduction in activities of daily living in the medium and long term, favoring the development of effective treatment measures for recovery from the disease, reducing long-term impacts. In addition, it is hoped to support further research on the subject, since it is still a scarce area of theoretical material, thus highlighting the need for more studies on this topic.

## CONCLUSION

This study looked at the factors associated with reduced life activities in patients 12 months after admission to COVID-19 intensive care units at a university hospital in southern Brazil. The most prevalent sequelae were those involving the physical and psychological domains, directly influencing their recovery. It is known that these symptoms are largely linked to the symptomatology of these patients and the measures suffered by each one during their time in hospital.

However, there is room for further research in this field. Firstly, it is important to investigate the exact mechanisms by which these physical and psychological sequelae affect patients' long-term quality of life. In addition, future research could focus on specific intervention strategies to minimize the impact of these sequelae and improve rehabilitation in these COVID-19 patients. Therefore, a multidisciplinary approach can help fill in information and provide better care for patients facing the challenges of post COVID-19 syndrome.

## CONTRIBUTIONS

Conception or design of the study: Amaral I, Fadel CB, Martins HMT, Data collection: Amaral I, Souza TKP, Duarte CR, Schiochet GF, Martins HMT, Data analysis and interpretation: Amaral I, Santos CB, Martins HMT, Writing of the article or critical review: Amaral I, Fadel CB, Martins HMT, Final approval of the version to be published: Amaral I, Fadel CB, Santos CB.

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