

SELF-REPORTED MENTAL HEALTH IN HOSPITALIZED PATIENTS WITH COVID-19: A 1-YEAR FOLLOW-UP

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Objectives: This study aimed to longitudinally follow self-reported symptoms of depression, anxiety, post-traumatic stress disorder, and fatigue during the first year after hospitalization because of COVID-19.

Design: The study was an observational longitudinal study.

Methods and participants: Between July 2020, and February 2021, 211 patients aged ≥ 18 years, hospitalized ≥ 5 days at 5 hospitals in Region Västra Götaland, who had COVID-19, and were non-contagious (at study enrolment) were included in the baseline assessment. Of these, 168 (79.6%) patients completed mental health questionnaires at a 3-month follow-up, and 172 (83.1%) at a 12-month follow-up. A total of 120 (56.9%) participants who completed at least 1 questionnaire at both the 3- and 12-month follow-ups were analysed; the majority were male ($n = 78$, 65.0%).

Results: There was an improvement in all patients from 3 to 12 months on the fatigue subscales "reduced activity" ($p = 0.02$) and "physical fatigue" ($p = 0.04$). No other significant mental health improvements were found. At 12 months, 34 (28.4%) were classified as having anxiety symptoms, 29 (24.1%) as having depression symptoms, and 40 (33.3%) had symptoms of probable post-traumatic stress disorder.

Conclusions: Participants in the present study did not report full mental health recovery 1 year after hospitalization for COVID-19.

Key words: COVID-19; fatigue; mental health; post-acute COVID-19 syndrome; post-traumatic stress disorder; SARS-CoV-2.

Submitted May 2, 2024. Accepted after revision Jul 29, 2024

Published Sep 24, 2024. DOI: 10.2340/jrm.v56.40654

J Rehabil Med 2024; 56: jrm40654.

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Coronavirus disease 2019 (COVID-19) causes heterogeneous symptomatology, including both mental and physical components, which has been addressed in

LAY ABSTRACT

Many different symptoms can arise in patients who have been hospitalized due to COVID-19. This study analysed self-reported data regarding mental health in 120 individuals who had been hospitalized due to COVID-19 in Sweden during the first and second wave of the COVID-19 pandemic. The participants reported an improvement from 3 to 12 months regarding fatigue, which is a feeling of tiredness that can be both mental and/or physical. At 12 months, 28.4% individuals were classified as having anxiety symptoms, 24.1% as having depression symptoms, and 33.3% reported symptoms of probable post-traumatic stress disorder. Participants in the present study did not report full mental health recovery 1 year after hospitalization for COVID-19 and these participants may therefore need rehabilitation. Use of a multidisciplinary team has been found to be advantageous for patients with prior COVID-19 as symptomatology may be multifactorial.

several systematic reviews and meta-analyses (1, 2). This symptomatology may fluctuate and persist long after the acute phase of COVID-19. The diagnosis of post COVID-19 has therefore been introduced to define patients with a history of probable or confirmed COVID-19 with symptoms remaining for at least 3 months after infection (3).

Mental health is defined by the World Health Organization (WHO) as a state of well-being in which the individual realizes their own abilities, can cope with the normal stress of life, can work productively and fruitfully, and is able to make a contribution to their community (4). Various cross-sectional studies have evaluated the impacts of COVID-19 on mental health, including post-traumatic stress disorder (PTSD) (5), fatigue (6, 7), impaired health-related quality of life (8), and anxiety and depression (9). A previous study that assessed anxiety, depression, and PTSD longitudinally at 3 and 6 months among hospitalized and non-hospitalized patients found that symptoms of PTSD, anxiety, and depression had barely improved at 6 months (10). However, it is common for the onset of PTSD to be delayed for >6 months after a

traumatic event, even though sub-threshold PTSD symptoms may be present earlier (11). Another study found an increase in the number of hospital survivors with COVID-19 reporting anxiety and depression at 12 vs 6 months (12). Because of the novel nature of the COVID-19 pandemic, longitudinal data regarding effects on mental health among previously hospitalized patients could benefit from being analysed so as to be able to assess the rehabilitation needs in this population. We hypothesized that there would be improvements in mental health 1 year after discharge from hospitalization due to COVID-19, and that there may be differences in recovery between men and women. We therefore aimed to longitudinally investigate aspects of mental health among patients during their first year after hospitalization for COVID-19, and assessed these aspects by participants' sex.

