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Health-related quality of life after 12 months post discharge in patients hospitalised with COVID-19-related severe acute respiratory infection (SARI): a prospective analysis of SF-36 data and correlation with retrospective admission data on age, disease severity, and frailty

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ABSTRACT

Long-term outcome and 'health-related quality of life' (HRQoL) following hospitalisation for COVID-19-related severe acute respiratory infection (SARI) is limited.

Objective To assess the impact of HRQoL in patients hospitalised with COVID-19-related SARI at 1 year post discharge, focusing on the potential impact of age, frailty, and disease severity.

Method Routinely collected outcome data on 1207 patients admitted with confirmed COVID-19 related SARI across all three secondary care sites in our NHS trust over 3 months were assessed in this retrospective cohort study. Of those surviving 1 year, we prospectively collected 36-item short form (SF-36) HRQoL questionnaires, comparing three age groups (<49, 49–69, and the over 69-year-olds), the relative impact of frailty (using the Clinical Frailty Score; CFS), and disease severity (using National Early Warning Score; NEWS) on HRQoL domains.

Results Overall mortality was 46.5% in admitted patients. In our SF-36 cohort (n=169), there was a significant reduction in all HRQoL domains versus normative data; the most significant reductions were in the *physical component* ($p<0.001$) across all ages and the *emotional component* ($p<0.01$) in the 49–69 year age group, with age having no additional impact on HRQoL. However, there was a significant correlation between p*hysical well-being* versus CFS (the correlation coefficient=−0.37, $p<0.05$), though not NEWS, with no gender difference observed.

Conclusion There was a significant reduction in all SF-36 domains at 1 year. Poor CFS at admission was associated with a significant and prolonged impact on physical parameters at 1 year. Age had little impact on the severity of HRQoL, except in the domains of *physical functioning* and the overall *physical component*.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is the largest study exploring the impact on health-related quality of life (HRQoL) at 1 year of recovery from hospital admission for COVID-19.
⇒ We did not choose to perform two-data point analysis, as previous studies demonstrated a clear negative impact on HRQoL in the early phases of recovery, especially in hospitalised patients.
⇒ Although our 36-item short form cohort mirrored our overall hospitalised COVID-19 population, we must be cognisant that normative UK-wide data may not truly reflect our local population, given the potential confounding impact of generational and regional demographic variances and may particularly underrepresent the significance of cultural and societal changes over recent decades.
⇒ There was no direct non-COVID comparative disease group. Nonetheless, the nature of the question was to discern whether there was any relative difference with age, frailty, and disease severity on HRQoL.
⇒ Clinical Frailty Score is not validated in the under 65 age group but does serve some utility in its limited comparative use in this study, and the results are not unexpected.

INTRODUCTION

COVID-19 has had a profound impact on global healthcare systems with huge impact on mortality and morbidity. Worldwide, there have been over 620 million cases and 6.5 million deaths related to acute severe respiratory infection (SARI) secondary to

COVID-19.[1] The UK has arguably been the seventh most impacted country, reporting over 23 million cases and 190 000 deaths,[1] despite the country's 'National Healthcare System' (NHS) being at the vanguard of developing medical interventions for COVID-19, such as steroids[2] and vaccines.[3 4] The 'first wave' of infection was associated with severe respiratory presentations requiring ventilatory support; with significant morbidity and mortality, especially in the more infirm and mature. An association between COVID-related mortality and frailty, often measured using the 'Clinical Frailty Scale' (CFS),[5] has been shown in multiple studies, with frailty a potentially better predictor of outcome than age or comorbidity.[6] In the UK, the CFS scoring was incorporated into a 'decision support tool' (online supplemental figure 1) to suggest the maximum level of respiratory support to provide to those admitted with COVID-19 infection. Meta-analyses[7] have clearly demonstrated worsening mortality with increasing CFS, 'National Early Warning Score' (NEWS),[8] male-gender and significant comorbidity, though advise caution when basing treatment decisions on CFS in patients younger than 65 years.[9]

