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# Association between self-perceived physical functional capacity and mental health of patients after hospitalization for covid-19

## *Associação entre a autopercepção da capacidade funcional física e a saúde mental de pacientes após hospitalização por covid-19*

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## Abstract

**Background:** The post-acute phase of COVID-19 frequently leads to persistent physical and psychological sequelae. However, the relationship between psychological problems, such as anxiety and depression, and functional capacity remains unclear. **Aim:** To verify the association between anxiety and depression symptoms and the loss of self-perceived functional capacity in patients after COVID-19–related hospital admission. **Methods:** This is an observational analytical cross-sectional study conducted in individuals after hospital discharge due to COVID-19. Participants completed the Short Form-36 Health Survey (SF-36) and the Hospital Anxiety and Depression Scale (HADS) via online videoconference. Correlation analyses and multiple linear regression models were performed to explore associations between HADS and SF-36 domains. Group comparisons were conducted between participants with and without anxiety or depressive symptoms. **Results:** The sample was composed by 88 patients who were hospitalized for 12.88±10.82 days, and 42% required intensive care. Anxiety symptoms were present in 45.45% of participants, while depressive symptoms were identified in 43.18%. Physical functioning was independently associated with anxiety ($p<0.001$; $R^2=0.25$), whereas energy/fatigue was independently associated with both anxiety and depression ($p<0.05$; $R^2=0.31$). Participants with anxiety showed significantly worse physical functioning, pain, vitality, general health, and emotional well-being scores. Those with depressive symptoms exhibited worse physical functioning, vitality, role limitations, pain, emotional well-being and social functioning. **Conclusion**: Anxiety symptoms were associated with lower physical functional capacity and worse scores in multiple quality-of-life domains. Although depressive symptoms were not independently associated with functional capacity, they were associated with worse scores in vitality, pain, and social and emotional functioning.

**Keywords:** Covid-19; Depression; Anxiety; Functionality, Physical therapy.

## Resumo

**Introdução:** A fase pós-aguda da COVID-19 frequentemente resulta em prejuízos físicos e psicológicos persistentes. Contudo, a relação entre problemas psicológicos, como ansiedade e depressão, e a capacidade funcional permanece pouco clara. **Objetivo:** Verificar a associação entre sintomas de ansiedade e depressão e a perda da capacidade funcional autopercebida em pacientes após hospitalização por COVID-19. **Métodos:** Estudo transversal observacional realizado em indivíduos avaliados após a alta hospitalar por COVID-19. Os participantes responderam ao SF-36 e à HADS por videoconferência. Foram realizadas correlações e regressões lineares múltiplas para explorar associações entre os escores da HADS e os domínios do SF-36. Comparações entre grupos com e sem sintomas de ansiedade ou depressão foram feitas. **Resultados:** A amostra incluiu 88 pacientes, hospitalizados por 12,88±10,82 dias; 42% necessitaram de cuidados intensivos. Sintomas de ansiedade estavam presentes em 45,45% dos participantes, e sintomas de depressão em 43,18%. A capacidade funcional associou-se de forma independente à ansiedade ($p<0.001$; $R^2=0.25$), enquanto energia/fadiga associou-se independentemente tanto à ansiedade quanto à depressão ($p<0.05$; $R^2=0.31$). Pacientes com ansiedade apresentaram pior capacidade funcional, dor, vitalidade, saúde geral e bem-estar emocional. Aqueles com sintomas de depressão apresentaram pior capacidade funcional, menor vitalidade, maiores limitações, mais dor, pior bem-estar emocional e pior funcionamento social. **Conclusão:** Sintomas de ansiedade foram associados à menor capacidade funcional e a piores escores em vários domínios de qualidade de vida. Embora os sintomas de depressão não tenham se associado de forma independente à capacidade funcional, estiveram relacionados a piores escores de vitalidade, dor e funcionamento social e emocional.

**Palavras-chave:** Covid-19; Depressão; Ansiedade; Funcionalidade; Fisioterapia.

## INTRODUCTION

At the end of 2019, SARS-CoV-2 virus was identified as the etiological agent of COVID-19, a health condition with a wide variety of severity, with some asymptomatic individuals and some could develop a serious condition, leading to acute respiratory distress syndrome or death[1]. In Brazil, the first case was in February 2020, and in 2023, 37 million individuals were diagnosed with COVID-19[2]. During this period, COVID-19 pandemic was responsible for a public and private health system overburden, and even those individuals without COVID-19 presented loss in their health status due to social isolation, and other social issues such as risk of occupational and financial loss[3,4].

