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RESEARCH ARTICLE

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Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: A cross-sectional evaluation

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Abstract

Background: There is currently very limited information on the nature and prevalence of post-COVID-19 symptoms after hospital discharge.

Methods: A purposive sample of 100 survivors discharged from a large University hospital were assessed 4 to 8 weeks after discharge by a multidisciplinary team of rehabilitation professionals using a specialist telephone screening tool designed to capture symptoms and impact on daily life. EQ-5D-5L telephone version was also completed.

Results: Participants were between 29 and 71 days (mean 48 days) postdischarge from hospital. Thirty-two participants required treatment in intensive care unit (ICU group) and 68 were managed in hospital wards without needing ICU care (ward group). New illness-related fatigue was the most common reported symptom by 72% participants in ICU group and 60.3% in ward group. The next most common symptoms were breathlessness (65.6% in ICU group and 42.6% in ward group) and psychological distress (46.9% in ICU group and 23.5% in ward group). There was a clinically significant drop in EQ5D in 68.8% in ICU group and in 45.6% in ward group.

Conclusions: This is the first study from the United Kingdom reporting on postdischarge symptoms. We recommend planning rehabilitation services to manage these symptoms appropriately and maximize the functional return of COVID-19 survivors.

KEYWORDS

acute respiratory distress syndrome, post-COVID syndrome, post-intensive care syndrome, SARS CoV-2

Stephen J. Halpin and Claire McIvor contributed equally to this study and joint first author.

1 | BACKGROUND

On 11 March 2020, coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organisation (WHO). The United Kingdom has been one of the worst affected countries with over 286 000 confirmed cases and more than 44 000 confirmed deaths at the time of writing.[1] COVID-19 is caused by the coronavirus SARS-CoV-2 and presents with a wide spectrum of clinical symptoms. Wu and McGoogan[2] reported that 81% of people with COVID-19 in China presented with mild symptoms; 14% presented with symptoms of severe respiratory dysfunction; and 5% developed a critical illness with respiratory failure, septic shock, and multiple organ dysfunction or failure.

The medium and long-term problems experienced by survivors of COVID-19 after discharge from hospital are currently unknown, but there is some emerging evidence. An Italian study followed-up 143 individuals 7 weeks postdischarge and found 53% reporting fatigue, 43% breathlessness, and 27% joint pain.[3] Postdischarge symptoms may also be predicted from the previous coronavirus outbreaks of severe acute respiratory syndrome (SARS) in 2002 and Middle East respiratory syndrome (MERS) in 2012. A meta-analysis of 28 follow-up studies found that one-quarter of hospitalized survivors of SARS and MERS had reduced lung function and exercise capacity at 6 months postdischarge.[4] At 1 year, posttraumatic stress disorder (PTSD), depression and anxiety, and reduced quality of life were observed. This study suggested that the impact of COVID-19 is likely to be similar.

We believe that it is vital to develop rehabilitation services to address the impact of COVID-19 in people who survive the infection. In the United Kingdom, guidance from NHS England on the needs of COVID-19 survivors predicts a high burden of physical, neuropsychological, and social need following discharge, drawing largely from literature on Acute Respiratory Distress Syndrome.[5] However, COVID-19 is a truly multisystem disease, with common extra-respiratory complications affecting the cardiac (arrhythmias and myocardial injury), renal (acute kidney injury), gastrointestinal, nervous (neuropathy, encephalopathy), endocrine and musculoskeletal (weakness, pain, and fatigue) systems.[6] Specific data concerning the rehabilitation needs of this group is therefore urgently required.

To inform service development, our multidisciplinary rehabilitation team examined the impact of COVID-19 on survivors discharged from hospital. This study reports the first systematic assessment (in the current literature) of postdischarge symptoms and rehabilitation needs in COVID-19 survivors after hospital discharge.

2 | METHODS

2.1 | Setting

This service evaluation study was conducted within Leeds Teaching Hospitals NHS Trust (LTHT), one of the largest hospital trusts in Europe with approximately 1800 beds and providing secondary and tertiary services to a population of 2.5 million people. Patients treated for COVID-19 were followed up by telephone by a multidisciplinary team of physiotherapists, occupational therapists, dietitians, speech and language therapists, neuropsychologists, and rehabilitation physicians from LTHT and Leeds Community Healthcare NHS Trust.

2.2 | Participant identification

Participants were identified using a centrally compiled list of all patients discharged from LTHT following a positive COVID-19 test. Inclusion criteria for telephone follow-up were: patients diagnosed with COVID-19 by polymerase chain reaction (PCR) test of a nasopharyngeal sample during inpatient hospital admission, 4 weeks, or more since discharge from hospital for the index admission, not currently a hospital inpatient, and resident within the Leeds Metropolitan District. Exclusion criteria were if no contact details were available for the patient, under 18 years of age, or if telephone contact was inappropriate due to dementia, learning disability, or other cognitive or communication impairment.

We were particularly keen to evaluate the needs of participants who were treated in the intensive care unit (ICU) at any point during their hospital admission. Participants who received treatment on the ICU were expected to present as a distinct group with more severe needs, therefore, as many as possible of this group were included in follow-up. Participants who had received ward-based care were then selected randomly from the list and we continued to recruit participants until a total of 100 participants had been successfully followed up. Our results are presented with two groups disaggregated participants who received ward-level care only (who will be referred to as "ward group") and participants who received ICU treatment ("ICU group").