PARTICIPANTS AND METHODS

Study population

This study was an observational longitudinal study. Data were collected in collaboration with 5 (of 6 possible) hospitals in Region Västra Götaland, Sweden. Region Västra Götaland has a population of approximately 1.77 million inhabitants and constitutes both rural and urban areas. Between 9 July 2020, and 23 February 2021 (mainly the first and second wave of the COVID-19 pandemic in Sweden: [1] 1-3-2020–30-09-2020 and [2] 1-10-2020–31-01-2021 respectively), patients were included if fulfilling the following criteria: non-contagious (at the time of enrolment); hospitalized ≥ 5 days with COVID-19; aged ≥ 18 years; Swedish residents; and living in their own housing at the time of hospital admission. Exclusion was applied in patients with a clinical assessment of comorbidities resulting in high 1-year mortality, which was discussed with the medical doctor in charge. All patients were informed orally and in writing about this study, and provided written informed consent if they agreed to participate. Data collection was carried out by physiotherapists and occupational therapists. Information regarding inpatient care and comorbidities before COVID-19 was retrieved from patients' medical files. Demographic data (e.g., country of birth, level of education, and living situation) were also collected. Medical characteristics and demographic data were both collected at the time of enrolment in the study. This study was part of the "Life in the time Of COVID study in GÖThenburg (GOT-LOCO)" project, which aims to longitudinally assess hospitalized patients with COVID-19 in Region Västra Götaland. The characteristics of the study population have been described elsewhere (13, 14). Two follow-ups were conducted after hospitalization and the time for follow-up was calculated based on each individual's discharge date: one at 3 months (± 7 days) (telephone interview) and one at 12 months (± 14 days). Each participant was contacted by telephone at each follow-up, and if unable to be reached participants were sent a letter of invitation. All participants, including those who did not participate in the 3-month follow-up, were invited to participate in the 12-month follow-up. The follow-up at 12 months post-discharge was an in-person assessment conducted by physiotherapists and occupational therapists and was preceded by participants completing questionnaires. Participants were included in the present study if they filled in at least 1 of the

3 mental health questionnaires (see below) at both the 3- and 12-month follow-ups.

This study was approved by the Swedish Ethical Review Authority (No 2020-03046, 2020-03922, 2021-03556, 2021-00444), and followed the principles laid out in the Declaration of Helsinki. This study was guided by the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for observational studies (15).

At baseline, 211 patients were recruited from the participating hospitals: Sahlgrenska University Hospital $n=147$; Södra Älvsborg Hospital $n=23$; Alingsås Hospital $n=5$; Skaraborg Hospital $n=22$; and the Norra Älvsborgs Länssjukhus and Uddevalla Hospital $n=14$. There were 168 (79.6%) assessed participants at the 3-month follow-up and 172 (83.1%) at the 12-month follow-up. In total, 120 participants responded to at least 1 mental health questionnaire and were included in the present study, which resulted in a response rate of 56.9%. A flow chart of participant recruitment is presented in Fig. 1.

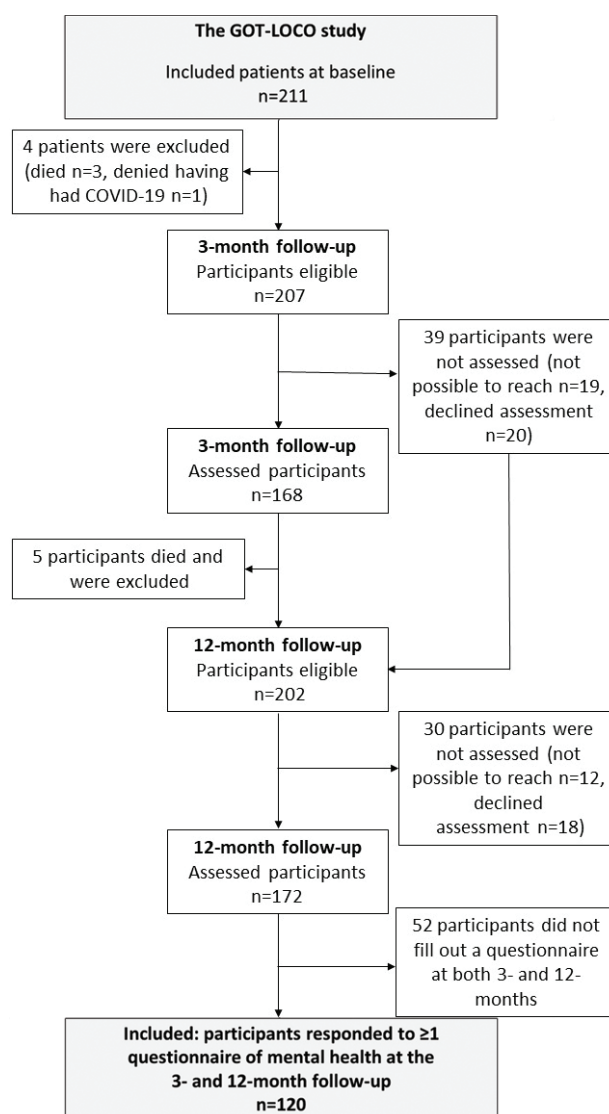


Fig. 1. Flowchart of patient inclusion. GOT-LOCO: Life in the time of COVID study in GÖThenburg; COVID-19: coronavirus disease 2019. All participants, including those who did not participate in the 3-month follow-up, were invited to participate in the 12-month follow-up.