For those who recovered from an acute hospital admission with COVID-19 and were later discharged, many developed persistent COVID-19-related physical, cognitive, and psychological symptoms later termed 'long-COVID' online supplemental table 1). Long-term impact after convalescence has been seen in other SARIs such as other coronaviruses,[10] notably 'severe acute respiratory syndrome' (SARS), in 2002, and 'middle east respiratory syndrome' (MERS) in 2012. These diseases caused persistent reduction of lung function and exercise capacity at 6 months, and 'post-traumatic stress disorder' (PTSD), depression and reduced 'health-related quality of life' (HRQoL) at 1 year.[11] Long-COVID now describes a plethora of physical and psychological symptoms.[12–14]

Several recent studies have assessed the impact on HRQoL following COVID-19, primarily within the first 3 months of recovery. Most of these HRQoL questionnaire studies report that survivors see an impact on physical and psychological functioning over the first few months of recovery.[15–17] One meta-analysis of HRQoL COVID-19 studies highlighted the psychiatric burden during the first wave, with one-third reporting depression, anxiety, and PTSD.[18] Others have described central nervous system manifestations (eg, headache, dizziness, confusion, ataxia, and seizures).[19 20] Importantly, another study of elderly patients recovering from COVID-19-related SARI highlighted the benefit of early intervention, with improved respiratory function, HRQoL, and anxiety following 6 weeks of respiratory rehabilitation.[21] A small (n=62) American study, comparing HRQoL outcomes in hospitalised versus non-hospitalised adults 6 months after COVID-19, found that hospitalisation and disease severity were associated with significantly poorer HRQoL outcomes.[22] In a recent post-COVID-19 study, there was significant deterioration in all '36-item short form survey' (SF-36) domains at 3- and 12 months when compared with the general population, especially in physical and emotional roles, with a trend towards improvement across all domains with time.[23] Moreover, in COVID-19 post-'intensive therapy unit' patients at 1 year, many self-reported both ongoing psychological and predominately physical symptoms.[24]

All agree that larger and longer follow-up studies compared with normative population data are necessary to fully understand the impact of COVID-19 on HRQoL, especially with age and disease severity. To this aim, we undertook a prospective 1 year HRQoL COVID-19 study. We employed the SF-36, which is an internationally recognised and well-validated HRQoL questionnaire,[25] previously used in other coronavirus respiratory outbreaks.[11 26] This 36 question survey enquires into indicators of physical functioning and mental and emotional well-being, such as standard activities, fatigue, emotional well-being, pain, and general health perception; and allows for comparison to national normative population data. Our study would be the largest assessing HRQoL 1 year after discharge and explores factors that may impact HRQoL, including age, disease severity, and frailty.

METHODS

Study design

We conducted a multisite prospective collection of SF-36 questionnaires to assess HRQoL of patients 12 months postdischarge from a hospital admission with COVID-19 SARI. Retrospective routine clinical data were collected to correlate the factors, on admission to hospital, that may have affected the HRQoL.

Setting

Mid and South Essex NHS Foundation Trust (MSE NHSFT) comprises of three secondary and tertiary care hospitals: Southend, Basildon, and Chelmsford Hospitals. It covers a relatively older and frailer population near London, UK.

Participants

Inclusion criteria

Patients were included if admitted between 1 March 2020 and 31 May 2020 to a hospital within the MSE NHSFT with respiratory COVID-19 infection, where infection was confirmed using nasopharyngeal swab reverse transcriptase polymerase chain reaction (RT-PCR) assay positivity and/or key clinical and radiological evidence. SF-36 questionnaires were sent to all patients alive and contactable at 12 months. The recruitment period for returned questionnaires spanned a 4 month period between 1 April 2021 and 31 July 2021. The number of respondents determined the sample size of the study. Of those with returned forms, we retrospectively collected admission data from electronic patient records (EPR) and paper clinical notes to assess the factors that may have impacted SF-36.

Exclusion criteria

Unavailability of inpatient notes, paediatric cases, pregnancy or active malignant neoplasms. Patients with likely

nosocomial COVID-19 infection were also excluded; these individuals were confirmed or highly suspected to have contracted COVID-19 after the seventh, consecutive day of an initially unrelated admission, for which admission data pertaining to COVID-19 were absent.

Variables

Clinical data using EPR and written paper notes were retrospectively collected for all patients admitted with COVID-19. Baseline demographic details included age, sex, smoking status, underlying major comorbidities, baseline vital data, NEWS[8] and CFS[5] on admission.