2.3 | Development of the telephone screening tool

A COVID-19 rehabilitation telephone screening tool was developed by the multidisciplinary team using an iterative peer review process. Domains captured in the tool were breathlessness, fatigue, swallowing, nutrition, voice quality, laryngeal sensitivity, communication, PTSD disorder, continence, cognition, perceived health status, vocation, and family/carers' views. The impact of each domain on the participant functioning was graded using a Likert scale to assess the impact pre- and post-COVID-19 disease. Additionally, the domains of mobility, personal care, usual activities, pain and anxiety/depression were addressed using the EQ-5D-5L Version for Interviewer Administration.[7] A version of the telephone screening tool has been mapped to WHO ICF Framework and been shown to incorporate all domains.[8,9]

2.4 | Telephone follow-up of patients postdischarge

Demographic data and admission details of the 100 identified participants were extracted from electronic patient records using a predetermined pro forma. Members of the COVID-19 rehabilitation multidisciplinary team (MDT) conducted telephone follow-up using the screening tool. Patients were called at various times throughout the day

to allow for increased chances of success with calls. Informed verbal consent was taken to proceed with the telephone consultation. Patients were directed to self-management resources, given specialist advice, and referred to relevant rehabilitation services as required. The completed Microsoft Word telephone screening tool was uploaded to the patients' electronic records and imported to a Microsoft Excel spreadsheet.

Patient information was stored securely and accessed via NHS computers. Only the relevant and necessary patient data was shared with individual clinicians involved in conducting the telephone surveys, via secure nhs.net email systems.

2.5 | Analysis

Data analysis was carried out using Microsoft Excel with descriptive statistics. Mean (and SD) is used to present average values for normal data and median (and interquartile range) used to present nonnormal data. Prevalence is reported as number of and percentage of patients reporting the symptom within the group (ICU or ward).

3 | RESULTS

One hundred and ninety-one potential participants were identified from the central list, 33 were deemed inappropriate for telephone follow-up due to dementia, cognitive impairment or receiving palliative care; 56 had wrong numbers or did not answer repeated phone calls; and 2 declined to participate. One hundred participants completed the telephone screen over a 4-week period from May to June 2020. Participants were between 29 and 71 days postdischarge (mean 48 days and SD 10.3 days).

Demographics and comorbidities (pre-COVID-19) of the cohort are displayed in Table 1. Table 2 provides details of the index admission. Patients predominantly had single-organ (respiratory) dysfunction requiring oxygen or noninvasive ventilation and only one patient in this cohort was intubated. This low rate of intubation reflects the timing of this study in relation to the pandemic wave seen in our hospitals. As such, those who required intubation had largely not been discharged for long enough to be included in this study.

The prevalence of reported problems detected on telephone screening after hospital discharge are reported in Table 3 and Figure 1

3.1 | Fatigue

Extremely high levels of fatigue were reported. The severity of the impact of this fatigue was high, with a mean rating of 4.8 out of 10 across both groups. Moderate or severe fatigue (rated 4 + /10) was reported more frequently by female patients than male patients in both groups. Overall, 61% of those with moderate or severe fatigue were female and 54.3% of all female patients reported moderate or severe fatigue, compared to 29.6% of male patients. There was no marked difference in ethnicity or body mass index (BMI) between those with moderate to severe fatigue and those without. In the ward

TABLE 1 Demographics and pre-COVID-19 comorbidities of patients discharged from hospital following COVID-19 infection

	Ward patients No. (%)	Intensive care unit patients
Demographic information		
Total no.	68	32
Age, median (range), y	70.5 (20-93)	58.5 (34-84)
Sex		
Female	33 (48.5)	13 (40.6)
Male	35 (51.5)	19 (59.4)
Ethnicity		
White	54 (79.4)	19 (59.4)
Mixed	1 (1.5)	0
Asian or Asian British	2 (2.9)	8 (25)
Black or Black British	5 (7.4)	3 (9.4)
Other Ethnic groups	0	0
Unknown	6 (8.8)	2 (6.3)
Occupation		
Keyworker	16 (23.5)	14 (20.6)
Works in a health care setting	4 (5.9)	11 (16.2)
Comorbidities		
Body mass index		
Underweight	2 (2.9)	1 (3.3)
Healthy weight	18 (26.5)	7 (23.3)
Overweight	25 (36.8)	10 (33.3)
Obese	12 (17.6)	12 (40.0)
Unknown	11 (16.2)	0
Cancer		
Active	7 (10.3)	0
Active or previous	16 (23.5)	5 (15.6)
Cardiovascular disease		
Heart failure	5 (7.4)	0
Hyperlipidemia	2 (2.9)	2 (6.3)
Hypertension	27 (39.7)	14 (43.8)
Ischemic heart disease	9 (13.2)	1 (3.1)
Tachyarrhythmias	9 (13.2)	2 (6.3)
Valvular heart disease	2 (2.9)	1 (3.1)
Venous thromboembolism	4 (5.9)	1 (3.1)
Chronic respiratory disease		
Asthma	9 (13.2)	4 (12.5)
Chronic obstructive pulmonary disease	6 (8.8)	2 (6.3)
Obstructive sleep apnea	4 (5.9)	3 (9.4)
Other	3 (4.4)	0
Chronic kidney disease	11 (16.2)	4 (12.5)
Other urological disease	9 (13.2)	4 (12.5)
Endocrine		
Type 1 diabetes	1 (1.5)	0
Type 2 diabetes	19 (27.9)	9 (28.1)
Prediabetic	5 (7.4)	1 (3.1)