COVID-19 may distress the nervous system leading not only to cognitive impairment, but also with psychiatric symptoms, such as depression, anxiety and stress[3]. A meta-analysis found a pooled prevalence of depressive symptoms in 45% and of anxiety symptoms in 47% in COVID-19 survivors[5]. Although all the pathways leading to neurological impairment are not fully understood, a multifactorial hypothesis is accepted due to disturbed immunological response, non-specific systemic inflammation, treatments such as corticosteroids, hospital and intensive care admission, and possibly due to direct viral infection in nervous cells[6].

In patients with a more severe presentation of COVID-19, especially those who needed intensive care and a life-threatening presentation, the presence of post-traumatic stress during the subacute phase might contribute to mental health prejudice[1]. Patients who were hospitalized, would also present loss in muscle mass and function, which might contribute to a greater loss in quality of life.

Even after the post-acute phase (ongoing symptomatic COVID), four to twelve weeks after infection[7], some individuals may experience fluctuating symptoms, which was denominated by the World Health Organization as post-COVID condition. The most common presentation is breathlessness, fatigue, and cognitive impairment[8]. Although the loss in physical function is the first worry when these symptoms are present, an association between post-COVID condition and mental health prejudice was already established[9].

Even though COVID-19 consequences in mental health are increasing, there is a lack of understanding of the association between this loss and the aspects that encompasses quality of life. Specifically, a greater understanding of the association of anxiety and depression symptoms and self-perceived functional physical capacity may shed some light on the need of mental health support in people after COVID-19. Therefore, the aim of this study is to verify the association between anxiety and depression symptoms and the loss of self-perceived physical functional capacity in patients after COVID-related hospital admission. As secondary objectives, we assessed the association of other quality of life domains with depression and anxiety scores, and compared quality of life and other clinical aspects of individuals with and without anxiety and depression symptoms.

## METHODS

### Study design and participants

This was an observational analytical cross-sectional study, with data collection in a single time point, developed by researchers of *blinded information*. The data was collected alongside other data from a larger study aiming to assess a rehabilitation protocol after COVID-related hospital admission[10]. In the present study, symptoms of anxiety and depression were assessed through the Hospital Anxiety and Depression Scale (HADS). Furthermore, self-perceived physical functional capacity and other aspects of quality of life were obtained using the Short Form Health Survey – 36 items (SF-36) questionnaire. The participants of this study were those hospitalized due to COVID-19 in the *blinded information*. The participants were invited to participate in close to thirty days after discharge during the period of August 2020 to June 2021. The study was approved by the ethics committee of the institution (number - *blinded information*), and all participants consented with the study.

We included patients discharged from a hospital admission due to COVID-19, which were able to correctly answer the questionnaires through a conference call. Patients were excluded if they did not complete the questionnaire, if they presented a score lower than 15 in a Mini-Mental State Examination, or if they were bedridden or presented an absolute contraindication to exercise since they would not be able to perform all the assessments from the larger study. Furthermore, patients were also excluded if they were younger than 35 years old, to focus on a population at higher risk for post-acute sequelae of SARS-CoV-2 infection, including functional impairments and mental health disorders such as depression and anxiety. Research indicates that middle-aged individuals have a significantly increased likelihood of developing impairments compared to younger adults[11].

### Measurements

SF-36 is a valid and reliable questionnaire[12] employed in the assessment of the quality of life of the general population, evaluating aspects of eight domains (physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain, general health). This questionnaire has 36 questions and each domain has a weighted score ranging from 0 to 100, as established by its original authors. There is no combined or total score, and domain scores are analyzed and presented individually. Higher scores indicate better health status in the domain assessed[12]. Furthermore, the eight domains of

the SF-36 can be conceptually grouped into two broader categories: physical health (including physical functioning, role limitations due to physical health, pain, and general health) and mental health (including energy/fatigue, social functioning, role limitations due to emotional problems, and emotional well-being), as originally proposed by its authors. The scores in each domain were compared to the 95% confidence interval of the Brazilian population[13] in order to verify if it was in the normal expected range for that age and gender.

HADS is also a reliable and valid measurement[14,15], used to verify the presence of anxiety and depression symptoms in the general population, assessing how the patient feels in some specific situations of daily living. The scale has 14 questions, seven assessing anxiety symptoms (HADS-Anxiety subscale) and seven assessing depression symptoms (HADS-Depression subscale). The lower the score in the subscale, the better is the assessed aspect[14]. In addition, patients were classified as having depressive symptoms when they presented a HADS-depression score equal or greater than six points and as presenting anxiety symptoms when their HADS-Anxiety scores were equal or greater than seven points[15].