Measurements of mental health

Three questionnaires were used to assess different self-reported aspects of mental health (depression and anxiety, PTSD, and fatigue). Depression and anxiety were assessed using the Hospital Anxiety and Depression Scale (HADS), which consists of 7 questions on each of these 2 domains. Scores for each question range from 0–3, and cut-off scores of ≥ 8 (interpreted as indications of anxiety or depression, respectively) and ≥ 11 were used to identify anxiety and depression (16). PTSD was assessed with the Impact of Event Scale-revised (IES-R), which consists of 22 questions. The score range for each item is 0–4 (from “not at all” to “extremely”) and item scores are summed to give a total score. Scores ≥ 24 points are regarded as PTSD of clinical concern, ≥ 33 as probable cut-off for a PTSD diagnosis (17, 18), and ≥ 37 as high enough to suppress the immune system’s function 10 years after the stressful event (19). Fatigue was assessed using the Multidimensional Fatigue Inventory (MFI-20), which investigates 5 fatigue subscales (General fatigue; Physical fatigue; Reduced motivation; Reduced activity; and Mental fatigue). Each subscale comprises 4 questions, and scores range from 1 to 5 (possible range of 4–20 per subscale). Higher scores are indicative of more fatigue (20).

Definitions of central concepts

Severity of illness during hospitalization was defined according to the WHO Clinical Progression Scale (WHOCPS), which ranges from 0 (uninfected; no viral ribonucleic acid detected) to 10 (death). A score of 4–5 represents hospitalized patients with

moderate disease, and 6–9 represents hospitalized patients with severe disease (21). Classification of comorbidities was defined using the Charlson Comorbidity Index (CCI), which considers the number and seriousness of comorbidities, and adds up to a total index score (22).

Statistical methods

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 29.0 (IBM Corp, Armonk, NY, USA). Demographic data are presented as mean (standard deviation, SD), and non-parametric data as median (interquartile range, IQR) or (min, max). Comparisons between groups over time were analysed using non-parametric Wilcoxon signed-rank tests. P -values < 0.05 were considered statistically significant.

Missing values for the IES-R, MFI-20, and HADS were imputed using the mean of the answered items on each subscale if at least half of that subscale had been answered. If a questionnaire contained more missing values than that, case deletion was performed. We used the highest obtained WHOCPS score (21) to categorize patients based on severity (4–5 vs 6–9). Sankey diagrams were used to visualize the longitudinal effects on mental health using the HADS and IES-R scores. As no cut-off values were available for the MFI-20, a scatter plot was used to visualize the longitudinal effects on mental fatigue. Mathematical quartiles, based on scores for the 3 mental health questionnaires at the 12-month follow-up, were used to analyse participants’ clinical characteristics. We compared quartiles 1–3 with quartile 4 using the Mann–Whitney U test or χ^2 test to analyse participants who reported the highest/worst scores.

Table I. Baseline characteristics of the included patients at hospitalization ($n = 120$)