(Continues)

TABLE 1 (Continued)

	Ward patients No. (%)	Intensive care unit patients
Thyroid disease	2 (2.9)	3 (9.4)
Other	3 (4.4)	0
Gastrointestinal disease	20 (29.4)	5 (15.6)
Gynecological disease	3 (4.4)	0
Hematological disease (excluding malignancy)	4 (5.9)	6 (18.8)
Immunosuppressed	9 (13.2)	6 (18.8)
Infectious disease	3 (4.4)	3 (9.4)
Mental health condition	14 (20.6)	5 (15.6)
Musculoskeletal disease and rheumatology		
Osteoarthritis	11 (16.2)	2 (6.3)
Rheumatological disease	6 (8.8)	8 (25.0)
Other musculoskeletal disease	12 (17.6)	5 (15.6)
Neurological disease	8 (11.8)	4 (12.5)
Total with ≥3 significant comorbidities	48 (70.6)	18 (56.3)

TABLE 2 Details of index admission

	Ward patients		ICU patients	
Number	68		32	
Median hospital LoS in days	6.5		12	
Interquartile range hospital LoS in days	10 (4-14)		6 (10-16)	
Median ICU LoS in days			4	
Interquartile range ICU LoS in days			3.15 (2.6-5.75)	
	N	%	*N*	%
Level of respiratory support				
O_2	46	67.7	32	100
CPAP/NIV	2	2.9	28	87.5
Endotracheal I + V	0	0	1	3.1
Tracheostomy	0	0	0	0
Renal replacement therapy	2	2.9	1	3.1
Artificial feeding				
NG/NJ	2	2.9	4	12.5
PN	0	0	1	3.1
Seen by physiotherapy	40	58.8	31	96.9
Seen by OT	20	29.4	9	38.1
Seen by dietitian	11	16.2	14	43.8
Seen by SLT	4	5.9	2	6.3

Abbreviations: CPAP, continuous positive airway pressure; I + V, intubation and ventilation; ICU, intensive care unit; LoS, length of stay; NG, nasogastric; NIV, noninvasive ventilation; NJ, nasojejunal; OT, occupational therapy; PN, parenteral nutrition; SLT, speech and language therapy.

group, those with moderate to severe fatigue appeared to be younger than those without (mean of 63 years vs 67 years). There was no age difference in the ICU group. In both groups, patients with moderate or severe fatigue also had markedly higher levels of PTSD symptoms (43.9% vs 18.6%) cognitive problems (41.4% vs 18.6%) and breathlessness (65.9% vs 39.0%) than those without moderate to severe fatigue.

3.1.1 | Breathlessness

New or worsened breathlessness (when compared with pre-COVID illness) was a significant symptom even several weeks postdischarge, affecting over two-fifths of ward patients and two-thirds of ICU patients. Moderate or severe breathlessness was more often reported by females than males in the ICU group (53.8% compared with 21.1%) but the proportions were similar in the ward group (24.2% and 20.0%). Among all patients for whom ethnicity was known, 8/19 (42.1%) of Black Asian and Minority Ethnic (BAME) participants reported moderate or severe breathlessness, compared with 18/72 (25.0%) of white patients. In the ICU group, 54.5% of those with moderate or severe breathlessness were obese, compared with 28.6% of those who were not so breathless. Among all those for whom BMI was known, 9/24 (37.5%) of obese people had moderate or severe breathlessness, compared with 17/63 (27.0%) of those with a BMI of less than 30. Of the ICU patients aged 60 and above, 92.3% reported some degree of worsened breathlessness, compared with 47.4% of those aged below 60, whereas in the ward patients the proportion of patients reporting breathlessness was more similar across age groups, the highest group being patients aged 50 to 59 at 58.3%. One-fifth of the participants in each group had some degree of pre-existing breathlessness before developing COVID-19 illness. Of those who reported post-COVID breathlessness, 60% of ward participants and 66% of ICU participants had pre-existing respiratory conditions.