Since the data collected in this research was obtained during the social distancing period of the pandemic, both SF-36 and HADS were applied through an online video interview, patients were contacted using a smartphone app and later received a link to access a video conference through smartphone or a computer. Both, researchers and patients, were with their cameras, and the researchers read each question and alternatives before patients answered, and the researcher was ready to repeat as much as the patient required.

### Statistical analysis

Normality of data was assessed using the Shapiro-Wilk test. Data were presented as mean ± standard deviation when they were normal, median and 25% - 75% interquartile range when they were non-normal and as absolute values and percentage of total sample when they were categorical.

The associations were assessed using Pearson correlation coefficient or, when appropriate, its non-parametric equivalent, Spearman Coefficient Correlation. Correlations coefficients were classified as weak if they ranged from 0.20 to 0.39, moderate when they ranged from 0.40 to 0.69 and strong if they were above 0.70. Additionally, to verify the independent factors associated with quality-of-life domains, a multiple linear regression analysis using the stepwise model, including only as dependent variables (Physical Functioning, Role Limitations due to Physical Health, Energy/Fatigue, Social Functioning, Pain, General Health), and as possible independent variables HADS-Anxiety and HADS-Depression. Role Limitations due to Emotional Problems and Emotional Well-being were not included due to their obvious association with Anxiety and Depressive symptoms.

As a secondary analysis, patients were divided into subgroups with or without depressive symptoms (HADS depression ≥ 6 points) to compare clinical characteristics between them; and afterwards, patients with or without anxiety symptoms (HADS Anxiety ≥ 07 points). Intergroup comparisons were done using the T student test or its non-parametric equivalent (Mann-Whitney test), or the $X^2$ test for categorical variables.

All analyses were done at the SPSS software (version 26), and a $p<0.05$ was considered statistically significant. Sample size was calculated considering an expected correlation coefficient of 0.60 and a minimal correlation of 0.30, which demanded for an 80% power a minimum of 56 patients[16].

## RESULTS

A total of 244 individuals were screened to participate in the study, but only 111 met the inclusion criteria and consented with the study. Afterwards, 23 individuals were excluded since they presented an exclusion criteria. Then, the analysis were carried out with the remaining 88 patients (Figure 1). The sample characteristics are presented in Table 1.

Most individuals were men (57%), and the age ranged from 35 to 86 years old, and 79 individuals presented some previous clinical condition. Although all patients studied in this paper were hospitalized due to COVID-19, with a mean hospital stay of 12 days, only 42.04% needed intensive care.

At least one quality of life domain was lower than the expected for almost all analyzed individuals, considering the expected values for the same age and gender for a Brazilian population[12]. Three quarters of the present sample (71.5%) presented lower values for self-perceived physical functional capacity, 69.3% and 87.5% presented lower values for vitality and physical aspects limitations, respectively. Moreover, 76% presented a worse pain domain than the expected, 69.3% were under the expected general health perception, 63.6% and 56.8% were under the expected values for mental health and limitations due to emotional problems, respectively. Surprisingly, 93% presented impairment in social functioning[12].

Considering depression and anxiety symptoms evaluated by HADS, 38 individuals (43.18%) had a score equal or greater than six points on HADS-Depression, indicating they suffered with depressive symptoms, while 40 individuals (45.45%) presented a score equal or greater than seven points, indicating anxiety symptoms[15]. The co-occurrence of depression and anxiety was found in 25 patients (28.80%).

The correlations (Figure 2) between HADS-Anxiety and quality of life domains indicated a moderate correlation to all domains except role limitations due to physical health,