Characteristic	All patients $n = 120$	Men $n = 78$	Women $n = 42$
Demographics			
Age, years, mean (SD)	66.0 (12.4)	66.0 (10.5)	66.1 (15.4)
Country of birth, yes, n (%)			
Sweden	88 (73.3)	57 (73.1)	31 (73.8)
Other Scandinavian country	8 (6.7)	4 (5.1)	4 (9.5)
Other Europe	15 (12.5)	11 (14.1)	4 (9.5)
Asia, Africa, South America	9 (7.4)	6 (7.7)	3 (7.2)
Level of education, yes, n (%)			
Elementary school (6–9 years)	25 (20.8)	18 (23.1)	7 (16.7)
High school (10–12 years)	66 (55.5)	45 (57.7)	21 (50.0)
College/University (>12 years)	24 (20.2)	12 (15.4)	12 (28.6)
Other	5 (4.2)	3 (3.9)	2 (4.8)
Living situation, yes, n (%)			
Living alone	44 (36.7)	30 (38.5)	14 (33.3)
With another adult	60 (50.0)	39 (50.0)	21 (50.0)
With children ≤ 18 years	13 (10.8)	7 (9.0)	6 (14.3)
With spouse and children	3 (2.5)	2 (2.6)	1 (2.4)
Comorbidity^a			
Charlson Comorbidity Index, median [min, max]	1.0 [0, 6]	1.0 [0, 6]	1.0 [0, 4]
0 points, yes, n (%)	31 (25.8)	21 (26.9)	10 (23.8)
1–2 points, yes, n (%)	64 (53.3)	41 (52.6)	23 (54.8)
3–4 points, yes, n (%)	21 (17.5)	13 (16.7)	8 (19.0)
≥ 5 points, yes, n (%)	2 (1.7)	2 (2.6)	0 (0)
Inpatient care			
Length of hospital stay, days, mean (SD)	34.7 (38.7)	40.6 (44.8)	24.0 (20.0)
Median [IQR]	20.0 [11.0, 42.0]	21.0 [12.0, 52.0]	18.5 [10.0, 27.7]
Patients admitted to an intensive care unit, yes, n (%)	64 (53.3)	48 (61.5)	16 (38.1)
Duration of intensive care unit care, days, mean (SD)	20.2 (21.5)	22.8 (23.4)	12.3 (11.5)
Median [IQR]	13.0 [6.0, 29.0]	14.0 [7.0, 35.0]	8.5 [4.5, 16.0]
Supplemental oxygen, yes, n (%)	114 (95.0)	76 (97.4)	38 (90.5)
Tracheotomy, yes, n (%)	26 (21.7)	22 (28.2)	4 (9.5)
WHOCPS^b, yes, n (%)			
Moderate disease (score 4–5)	38 (31.7)	22 (28.2)	16 (38.1)
Severe disease (score 6–9)	81 (67.5)	56 (71.8)	25 (59.5)

^a $n = 118$. ^b $n = 119$.

SD: standard deviation; IQR: interquartile range; WHOCPS: World Health Organization Clinical Progression Scale; COVID-19: coronavirus disease 2019.

RESULTS

Participants' baseline demographics

The majority of the 120 participants were male ($n=78$, 65.0%), and the mean age was 66.0 (SD 12.4) years. The median length of hospital stay was 20.0 (11.0, 42.0) days. The demographics and inpatient data for the study population are shown in Table I.

Mental health

There was an improvement in all patients between the 3- and 12-month follow-ups on the fatigue subscale "Reduced activity" ($p=0.02$) and this was also significant in males ($p=0.05$). Furthermore, "physical fatigue" improved ($p=0.04$), and this was also attributable to decreased fatigue in males ($p=0.03$). No other significant improvements in mental health were found in the study population. In the total study population, the indication of depression significantly increased between 3 and 12 months ($p=0.037$), as did the total score ($p=0.007$). In males this difference was significant ($p=0.013$) (Table SI). At 12 months, 34 (28.4%) participants scored ≥ 8 on the HADS anxiety subscale (indicating anxiety) and 29 (24.1%) scored ≥ 8 on the depression scale (indicating depression). In addition, 40 (33.3%) participants reached the cut-off score for a probable PTSD diagnosis (scores ≥ 33) (Table SI). The longitudinal effects on mental health are presented in Figs 2 and 3.

Among participants who reported the highest anxiety and depression scores at 12 months, there were greater proportions of participants born in other countries outside Sweden compared with those born in Sweden ($p=0.008$ and $p<0.001$, respectively) (Table II). There were also greater proportions of participants born outside Sweden among those who reported the highest IES-R scores ($p<0.001$) (Table III).

There was a greater proportion of participants with a university education in the group who reported the highest degree of mental fatigue on the MFI-20 compared with other education levels ($p=0.049$), as well as a greater proportion of women ($p=0.046$) (Table III). There were no significant differences between the sexes in HADS, IES-R, or MFI-20 scores at the 3- or 12-month follow-ups (Fig. S1).

DISCUSSION

The present study analysed the longitudinal effects on mental health among individuals hospitalized during the first and second wave of the COVID-19 pandemic at 3 and 12 months after acute COVID-19. The results of the present study suggest that mental health was not fully recovered after 1 year in participants who had