3.1.2 | Neuropsychological

PTSD symptoms were reported by a much higher proportion of females (10/13; 76.9%) than males (5/19; 38.5%) in the ICU, whereas in the ward group these proportions were similar (22.9% of males and 24.2% of females). In both groups, those reporting PTSD symptoms were younger. The median age of all participants with these symptoms was 59 years, compared with 68 years in those without PTSD symptoms. PTSD symptom reporting co-occurred with obesity in the ICU group, but not in the ward group. Eighty percent of the ICU group reporting PTSD symptoms (12/15 people) were obese. 85.7% of obese people reported PTSD symptoms, compared with 16.7% of

TABLE 3 Prevalence of reported problems after COVID-19 in patients discharged from hospital

	Ward patients (68)		ICU patients (32)	
Domain	**Number**	**%**	**Number**	**%**
Fatigue				
Any new fatigue	41	60.3	23	72.0
Mild (0-3)	17	25.0	6	18.8
Moderate (4-6)	14	20.6	13	40.6
Severe (7-10)	10	14.7	4	12.5
Breathlessness				
Any new or worsened breathlessness[a]	29	42.6	21	65.6
Mild (increased by 1-3/10)	14	20.6	10	31.3
Moderate (increased by 4-6/10)	10	14.7	7	21.9
Severe (increased by 7-10/10)	5	7.4	4	12.5
Increased at rest	13	19.1	9	28.1
Increased on dressing	18 (/66)[b]	27.3	10	31.3
Increased on stairs	24 (/57)[b]	42.1	21	65.6
Neuropsychological				
Any PTSD symptoms related to illness	16	23.5	15	46.9
Mild symptoms	12	17.6	9	28.1
Moderate symptoms	4	5.9	4	12.5
Severe symptoms	0	0.0	2	6.3
Thoughts of self-harm	1	1.5	1	3.1
New or worsened concentration problem	11	16.2	11	34.4
New or worsened short-term memory problem	12	17.6	6	18.8
Speech and swallow				
Swallow problem	4	5.9	4	12.5
Laryngeal sensitivity	9	11.8	8	25.0
Voice change	12	17.6	8	25.0
Communication difficulty	4	5.9	2	6.3
SLT referral criteria met (impact rating of 1 or more in any SLT domain)	14	20.6	9	28.1
Nutrition				
Concern about weight/nutrition	10	14.7	2	6.3
Appetite problem severity 2 or more	6	8.8	2	6.3
Dietetics referral criteria met (either of the above criteria)	12	17.6	4	12.5
Continence				
New bowel control problem	2	2.9	1	3.1
New bladder control problem	6	8.8	4	12.5
EQ-5D-5L				
Mean EQ-5D-5L index value on day of screen	0.724		0.693	
Mean change	−0.061		−0.155	
Decreased by at least 0.05 (MCID[c])	31	45.6	22	68.8
Worsened mobility	21	30.9	16	50
Worsened self-care	12	17.6	4	12.5
Worsened usual activities	25	36.8	19	29.4
Worsened pain/discomfort	10	14.7	9	28.1
Worsened anxiety/depression	11	16.2	12	37.5
Perceived health (self-rated 0-100 scale)				
Mean change	−5.8		−12.53	
Decrease by more than 7 points (MCID[c])	22	32.4	17	53.1
Health service contact				
Represented to hospital	8	11.8	4	12.5
Used other health services	42	61.8	21	65.6

(Continues)

TABLE 3 (Continued)

Domain	Ward patients (68) Number	%	ICU patients (32) Number	%
Vocation change since COVID-19 illness	*n* = 20[d]		*n* = 20[d]	
Returned to same level of employment	14	70.0	2	10.0
Previously full time, now part-time	0	0.0	2	10.0
Off sick	3	15.0	12	60.0
Furloughed	2	10.0	4	20.0
Newly retired	1	5.0	0	0.0

[a]When compared with pre-COVID-19.
[b]Denominator differs as not all patients performed these activities.
[c]Minimal clinically important difference as validated in respiratory disease.[10]
[d]Twenty patients from each group were previously in full or part-time employment before their hospital admission.

those with a BMI of less than 30, in the ICU group. Overall the rates of PTSD symptoms reported by BAME individuals were similar to white participants (35.0% and 29.2%). Of the 35 participants overall reporting anxiety and depression post-COVID-19, 74% had no previously diagnosed mental health condition.

3.1.3 | Speech, swallow, and nutrition

Symptoms relating to communication, voice, swallow, and laryngeal sensitivity (including persistent cough) were more common in the ICU group than the ward group. There was no clear difference in age, gender or ethnicity between those who reported these symptoms and those who did not. In the ICU group, 5/12 (41.7%) of obese people reported these problems, compared with 3/18 (16.7%) of people with a BMI under 30. Recorded weight change during hospital admission was available for 36 of the ward group and 21 of the ICU group. Both showed an average weight loss of 1 kg with no marked difference between the groups.

3.1.4 | Daily activities and health-related quality of life (QOL)

Of the 22 ICU participants experiencing new problems in mobility, self-care or usual activities, 17 had new or worsened breathlessness and 19 had new fatigue. There was no difference in age, ethnicity, BMI, or gender between those who reported problems with mobility,