**Table 1.** Demographic, anthropometric, and clinical characteristics of the sample.

| Characteristics | Sample (n=88) |
|---|---|
| Male, n (%) | 50 (57) |
| Female, n (%) | 38 (43) |
| Age (years) | 54 ± 11 |
| Height (m) | 1.66 ± 0.09 |
| Weight (Kg) | 86 ± 17 |
| BMI (Kg/m$^2$) | 30.9 ± 5.24 |
| Cardiovascular diseases, n (%) | 47 (53.47) |
| Skeletal-muscle diseases, n (%) | 7 (7.95) |
| Respiratory diseases, n (%) | 10 (11.36) |
| Obesity, n (%) | 27 (30.68) |
| Smokers, n (%) | 37 (42.04) |
| Hospitalization period (days) | 12.88 ± 10.82 |
| Need of intensive care, n (%) | 37 (42.04) |
| HADS – Anxiety (points) | 6 [4-10] |
| HADS – Depression (points) | 5 [3-8] |
| SF 36 – Physical Functioning (points) | 56.56 ± 22.19 |
| SF 36 – Role Limitations due to physical health (points) | 0 [0-50] |
| SF 36 – Pain (points) | 56.53 ± 24.33 |
| SF 36 – Energy/fatigue (points) | 59.59 ± 19.06 |
| SF 36 – Emotional Well-being | 67.76 ± 18.59 |
| SF 36 – Social functioning (points) | 62.5 [43.5-62.5] |
| SF 36 – Role Limitations due emotional problems (points) | 33.33 [0-100] |
| SF 36 – General Health (points) | 56.9 ± 15.46 |

Data presented according to standard mean ± standard deviation, median [interquartile range]. BMI: Body mass index. HADS: Hospital Anxiety and Depression Scale. SF36: The Short Form (36) Health Survey.

**Source:** Data from the present study.

general health and social functioning, which presented a weak correlation. Furthermore, the correlations between HADS-Depression were also moderate to most of SF-36 domains, except for role limitations due to physical health, and general health (Table 2).

In order to verify if there were an independent association between SF36 domains which were associated with anxiety and depressive symptoms (HADS-Anxiety and HADS-Depression, respectively), multiple regressions were carried out (Table 3) and physical functioning impairment was only explained by anxiety ($p<0.05$, $R^2$ 0.25), while energy/fatigue changes was explained by changes both in anxiety and depression ($p<0.05$, $R^2$ 0.31). Pain variability was explained only by anxiety symptoms ($p<0.05$, $R^2$ 0.20). Role Limitations due to Physical Health, Social Functioning, and General Health were weakly explained by HADS-Anxiety or HADS-Depression.

As a secondary analysis, patients with anxiety symptoms presented a worst general health perception, lower self-perceived physical functional capacity, energy and more pain (Table 4). In addition, when comparing post-COVID patients with or without depressive symptoms, although there was a larger difference of the percentage of men and women between groups, it was not statistically significant. Furthermore, differences were found between self-perceived social and physical functional capacity, role limitations due to physical health, energy, and pain (Table 4).

## DISCUSSION

As verified by this study, an independent association between anxiety symptoms and self-perceived physical functional capacity was found, as well as an independent