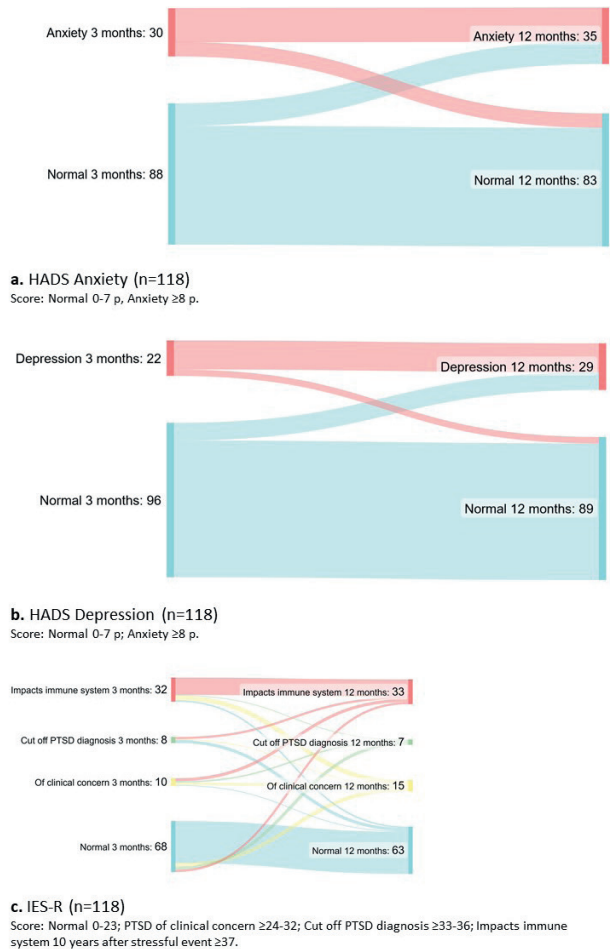


Fig. 2. Sankey diagrams displaying the longitudinal effect on different aspects of mental health (a, anxiety; b, depression; c, PTSD) after hospitalization because of COVID-19 ($n=120$). COVID-19: coronavirus disease 2019; HADS: Hospital Anxiety and Depression Scale; IES-R: Impact of Event Scale-Revised; PTSD: post-traumatic stress disorder; p: points; n: number of participants.

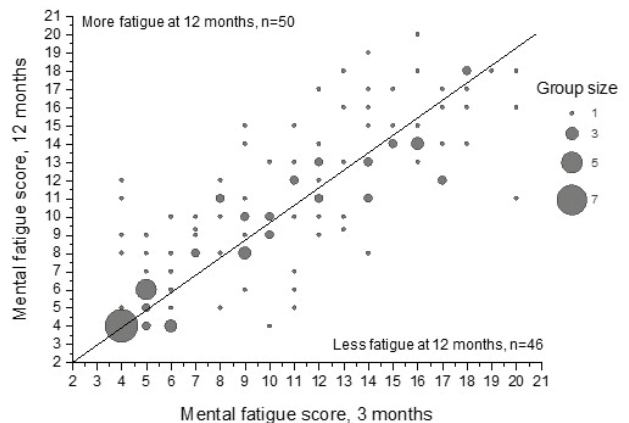


Fig. 3. Scatter plot of mental fatigue scores at the 3- and 12-month follow-ups ($n=118$). Dots above the diagonal line indicate a worsened degree of fatigue at the 12-month follow-up. Dots below the diagonal line indicate a lesser degree of fatigue at the 12-month follow-up. n=number of participants. Possible range of score is 4–20, and higher scores are indicative of more fatigue.

Table II. Characteristics of participants divided into quartiles based on Hospital Anxiety and Depression Scale (HADS) scores at the 12-month follow-up ($n = 120$)