CFS data were collected on patients' degree of frailty using the Rockwood CFS.[5] This is an ordinal, nine-point visual scale used to assess the degree of frailty from clinical data. It ranges from very fit (CFS=1) to very severely frail (CFS=8) and terminally ill (CFS=9); with frailty usually defined as CFS>4. CFS was usually documented by the clerking doctor, using the COVID-19 *Decision Support Tool*, which was widely across the NHS (online supplemental figure 1). An estimated CFS was otherwise calculated retrospectively from documentation taken no later than the first 24 hours of admission.

National Early Warning Score (NEWS): a quick bedside assessment of the degree of a patients' illness that is not dependent on laboratory tests, which has reasonable prognostic utility and has been used in many studies of clinical outcome in hospitalised patients, including those with COVID-19. It is based on vital signs [respiratory rate, oxygen saturation, temperature, blood pressure, pulse/heart rate, and AVPU (alert, verbal, pain, and unresponsive) scale].[8]

SF-36 questionnaire on the evaluation of HRQoL

The short form-36 was used to assess eight health domains: *physical functioning* (PF), *role physical* (RP), *bodily pain* (BP), *general health* (GH), *vitality* (VT), *social functioning* (SF), *role emotional* (RE), and *mental health* (MH). Simple questions assess the impact on these domains—looking at general factors such as standard activities, fatigue, emotional well-being, pain, and general health perception, and allows for comparison to national normative population data. Scores for each domain range from 0 (worst) to 100 (best); higher scores indicate good HRQoL. Survivors at 1 year post hospitalisation for COVID, at MSE NHSFT, were sent a SF-36 questionnaire and 'patient information sheet'. Return of a completed voluntary SF-36 questionnaire constituted informed consent. Of the (n=1207) patients, (n=559) died. At the time of the prospective recruitment for SF-36, only (n=500) were alive and contactable. Of the (n=500), we received (n=204) completed questionnaires. We included (n=169) patients in the analysis (incomplete questionnaire were excluded). Please see flow chart.

Bias

Baseline SF-36 data on admission was not collected as it was unfeasible to do so in critically unwell patients. To reduce inequality of response rates from frailer or more unwell patients, proxy (in the way of relatives, etc) was offered as an option to support response rates to improve access to the recruitment.

Patient and public involvement

To allow for acquisition of ethics approval, we received advice from the 'Clinical Research Network (North Thames) patient champions' (voluntary patient representatives). They reviewed research practices across our trust during the development of the initial study questions and design. They were invited to review the study protocol and provide comments as patient advocates.

Statistical analysis

Continuous variables were expressed as mean (±SD) or median (±IQR) and categorical variables were expressed as number (%). One-way analysis of variance or Kruskal–Wallis tests were used to compare different age groups on SF-36 data. Pearson's correlation coefficients were used to assess the correlations between variables. Missing retrospective data were excluded in group analysis and only confirmed data points were used. Given the lack of formal control group, multivariate analyses were not performed. Stata statistical software was used for data analysis.

RESULTS

Over a 3 month period, from 1 March 2020 to 31 May 2020, general demographic and clinical data were retrospectively collected across MSE NHSFT for all patients hospitalised with COVID-related SARI. Of the 1207 patients with COVID-related SARI at our Trust, the overall mortality reached 46.5% (559/1207) by time of SF-36 recruitment, consistent with the 40%–50% national mortality rate for COVID-related SARI at this earlier stage of the pandemic.[27] Collection of full demographic and clinical data for the whole (n=1207) cohort enabled us to validate our outcomes against national outcome norms.[27]

Prospective SF-36 Questionnaire: there were 500 patients who were alive and contactable at 1 year post discharge at the time of the prospective recruitment for HRQoL data who were sent SF-36 questionnaires. We received 204 postal and/or telephonically communicated responses (41% response rate). Of these, there were 35 enquiries (via e-mail, letter and/or telephone calls) to explain non-response and/or reason for exclusion (online supplemental figure 2), with a complete lack of response from a further 296. Therefore, 169 patients (responders) appropriately completed the SF-36 HRQoL questionnaire and were included for further analyses, and equally, there were 331 non-responders. The basic demographic data were similar for both age and sex between responders (63% male, 37% female; average age 66), and non-responders (60% male, 40% female; average age of 69).