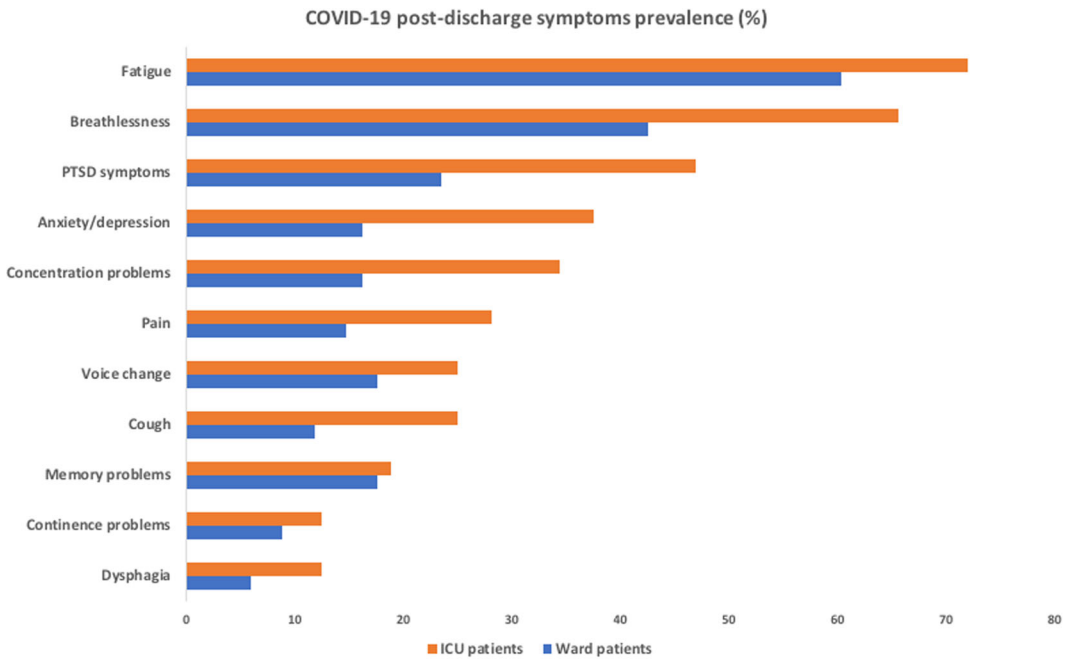

FIGURE 1 Prevalence of persistent symptoms in the intensive care unit and ward groups

self-care, or usual activities, and those who did not. Of the 30 ward participants experiencing new problems in mobility, self-care or usual activities, 21 had new or worsened breathlessness and 26 had new fatigue. There was no difference in age, ethnicity, or BMI between the participants with these problems and those without, but 67% of those with these problems were female. Sixty-one percent of female ward patients reported these problems, compared with 29% of male ward participants. The change in scores in the five domains of EQ-5D 5 L due to COVID-19 is shown in Figures 2 and 3.

4 | DISCUSSION

This is the first UK study of its kind on the postdischarge medium-term impact of COVID-19 infection on the health status of survivors. New illness-related fatigue was the most common reported symptom by 72% participants in the ICU group and 60.3% participants in the ward group. The next common symptoms were breathlessness (65.6% in ICU group and 42.6% in ward group) and psychological distress (46.9% in ICU group and 23.5% in ward group). There was a clinically significant drop in EQ5D in 68.8% of participants in the ICU group and in 45.6% of participants in the ward group. Sixty percent of the ICU group and 15% of the ward group remained off-sick from work at the point of follow-up.

This duration of symptom persistence appears to be greater than that seen in community-acquired bacterial pneumonia. A longitudinal study of time to symptom recovery in patients with community-acquired pneumonia hospitalized for an identical median length of stay to our ward group (6 days) found that on average patients had recovered 97% of their symptoms by 10 days.[11] A further longitudinal study including 201 patients hospitalized with community-acquired pneumonia showed that breathlessness settled after an average of 14 days from symptom onset, and fatigue after 20 days.[12] The findings in this study are similar to the Italian COVID-19 Post-Acute Care Study.[3] Fatigue, breathlessness, joint pain, and reduced QoL were the most common problems observed in that prospective study involving 143 individuals. Our study in addition measures the severity of symptoms and rehabilitation needs of the individuals. We have also investigated the difference between ward and ICU-managed individuals.

Current literature on previous coronavirus outbreaks also suggests similar postdischarge symptoms. A systematic review and meta-analysis of the short- and long-term clinical outcomes after SARS and MERS identified respiratory compromise, reduced exercise tolerance, PTSD, and reduced QoL as key issues in survivors, which can persist up to 12 months after hospital discharge.[4] However, our results contrast with an early report of COVID-19 postdischarge symptoms, which emerged from China.[13] A prospective cohort study of 131 COVID-19 patients who had been discharged from hospital in Wuhan found that by 3 to 4 weeks postdischarge 86% of patients were symptom-free, only 1.5% had shortness of breath and 0% had fatigue. This study had a younger population (median age 49) with less comorbidity than that presented in our study; however, the magnitude of the differences seen between these findings suggest additional factors. The fact that this study was oriented around detecting ongoing transmissibility, and patients were also questioned on their quarantine status and contacts raises the possibility of underreporting.