Characteristic	Q1	Q2	Q3	Q4	<i>p</i> -value Q1–Q3 vs Q4
<i>HADS – Anxiety, n = 118^c</i>					
Anxiety score	0–1	2–4	5–8	9–18	
<i>n</i> (%)	27 (22.5)	35 (29.2)	27 (22.5)	29 (24.2)	
Age, years, mean (SD)	65.8 (11.8)	63.5 (11.3)	70.7 (14.1)	64.4 (12.1)	0.35 ^a
Female, <i>n</i> (%)	7 (25.9)	16 (45.7)	9 (33.3)	10 (34.5)	0.89 ^b
Country of birth: Sweden and other Scandinavia/Other Europe/ All other	25/1/1	30/4/1	20/6/1	19/4/6	0.008^b
College/University (> 12 years), yes (%)	4 (14.8)	10 (28.6)	2 (7.4)	8 (27.6)	0.26 ^b
Living situation (Living alone/Cohabiting)	10/17	13/22	8/19	12/17	0.52 ^b
Length of hospital stay, days, median [IQR]	18.5 [12.7, 49.7]	21.0 [10.0, 42.0]	22.0 [13.0, 46.0]	17.0 [10.0, 25.0]	0.14 ^a
Admitted to an intensive care unit, yes, <i>n</i> (%)	17 (63.0)	17 (48.6)	14 (51.9)	14 (48.3)	0.60 ^b
WHOCPS, severe disease (score 6–9), yes, <i>n</i> (%)	21 (77.8)	26 (74.3)	15 (55.6)	17 (58.6)	0.24 ^b
Charlson Comorbidity Index, median [min, max]	1.0 [0.0, 2.0]	1.0 [0.0, 3.0]	2.0 [1.0, 3.0]	1.0 [1.0, 1.0]	0.24 ^a
<i>HADS – Depression, n = 118^c</i>					
Depression score	0–1	1.2–3	4–7	8–20	
<i>n</i> (%)	34 (28.3)	23 (19.2)	32 (26.7)	29 (24.2)	
Age, years, mean (SD)	65.4 (12.6)	66.5 (12.8)	67.2 (13.0)	64.7 (11.7)	0.39 ^a
Female, <i>n</i> (%)	12 (35.3)	6 (26.1)	13 (40.6)	11 (37.9)	0.76 ^b
Country of birth: Sweden and other Scandinavia/Other Europe/ All other	27/6/1	21/2/0	27/4/1	19/3/7	<0.001^b
College/University (> 12 years), yes (%)	3 (8.8)	9 (39.1)	5 (15.6)	7 (24.1)	0.56 ^b
Living situation (Living alone/Cohabiting)	11/23	10/13	12/20	10/19	0.80 ^b
Length of hospital stay, days, median [IQR]	18.5 [10.7, 37.5]	18.5 [12.0, 49.0]	22.5 [11.5, 46.0]	17.0 [10.0, 34.5]	0.27 ^a
Admitted to an intensive care unit, yes, <i>n</i> (%)	18 (52.9)	14 (60.9)	11 (36.7)	11 (37.9)	0.60 ^b
WHOCPS, severe disease (score 6–9), yes, <i>n</i> (%)	24 (70.6)	16 (69.6)	21 (65.6)	18 (62.1)	0.47 ^b
Charlson Comorbidity Index, median [min, max]	1.0 [0.0, 1.5]	2.0 [1.0, 3.0]	1.5 [1.0, 3.0]	1.0 [0.0, 2.0]	0.24 ^a

^aMann–Whitney U test. ^b χ^2 test. ^c $n = 1$ did not fill in, $n = 1$ case deletion ($n = 3$ imputed variables).

Q: quartile; SD: standard deviation; IQR: interquartile range; WHOCPS: World Health Organization Clinical Progression Scale. Bold figures denote statistical significance.

Table III. Characteristics of participants divided into quartiles (Q) based on Impact of Event Scale-Revised (IES-r) and Multidimensional Fatigue Inventory (MFI-20) scores at the 12-month follow-up ($n = 120$)

Characteristic	Q1	Q2	Q3	Q4	<i>p</i> -value Q1–Q3 vs Q4
<i>IES-R, n = 118^c</i>					
Total score	0–8	9–21	21.1–38.0	38.1–71	
<i>n</i> (%)	30 (25.0)	29 (24.2)	30 (25.0)	29 (24.2)	
Age, years, mean (SD)	70.0 (12.9)	63.2 (10.1)	67.5 (13.4)	64.2 (11.7)	0.19 ^a
Female, <i>n</i> (%)	7 (23.3)	12 (41.4)	11 (36.7)	11 (37.9)	0.68 ^b
Country of birth: Sweden and other Scandinavia/ Other Europe/ All other	27/2/1	26/3/0	25/4/1	17/6/6	<0.001^b
College/University (> 12 years), yes (%)	5 (16.7)	9 (31.0)	2 (6.7)	7 (24.1)	0.47 ^b
Living situation (Living alone/Cohabiting)	16/14	10/19	10/20	7/22	0.11 ^b
Length of hospital stay, days, median [IQR]	15.0 [10.0, 28.0]	22.0 [11.0, 44.0]	35.0 [16.5, 57.2]	17 [10.0, 28.0]	0.15 ^b
Admitted to an intensive care unit, yes, <i>n</i> (%)	15 (50.0)	15 (51.7)	17 (56.7)	16 (55.2)	0.82 ^b
WHOCPS, severe disease (score 6–9), yes, <i>n</i> (%)	19 (63.3)	19 (65.5)	24 (80.0)	18 (62.1)	0.40 ^b
Charlson Comorbidity Index, median [min, max]	1.0 [0.0, 4.0]	1.0 [0.0, 5.0]	1.0 [0.0, 6.0]	1.0 [0.0, 4.0]	0.83 ^a
<i>MFI-20, n = 118^d</i>					
Mental fatigue score	4–6	7–10	11–13	14–20	
<i>n</i> (%)	28 (23.7)	32 (27.1)	26 (22.0)	32 (27.1)	
Age, years, mean (SD)	68.1 (10.5)	66.7 (12.5)	66.2 (13.7)	64.2 (13.0)	0.45 ^a
Female, <i>n</i> (%)	9 (32.1)	12 (37.5)	5 (19.2)	16 (50.0)	0.046^b
Country of birth: Sweden and other Scandinavia/ Other Europe/ All other	24/4/0	28/3/1	19/3/4	24/4/4	0.46 ^b
College/University (> 12 years), yes (%)	8 (28.6)	3 (9.4)	2 (7.7)	10 (31.3)	0.049^b
Living situation (Living alone/Cohabiting)	10/18	15/17	7/19	11/21	0.78 ^b
Length of hospital stay, days, median [IQR]	17.0 [13.2, 43.5]	26.0 [10.0, 69.0]	21.5 [11.5, 36.7]	20.0 [11.5, 37.7]	0.65 ^b
Admitted to an intensive care unit, yes, <i>n</i> (%)	17 (60.7)	17 (53.1)	13 (50.0)	15 (46.9)	0.45 ^b
WHOCPS, severe disease (score 6–9), yes, <i>n</i> (%)	19 (67.9)	20 (62.5)	19 (73.1)	21 (65.6)	0.79 ^b
Charlson Comorbidity Index, median [min, max]	1.0 [0.0, 4.0]	2.0 [0.0, 6.0]	1.0 [0.0, 4.0]	1.0 [0.0, 3.0]	0.43 ^a