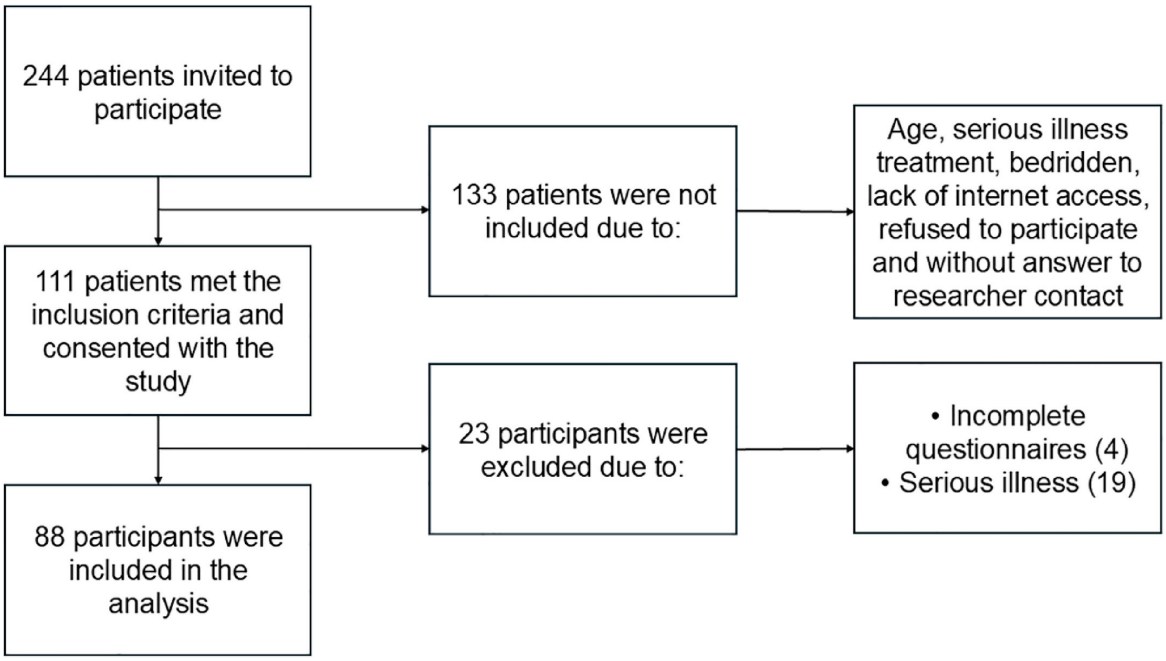


**Figure 1.** Eligibility flowchart.
**Source:** Data from the present study.

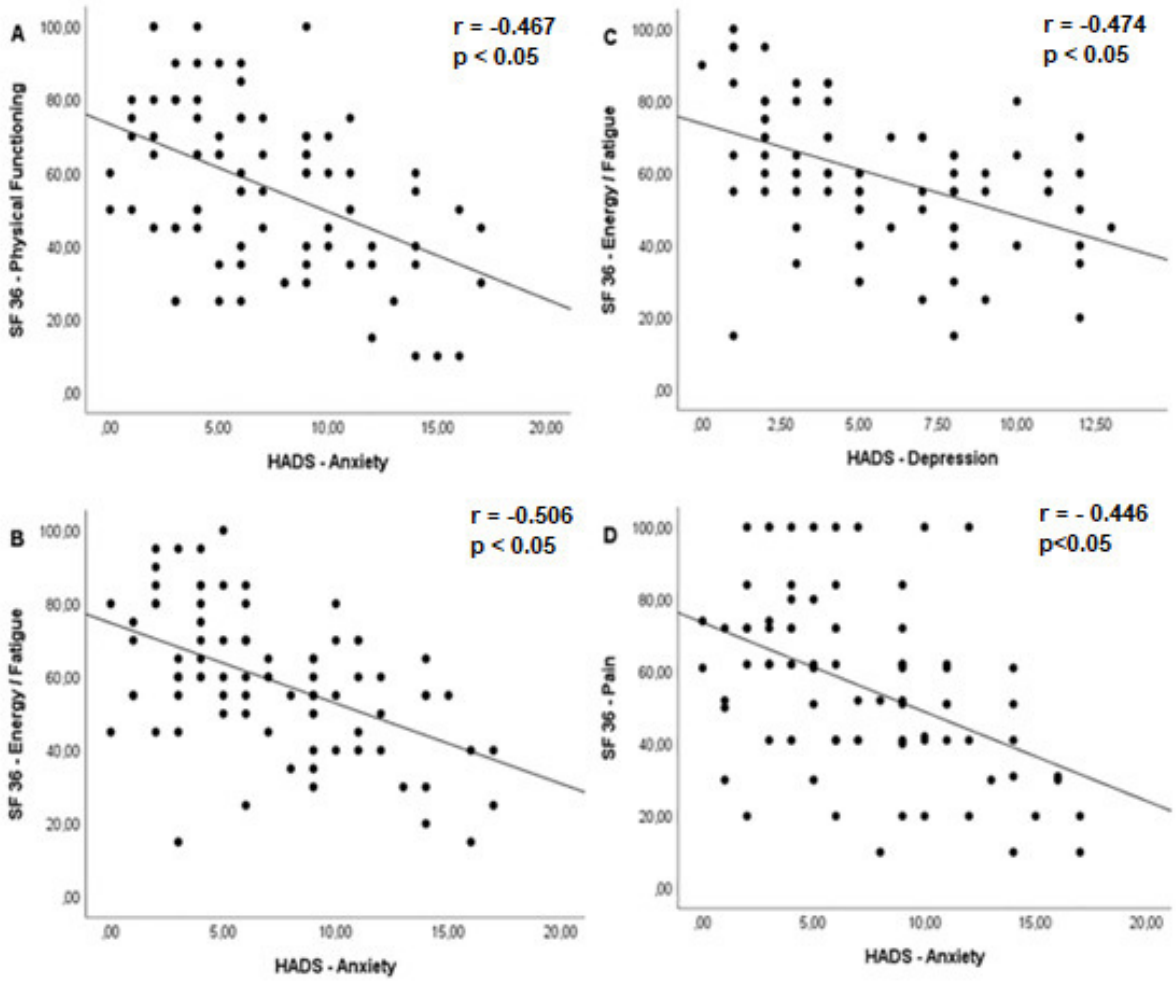


**Figure 2.** Pearson Correlation Coefficient between HADS-Anxiety and SF36 Physical Function, Pain and Energy/Fatigue Domains of SF36, and between HADS-Depression and Energy / Fatigue Domain of SF36.
SF36: The Short Form (36) Health Survey; HADS: The Hospital Anxiety and Depression Scale; p<0.05.
**Source:** Data from the present study.