Fatigue is a multidimensional health problem, which overlaps with breathlessness, cognitive dysfunction, and psychological distress as demonstrated in this study (those with moderate or severe fatigue

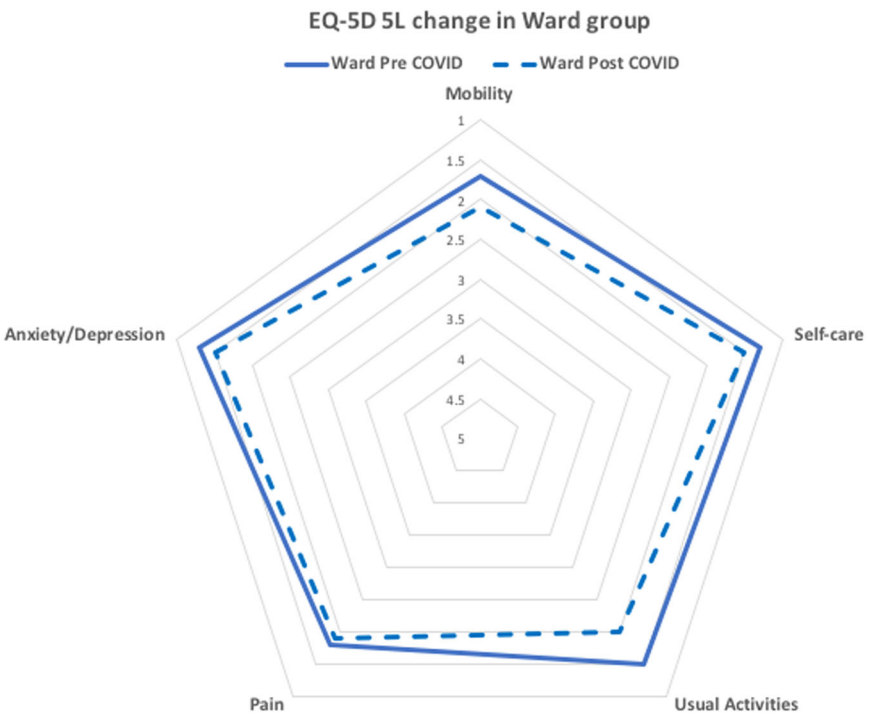

FIGURE 2 EQ-5D 5 L scores in the ward group pre- and post-COVID-19 (each domain of EQ-5D 5 L is scored on a 5-point scale: 1, no problem; 2, slight problem; 3, moderate problem; 4, severe problem; and 5, unable to do)

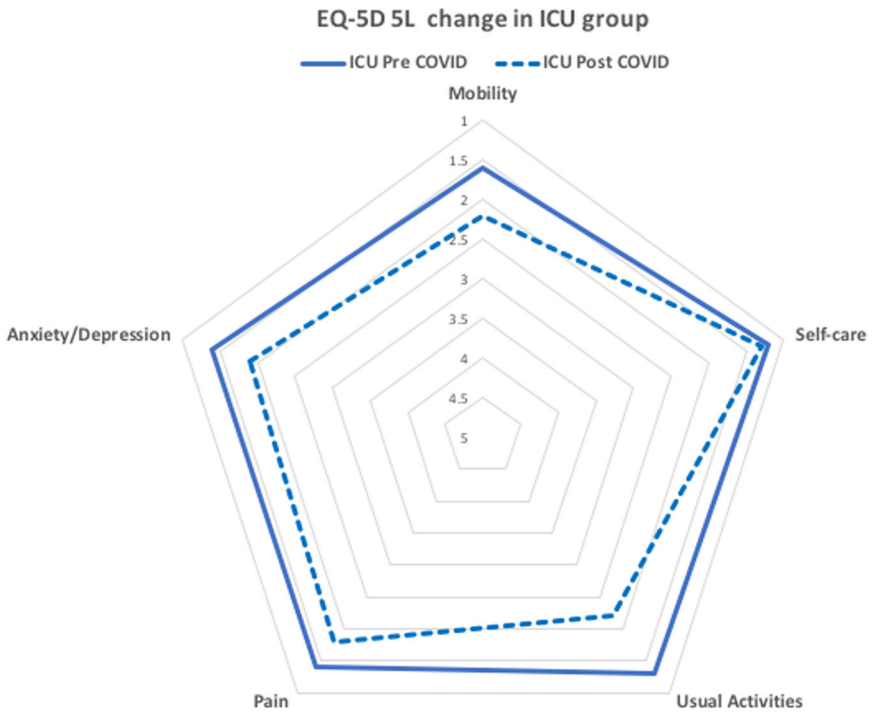

FIGURE 3 EQ-5D 5 L scores in the intensive care unit group pre- and post-COVID-19 (each domain of EQ-5D 5 L is scored on a 5-point scale: 1, no problem; 2, slight problem; 3, moderate problem; 4, severe problem; and 5, unable to do)

had higher incidence of these symptoms). The prevalence of fatigue is in keeping with previous epidemics of SARS, H1N1, and Ebola, in which a large proportion of fatigued patients have been found to qualify for a diagnosis of Myalgia Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS).[14] More than half of a sample of patients recovering from SARS experienced fatigue throughout their recovery 64% reported fatigue at 3 months, 54% at 6 months, and 60% at 12 months.[15]

Breathlessness secondary to acute respiratory distress syndrome (ARDS) and lung parenchymal infiltration disease is an anticipated symptom that can persist long-term after discharge. Our study has demonstrated that those needing ICU admission and respiratory support, premorbid lung problems, higher age, higher BMI, and BAME ethnicity are more likely to experience breathlessness post-discharge. The prevalence is comparable to those reported in the meta-analysis study of 11% to 45% of survivors having breathlessness even up to 12 months.[4] This is also in keeping with computed tomography findings of pulmonary fibrosis that has been reported to persist up to 7 years after discharge.[16]