^aMann–Whitney U test. ^b χ^2 test. ^c $n = 2$ case deletion ($n = 16$ imputed variables). ^d $n = 2$ did not fill in ($n = 7$ imputed variables).

SD: standard deviation; IQR: interquartile range; WHOCPS: World Health Organization Clinical Progression Scale. Bold figures denote statistical significance.

been hospitalized because of COVID-19. The indication of depression significantly increased between the 3- and 12-month follow-ups. These results are consistent with a previous study that had a follow-up time of 1 year after hospitalization, which found an increase in the number of patients reporting anxiety and depression at 6 vs 12 months (12). Furthermore, another study found no significant improvement in the proportion of hospitalized patients with an indication of anxiety or depression from 3 to 6 months (10). A meta-analysis that mainly involved hospitalized patients showed an overall prevalence of depression of 45% and anxiety of 47% after COVID-19; however, the time frame varied as to when assessments were conducted (9). Furthermore, that study showed no significant sex-based differences in the prevalence of depression and anxiety (9). These results are consistent with the results of the present study, which found no significant sex-based differences in depression and anxiety at the 3- and 12-month follow-up assessments.

We aimed to specifically study different mental health aspects in patients during their first year after hospitalization for COVID-19 and therefore we specifically analysed the mental fatigue subscale. The present study showed that mental fatigue scores did not significantly improve at the 12-month follow-up compared with the 3-month follow-up ($p=0.68$). These results are somewhat surprising as improvements could have been expected, and results also offer important knowledge to build understanding of the long-term consequences of COVID-19. Although there are no standardized cut-off values for the MFI-20, the present study population had higher median values of mental fatigue compared with the general Swedish population aged 65–75 years (7.7 in men and 7.9 in women vs 10.0 in men and 10.5 in women in the present study) (23). In the German general population aged ≥ 60 years, the mean mental fatigue score was 8.7 ± 3.5 (24). Therefore, the present results suggest fatigue was more common in participants after COVID-19 infection compared with general populations. Results for the general Swedish population also showed that women had higher levels of fatigue than men on all 4 presented subscales (the reduced motivation subscale was not used), and that older age was correlated with lower levels of both general and mental fatigue (23). However, in the present study there were no statistically significant sex-based differences, which may indicate that men had higher levels of fatigue after COVID-19 compared with the general population and women. There were, however, a greater proportion of women reporting the highest levels of mental fatigue ($p=0.046$) but results were only marginally significant.

Fatigue is a multidimensional concept and no single definition is considered the gold standard. A meta-

analysis including patients with COVID-19 (using different measurements of fatigue) showed that approximately one-third of hospitalized and non-hospitalized patients experienced fatigue 12 or more weeks after COVID-19 (6). In addition, clinically relevant fatigue was prevalent in 19% of patients 9 months after COVID-19 infection compared with 8% of controls. Furthermore, female sex, younger age, the number of symptoms during the acute phase of COVID-19, and a history of depression were factors previously found to be associated with greater fatigue (25). In contrast, a systematic review showed that a potential risk factor for post-COVID-19 fatigue was older age (7).