**Table 2.** Correlations between SF-36's and HADS's domains.

| | HADS | HADS |
|---|---|---|
| | Anxiety | Depression |
| SF 36 – Physical Functioning | - 0.467* | - 0.408* |
| SF 36 – Role Limitations due to physical health | - 0.222* | - 0.286* |
| SF 36 – Pain | - 0.446* | - 0.314* |
| SF 36 – Energy/fatigue | - 0.506* | - 0.474* |
| SF 36 – General Health | - 0.218* | - 0.203* |
| SF 36 – Role Limitations due emotional problems | - 0.432* | - 0.543* |
| SF 36 – Social functioning | - 0.271* | - 0.359* |
| SF 36 – Emotional Well-being | - 0.577* | - 0.480* |

HADS: Hospital Anxiety and Depression Scale. SF36: The Short Form (36) Health Survey. *Significant correlations, with p<0.05 using Pearson or Spearman tests, when adequate.

**Source:** Data from the present study.

**Table 3.** Linear regression predicting SF 36 domains using HADS score.

| Models | Beta | Beta IC (95%) | | Stand Beta | p | $R^2$ |
|---|---|---|---|---|---|---|
| ***SF 36 – Physical Functioning*** | | | | | < 0.001 | 0.250 |
| Constant | 73.361 | 65.131 | 81.592 | | < 0.001 | |
| HADS-Anxiety | -2.394 | -3.384 | -1.403 | -0.467 | < 0.001 | |
| ***SF 36 – Role Limitations due to physical health*** | | | | | < 0.001 | 0.072 |
| Constant | 38.050 | 24.872 | 51.228 | | < 0.001 | |
| HADS-Depression | -2.694 | -4.664 | -0.723 | -0.286 | 0.008 | |
| ***SF 36 – Pain*** | | | | | <0.001 | 0.200 |
| Constant | 73.577 | 64.582 | 82.572 | | <0.001 | |
| HADS-Anxiety | -2.470 | -3.553 | -1.388 | -0.446 | <0.001 | |
| ***SF 36 – Energy/Fatigue*** | | | | | <0.001 | 0.310 |
| Constant | 78.874 | 71.627 | 86.120 | | <0.001 | |
| HADS-Anxiety | -1.533 | -2.463 | -0.602 | -0.354 | 0.002 | |
| HADS-Depression | -1.540 | -2.695 | -0.385 | -0.286 | 0.010 | |
| ***SF 36 – General Health*** | | | | | 0.045 | 0.036 |
| Constant | 62.248 | 55.928 | 68.569 | | 0.000 | |
| HADS-Anxiety | -0.777 | -1.537 | -0.016 | -0.218 | 0.045 | |
| ***SF 36 – Social functioning*** | | | | | 0.001 | 0.118 |
| Constant | 62.827 | 56.158 | 69.495 | | 0.000 | |
| HADS-Depression | -1.755 | -2.752 | -0.758 | -0.359 | 0.001 | |

HADS: Hospital Anxiety and Depression Scale. SF36: The Short Form (36) Health Survey. Stand Beta: Standardized Beta values.

**Source:** Data from the present study.

association between energy/fatigue with anxiety and depressive symptoms. Moreover, when subdividing patients with or without depressive or anxiety symptoms, a worst quality of life was found in almost all domains. Lastly, a large proportion of post-hospitalized patients due to COVID-19 presented quality of life domains affected and significantly lower than Brazilian population, also, approximately half of these patients presented anxiety or depressive symptoms.