This study found levels of PTSD symptomology to be twice as high in ICU patients compared to ward patients. This prevalence is in keeping with the meta-analysis study that found that a third of survivors of previous coronavirus epidemics having psychological conditions such as PTSD, depression, and anxiety beyond 6 months of discharge.[4] PTSD symptoms are a well-recognized component of post-ICU syndrome caused by a variety of factors including fear of dying, invasive treatment, pain, delirium, inability to communicate, weakness, immobility, and sensory problems and sleep deprivation.[17]

Post-illness cough and voice changes were higher in the ICU group and are in keeping with a recent report describing the care needs of those affected by Covid-19, which highlights that patients with a diagnosis of ARDS often experience airway inflammation, epithelial damage, and heightened cough reflex sensitivity.[18] The reasons for loss of appetite in COVID-19 patients are purported to include the gastrointestinal problems, including diarrhea, vomiting, and abdominal pain, which are commonly reported symptoms in COVID-19 patients.[19]

Exercise tolerance problems or reduction in daily activities ability is also multifactorial similar to fatigue. There is overlap with symptoms of breathlessness, cognition, and psychological distress as seen in this study. Whether there are cardiac abnormalities contributing to exercise intolerance remains to be explored in future research. A systematic review of outcomes from previous coronavirus epidemics highlighted that 41% of patients had a reduced aerobic capacity at 3 months postillness.[4] ICU acquired weakness in patients with acute lung injury has been found to persist in 14% of patients at 12 months.[20] This is likely to contribute to the reduction in daily activities ability seen in this cohort of COVID-19 patients.

As the EQ5D measure is a reflection of mobility, self-care, usual activities, pain/discomfort, and psychological symptoms, the clinically significant decrease seen in this cohort reflects the impact of the illness on quality of life and health burden to the economy. The previous outbreaks of SARS and MERS used SF-36 to measure health-related QOL and showed a significantly low quality of life at 1 year, lower than the quality of life of those with chronic conditions (using normative data).[4] Given the high prevalence of breathlessness, fatigue, and psychological symptoms, it is not a surprise that there is a significant impact on fitness for work. One study found that two-thirds of previously employed ICU-survivors are jobless up to 3, 6, 12, and 60 months following hospital discharge.[21]

Patients admitted to ICU in this study had a greater prevalence of symptoms in almost all reported symptom domains, despite being a younger and less comorbid group. This is in keeping with the well-characterized post-intensive care syndrome.[22] Studies of previous coronavirus epidemics have reached contrasting conclusions on whether long-term pulmonary dysfunction is more common in ICU patients than ward patients.[23,24] Further reporting of outcomes in ICU COVID-19 survivors is needed as these impairments are likely to result in a substantial burden in terms of reduced physical function and quality of life.

This study has some limitations. The MDT made use of telephone calls as a method of contact, which allowed for data collection during a restrictive lockdown period; however, this created limitations on being able to contact certain participants, such as those with dementia, learning difficulties, non-English speakers. Selected participants were those who had been diagnosed with a positive PCR swab result of COVID-19 while as an inpatient within LTHT; however, patients who had a negative swab result but who were likely to have COVID-19 based on clinicoradiological criteria were not included in this study. This study does not include COVID-19 survivors who were not hospitalized. It is likely that non-hospitalized COVID-19 survivors will have different rehabilitation needs to those who were hospitalized and this merits further investigation.

The presence of comorbidity in some of those interviewed may have impacted on symptoms reported. Due to the necessity of gathering this information in real-time as the pandemic unfolded, patients with a longer inpatient admission time, such as those intubated in ICU are underrepresented in our cohort as they remained in hospital at the time of this follow-up. Telephone contact was made as a single point of follow-up. This method of data collection does not capture how problems evolve over time, and further follow up at 3, 6, or 12 months would aid further understanding of the progression of symptoms post-COVID-19.

To conclude, COVID-19 is a new illness, with symptoms post-discharge yet to be researched. This study is first of its kind to capture these symptoms in a cohort of patients discharged from a large tertiary teaching hospital. New illness-related fatigue, breathlessness, and psychological distress were commonly reported with greater prevalence in those needing ICU care when compared with those managed in wards without needing ICU treatment. There was a clinically significant drop in quality of life in many participants. Rehabilitation care for COVID-19 survivors must, therefore, be need-focused, delivered by specialist MDT and planned for the longer term to meet the needs of these individuals.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

AUTHOR CONTRIBUTIONS

MS and SH conceived the study and obtained institutional approvals. All authors developed the data collection tool, gathered and analysed the data. SH and CM wrote the first draft of the manuscript. All authors contributed to and revised the manuscript. All authors read and approved the final manuscript.

ETHICS STATEMENT

Approvals were obtained from the Leeds Teaching Hospitals NHS Trust's audit office, information governance office and research and innovation department.