The present study found no significant improvements in total IES-R scores from 3 to 12 months, as the total score increased (but not significantly). Results of the present study showed that, at the 12-month follow-up, one-third of participants had reached the cut-off point for a probable PTSD diagnosis (scores ≥ 33) (18). The gold standard for assessing PTSD after stressful life events is using a structured diagnostic interview (Clinician Administered PTSD Scale, CAPS) (26); however, the IES-R is a validated measure for self-reported assessment of traumatic events (18) and this tool is often used in the clinical setting as part of diagnosing PTSD. Therefore, the present results should not be interpreted as an actual diagnosis. A meta-analysis published in 2020 reported that the prevalence of PTSD in patients with COVID-19 was 15.45%; however, the time frame when PTSD was assessed was not reported (5). A more recent meta-analysis from 2023 reported that the prevalence of PTSD in patients hospitalized because of COVID-19 varied according to when it was assessed (23.1% at <3 months; 16.2% at 3–6 months; and 7.4% at 6–12 months) (27).

The concept of mental health is broad, and the present study used 3 self-assessment scales to assess different aspects of mental health. A previous study that analysed the associations between mental fatigue, depression, and anxiety showed that the highest correlation was that between fatigue and depression ($r=0.55$) (24). Mental health may also be affected by other factors, such as socioeconomic status, level of education, age, sex, and country of birth. There were greater proportions of participants born in countries outside of Sweden reporting the highest anxiety and depression scores. In the present study, 88 (73.3%) participants were born in Sweden, which is slightly less than the corresponding national number in Sweden of 80% (28). This indicates that a slightly larger percentage of the included population, in comparison with the general population, were born in countries other than Sweden. In the present study, we used the highest attained level of education as a proxy for socioeconomic status. A Danish study reported that

respondents with lower social class and less education reported more fatigue than their counterparts with a higher social class and more education (29). In addition, results from the general Swedish population showed that university-educated people had lower levels of fatigue than those with less education (23). These results contradicted those of the present study, which found a higher proportion of participants with university education in the group who reported the highest mental fatigue scores.

Strengths and limitations of the present study

The strengths of the present study included the prospective nature of the study design, which enabled inclusion of the parameters of interest. Furthermore, the study group was homogeneous in that they had all been hospitalized and we had a regional uptake (participants from 5 of 6 possible hospitals), which made it possible to retrieve a large cohort of participants from both rural and urban areas.

This study also had the following limitations. The reasons why patients were not included in the GOT-LOCO study were not recorded. Missing values were present in a few cases, primarily at the 12-month follow-up, and were managed by imputing values using the "half-rule", which involves using the mean of the answered items on each subscale if at least half of that subscale had been answered. The half-rule is commonly used when evaluating other self-assessed questionnaires, such as the 36-item Short-form Health Survey (30). This approach has also been adopted in studies that used the MFI-20 (24) and is recommended when using the HADS (31). We presented significance levels; however, values for the minimal clinically important difference would have been of interest for the 3 measurements but were not available for the population of patients with COVID-19. We were not able to differentiate between the WHOCPs scores 8 and 9 as we did not have data regarding dialysis or extracorporeal membrane oxygenation (ECMO), and therefore were only able to present the number of patients with moderate or severe WHOCPs scores. No regression analysis was performed because of the size of the study population. The mental health questionnaires used in this study had not been validated for patients with COVID-19; however, the HADS (9), MFI (32), and the IES-R (5) have previously been used in this population. Finally, we were not able to detect mental illness before COVID-19, which would have been of interest in the present study.

In conclusion, participants in the present study did not report full recovery of mental health 1 year after hospitalization due to COVID-19, and there were no sex-based differences. These participants may there-

fore need rehabilitation. Use of a multidisciplinary team has been found to be advantageous for patients with COVID-19 as their symptomatology may be multifactorial. Further studies may benefit from focusing on mental health with a longer follow-up period to analyse more comprehensively the long-term impact on patients hospitalized because of COVID-19.

ACKNOWLEDGEMENTS

The authors would like to acknowledge all participants in this study, along with the physiotherapists and occupational therapists from each hospital who contributed to data collection. They thank Edanz (<https://www.edanz.com/ac>) for editing a draft of this manuscript.

Funding: This work was supported by AFA Insurance (KSS grant number 200324), the Swedish state under the agreement between the Swedish government and the county council, the ALF agreement (KSS grant number 965653 and 73750; HCP 942914; LAK 983757), the Sahlgrenska University Hospital research funds (LAK grant number SU-984492; HCP grant number SU-961051), Forte/Formas (HCP grant number 2020-02775), and Västra Götaland regional research funding (HCP grant number 940508, and 969267).

Ethical clearance: This study was approved by the Swedish Ethical Review Authority (No 2020-03046, 2020-03922, 2021-03556, 2021-00444).

The authors have no conflicts of interest to declare.

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