**Table 4.** Comparison of the characteristics of patients with or without anxiety or depression symptoms.

| Characteristics | With Anxiety (n=40) | Without Anxiety (n=48) | p |
|---|---|---|---|
| Male, n (%) | 22 (55) | 28 (58.33) | 0.750 |
| Female, n (%) | 18 (45) | 20 (41.67) | |
| Age (years) | 52 ± 9 | 56 ± 12 | 0.130 |
| Height (m) | 1.65 ± 0.08 | 1.66 ± 0.09 | 0.696 |
| Weight (Kg) | 87.50 ± 16.35 | 79.15 ± 16.16 | 0.115 |
| BMI (Kg/m$^2$) | 31.65 ± 5.38 | 30.00 ± 4.79 | 0.067 |
| SF 36 – Physical Functioning | 47.75 ± 20.25 | 64.23 ± 21.10 | <0.001* |
| SF 36 – Role Limitations due to physical health | 13.75 ± 26.52 | 30.97 ± 35.81 | 0.014* |
| SF 36 – Pain | 46.70 ± 23.32 | 65.08 ± 22.05 | <0.001* |
| SF 36 – Energy/fatigue | 49.75 ± 14.97 | 68.15 ± 18.20 | <0.001* |
| SF 36 – General Health | 52.65 ± 13.44 | 60.60 ± 16.28 | 0.016* |
| SF 36 – Role Limitations due emotional problems | 35.00 ± 41.31 | 62.31 ± 41.93 | 0.003* |
| SF 36 – Social functioning | 49.37 ± 18.97 | 56.25 ± 14.84 | 0.063 |
| SF 36 – Emotional Well-being | 58.00 ± 17.56 | 76.26 ± 15.07 | <0.001* |
| Characteristics | With Depression (n=40) | Without Depression (n=48) | p |
| Male, n (%) | 19 (50) | 31 (62) | 0.26 |
| Female, n (%) | 19 (50) | 19 (38) | |
| Age (years) | 56 ± 9.8 | 52 ± 12.8 | 0.977 |
| Height (m) | 1.65 ± 0.07 | 1.68 ± 0.09 | 0.495 |
| Weight (Kg) | 88.20 ± 16.86 | 83.30 ± 17.06 | 0.434 |
| BMI (Kg/m$^2$) | 30.90 ± 5.66 | 30.20 ± 4.91 | 0.130 |
| SF 36 – Physical Functioning | 48.1 ± 21.77 | 62.95 ± 20.48 | 0.002* |
| SF 36 – Role Limitations due to physical health | 13.51 ± 25.40 | 30.10 ± 36.07 | 0.019* |
| SF 36 – Pain | 48.16 ± 26.24 | 62.85 ± 20.91 | 0.005* |
| SF 36 – Energy/fatigue | 50.81 ± 15.56 | 66.22 ± 18.91 | <0.001* |
| SF 36 – General Health | 54.83 ± 13.83 | 58.46 ± 16.56 | 0.284 |
| SF 36 – Role Limitations due emotional problems | 27.02 ± 37.54 | 66.66 ± 40.25 | <0.001* |
| SF 36 – Social functioning | 46.95 ± 19.63 | 57.65 ± 13.45 | 0.004* |
| SF 36 – Emotional Well-being | 58.48 ± 18.65 | 74.77 ± 15.32 | <0.001* |

Data presented according to standard mean ± standard deviation. BMI: Body mass index. SF36: The Short Form (36) Health Survey. *Significant differences, with $p<0.05$.

**Source:** Data from the present study.

Anxiety and depression are a world health issue, with an increasing prevalence since COVID-19 pandemic. A World Health Organization study[17], found a prevalence of anxiety and depression lower than 5% in 2015. Recently, a systematic review found anxiety and depression prevalence close to 25%[18], and in COVID-19 survivors, the prevalence is even greater.

There is a well-known association of the increase of psychiatric symptoms after an COVID-19 infection[5], especially in patients who were hospitalized[19]. In our sample, 45% of patients presented anxiety and 43% presented depression, which was within the confidence interval of a previous meta-analysis who found a pooled anxiety prevalence of 43% (CI 37% - 57%) and a pooled

depression prevalence of 45% (37% - 54%) after a COVID-19 infection. Surprisingly, a recent study[19] presented lower depression and anxiety prevalence in patients who were hospitalized due to COVID-19 (37% depression and 34.4% anxiety), which might be explained by the use of different symptom-assessment tools[5]. In Kibria et al.[19] study, they found hospitalization due to COVID-19 as an associated factor to a greater chance of anxiety and depression diagnosis.

Even in non-COVID survivors, there is a high rate of co-occurrence of anxiety and depressive symptoms, and the association between these symptoms has been already found previously[20,21]. In our sample, this was not different and 28% of patients presented both anxiety and depressive symptoms.