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REFERENCES

1. Department of Health and Social Care. Number of Coronavirus (COVID-19) cases in the UK. https://www.gov.uk/guidance/coronavirus-covid-19-information-for-the-public#number-of-cases-and-deaths. Accessed 8 July 2020.
2. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*. 2020;323(13):1239-1242.
3. Carfì A, Bernabei R, Landi F Gemelli Against. COVID-19 Post-Acute Care Study Group. Persistent symptoms in patients after acute COVID-19 [published online ahead of print July 9, 2020]. *JAMA*. 2020: e2012603.
4. Ahmed H, Patel K, Greenwood DC, et al. Long-term clinical outcomes in survivors of severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome coronavirus (MERS) outbreaks after hospitalisation or ICU admission: a systematic review and meta-analysis. *J Rehabil Med*. 2020;52:00063. https://doi.org/10.2340/16501977-2694
5. NHS-England and NHS-Improvement. After-care needs of inpatients recovering from COVID-19. https://www.england.nhs.uk/coronavirus/publication/after-care-needs-of-inpatients-recovering-from-covid-19/. Accessed 28 June 2020.
6. Zhang G, Hu C, Luo L, et al. Clinical features and short-term outcomes of 221 patients with COVID-19 in Wuhan, China. *J Clin Virol*. 2020; 127:104364. https://doi.org/10.1016/j.jcv.2020.104364
7. EuroQol. EQ-5D available upon request from https://euroqol.org/support/how-to-obtain-eq-5d/
8. World Health Organization (WHO). The International Classification of Functioning, Disability and Health. https://www.who.int/classifications/icf/en/. Accessed 8 July 2020.
9. Sivan M, Halpin SJ, Gee J. Assessing long-term rehabilitation needs in COVID-19 survivors using a telephone screening tool (C19-YRS tool). *Adv Clin Neurosci Rehabil*. 2020;19(4):14-17.
10. Nolan CM, Longworth L, Lord J, et al. The EQ-5D-5L health status questionnaire in COPD: validity, responsiveness and minimum important difference. *Thorax*. 2016;71(6):493-500.
11. Wootton DG, Dickinson L, Pertinez H, et al. A longitudinal modelling study estimates acute symptoms of community acquired pneumonia recover to baseline by 10 days. *Eur Respir J*. 2017;49:6.

12. Wyrwich KW, Yu H, Sato R, Powers JH. Observational longitudinal study of symptom burden and time for recovery from community-acquired pneumonia reported by older adults surveyed nationwide using the CAP Burden of Illness Questionnaire [published online ahead of print July 30, 2020]. *Patient Relat Outcome Meas*. 2015;6:215-223.
13. Wang X, Xu H, Jiang H, et al. The clinical features and outcomes of discharged coronavirus disease 2019 patients: a prospective cohort study [published online ahead of print May 22, 2020]. *QJM*. 2020: hcaa178. https://doi.org/10.1093/qjmed/hcaa178
14. Islam MF, Cotler J, Jason LA. Post-viral fatigue and COVID-19: lessons from past epidemics [published online ahead of print May 31, 2020]. *Fatigue Biomed Health Behav*. 2020. https://doi.org/10.1080/21641846.2020.1778227
15. Tansey CM, Louie M, Loeb M, et al. One-year outcomes and health care utilization in survivors of severe acute respiratory syndrome. *Arch Intern Med*. 2007;167(12):1312-1320.
16. Wu X, Dong D, Ma D. Thin-section computed tomography manifestations during convalescence and long-term follow-up of patients with severe acute respiratory syndrome (SARS). *Med Sci Monit*. 2016;22:2793-2799.
17. Wade D, Hardy R, Howell D, Mythen M. Identifying clinical and acute psychological risk factors for PTSD after critical care: a systematic review. *Minerva Anestesiol*. 2013;79(8):944-963.
18. Bajwah S, Wilcock A, Towers R, et al. Managing the supportive care needs of those affected by COVID-19. *Eur Respir J*. 2020;55:2000815.
19. Pan L, Mu M, Yang P, et al. Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicentre study. *Am J Gastroenterol*. 2020;115(5):766-773. https://doi.org/10.14309/ajg.0000000000000620
20. Fan E, Dowdy DW, Colantuoni E, et al. Physical complications in acute lung injury survivors: a 2-year longitudinal prospective study. *Crit Care Med*. 2014;42(4):849-859.
21. Kamdar BB, Suri R, Suchyta MR, et al. Return to work after critical illness: a systematic review and meta-analysis. *Thorax*. 2020;75(1):17-27. https://doi.org/10.1136/thoraxjnl-2019-213803
22. Stam H, Stucki G, Bickenbach J. Covid-19 and post intensive care syndrome: a call for action. *J Rehabil Med*. 2020;52:jrm00044.
23. Hui DS, Joynt GM, Wong KT, et al. Impact of severe acute respiratory syndrome (SARS) on pulmonary function, functional capacity and quality of life in a cohort of survivors. *Thorax*. 2005;60(5):401-409. https://doi.org/10.1136/thx.2004.030205
24. Ong KC, Ng AW, Lee LS, et al. Pulmonary function and exercise capacity in survivors of severe acute respiratory syndrome. *Eur Respir J*. 2004;24(3):436-442. https://doi.org/10.1183/09031936.04.00007104

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