Most patients presented self-perceived physical functional capacity limitations (75%). This corroborates with another Brazilian study with 140 COVID-19 survivors, with a 53% prevalence of functional limitations 30 days after COVID diagnosis. Furthermore, 40% of these patients persisted with this limitation one year after the initial diagnosis[22]. Our mean score in SF-36 functional capacity domain was 56.56 ± 22.19, corroborating with a previously published paper 52.40 ± 6.20[23]. In the other quality of life domain, our values were also similar to this study.

The association between anxiety/depression and functional status were already studied in a Brazilian population, which found that a significant loss in functional capacity was independently associated with a self-reported diagnosis of anxiety/depression[22], with a 23 times chance increase of functional limitation one year after COVID-19 diagnosis in people with anxiety/depression. Furthermore, an association between anxiety severity and loss in physical functioning showed that people with a more severe anxiety were more likely to present loss in occupational and social functioning, with $r=0.7$, $p<0.01$[24].

The decreased self-perceived physical functional capacity observed in post-COVID-19 patients might be due to a complex interrelated net of factors, including chronic inflammation, sarcopenia, and physical deconditioning. Prolonged systemic inflammation, marked by elevated levels of cytokines such as Interleukin 6 (IL-6) and Tumor Necrosis Factors Alpha (TNF-α), has been documented in COVID-19 survivors and may contribute to fatigue and muscle weakness[25]. Corroborating with the association of physical functional capacity and anxiety/depressive symptoms, elevated cytokines also are associated with depression, and with a lesser extent to anxiety[26], with a possible causality nexus, i.e., inflammation may cause depressive and/or anxiety symptoms.

Anxiety and depression may also contribute to functional loss, since they reduce motivation for rehabilitation and perpetuating a cycle of inactivity, which further increases sarcopenia, a result from prolonged immobilization during hospitalization and direct viral effects on muscle tissue. Sarcopenia and physical inactivity may exacerbate functional decline[27,28].

The bidirectional relationship between physical deconditioning and mental health disorders may explain the sustained self-perceived functional impairment in post-COVID-19 patients. Physical deconditioning, common after prolonged hospitalization, can worsen depressive and anxious symptoms, while the presence of these disorders reduces adherence to rehabilitation programs[29].

Furthermore, social isolation and fear of reinfection may limit patients' reintegration into daily activities, perpetuating both physical and psychological sequelae[30]. Addressing these multifactorial mechanisms through integrated rehabilitation strategies targeting both physical and mental health is crucial for improving long-term outcomes[31].

In our study, anxiety presented a weak association with social functioning, and this might have happened because our sample was composed mostly by individuals with very poor social functioning, probably due to hospitalization and social isolation. Depressive symptoms were better associated with poor social functioning in the present study. A significant independent association between depressive symptoms and energy/fatigue was found, and this result corroborates previous findings showing that most depressive symptoms in COVID-19 survivors were somatic, with complaints of lack of energy and sleep disturbances[21].

This study presents as a limitation the fact that patients were interviewed using online conferences, although assessors were trained using this technology and patients were interviewed in a synchronous mode, ensuring their possibility of asking for help to answer all questionnaires.

Professionals involved in the rehabilitation of post-acute COVID-19 patients should be attentive to disproportionate functional limitations or persistent fatigue, as these might indicate underlying anxiety or depression symptoms. These findings reinforce the need for a comprehensive and interdisciplinary approach in rehabilitation, integrating physical and mental aspects to optimize functional recovery and quality of life.

## CONCLUSION

Post-acute COVID-19 patients with anxiety symptoms reported lower self-perceived physical functional capacity and worse scores in multiple quality of life domains, including vitality, pain, and emotional and physical role limitations. Depressive symptoms were not associated with functional capacity but were related to worse scores in vitality, pain, and social and emotional functioning.

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## CONFLICT OF INTEREST

Nothing to declare

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## RESEARCH DATA AVAILABILITY

Research data is only available upon request

## ARTIFICIAL INTELLIGENCE USE STATEMENT

Artificial intelligence tools were used to assist in the translation of revisions suggested by the authors and editors. All outputs were reviewed and validated by the authors, who take full responsibility for the content.

## AUTHOR CONTRIBUTIONS

V.A.P.D.L. and M.M.C.S. contributed to the conceptualization of the study; M.M.C.S. and D.R.V. conducted the investigation and data curation; T.A.P.L.U., H.C.B., and J.F.A. performed the formal analysis and data interpretation; T.A.P.L.U. and J.F.A. wrote the original draft of the manuscript; J.F.A. supervised the study; all authors contributed to the critical review and editing of the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

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