Importantly, the demographic and clinical characteristics of the SF-36 cohort were similarly reflective of the whole study population. Of the 169 responders, 63%

were males and 37% were females; 24.2% (n=41) were confirmed former or current smokers. The median number of days from symptom onset to hospitalisation was 8 (4–14). The median number of days of hospitalisation was 14 (3–16). Common findings on chest CT (table 1) were pulmonary opacities (39.0%), pulmonary infiltrates (34.9%), bilateral and peripheral changes (34.3%), with progressive abnormalities in 12.4%. From the SF-36 responders, participants were categorised into three groups based on their age; 24 (14%) were under 49 years of age, 80 (47%) were aged between 49 and 69 years, and 65 (38%) were over 69 years of age.

Comorbidities

Comorbidities (table 2) were generally more common in the >69 age group, of which 88% (n=57/65) had between 2 and 4 comorbidities, compared with 73% (n=58/80) in the 49–69 age group, and only 21% (n=5/24) in the under 49s (online supplemental table 2). Thus, 79% (n=19/24) of the <49 age group had 1 or fewer comorbidities. There was a significant increase in the number comorbidities (table 2) when comparing the under 49s versus the 49–69 group (p<0.001) and the over 69s (p<0.01). No clear statistical difference was observed between the latter two, older age groups (p=0.19). Those with greater comorbidity were of increasing age (table 2), with the mean number of comorbidities in the 49–69 group being 1.65) versus>2 in the over 69s. The most common comorbidities in the whole SF-36 cohort (table 2) were hypertension (43%, n=73/169), chronic cardiac heart disease (22%, n=37/169), chronic pulmonary disease (17%, n=28/169), asthma (15%, n=25/169), and diabetes without complications (15%, n=25/169), which again were comparable to UK normative data.[27] Other less common comorbidities were obesity (14%, n=23/169), chronic kidney disease (8%, n=13/169), chronic neurological disorders (8%, n=13/169), diabetes with complications (6%, n=10/169), rheumatological disorders (4%, n=6/169), and moderate or severe liver disease (2%, n=3/169).

Management

As per the NICE-approved 'COVID-19 Decision Support Tool', which was widely adopted by UK NHS hospitals throughout the pandemic, patients over 69 years of age, especially those with significant comorbidity, typically received ward-based care as their 'ceiling' of respiratory support. This consisted of standard oxygen therapy or high-flow nasal cannula oxygen therapy, in addition to standard of care management (eg, antibiotics, fluids, etc). In the over 69-year-olds, the majority had significant COVID-related SARI that required high-flow oxygen, but only one received critical care support, compared with nearly all 49–69 year-olds necessitating high-flow oxygen and critical care support with invasive ventilation (p=0.01) (table 1). The over 69-year-olds had longer lengths of stay but this was non-significant, higher rates of readmission, and greater need for domiciliary placement. Transfer

Table 1 Demographics and treatment and outcomes of the SF-36 cohort

		N (%)	
		(n=169)	
Age (years):			
<49		24 (14)	
49–69		80 (47)	
>69		65 (38)	
Gender:			
Male		106 (63)	
Female		63 (37)	
Symptom onset to hospitalisation		Median (IQR): 8 (4–14) days	
Smoking status:			
Current		8 (6)	
Former		33 (23)	
Never		50 (35)	
Missing		78 (46)	
Number of days in the hospital		Median (IQR): 7 (3–16) days	
Chest XR and/or CT consistent with COVID (specific findings):			
Pulmonary infiltrates		59 (35)	
Bilateral and peripheral changes		58 (34)	
Consolidative pulmonary opacities		66 (39)	
Small effusion		8 (5)	
Linear opacities		12 (7)	
Progressively more bilateral with time/ disease severity		21 (12)	
Age groups (years)			
	<49	49–69	>69
	(n=24)	(n=80)	(n=65)
Oxygen therapy:			
Oxygen therapy	0	19	22
High-flow nasal cannula oxygen therapy	11	40	36
Required ICU:			
Invasive ventilation	6	11	1
ICU/HDU admission	7	20	6
Readmission	4	14	10
Domiciliary placement:			
Transfer to other facility	0	4	6
Palliative discharge	0	0	2
Return to care home	0	6	6
Home with increased care package	0	3	6
Home with oxygen therapy	0	1	2
Community bed temporary	2	5	14
Same as before	22	61	31

In the over 69-year-olds, the majority had significant COVID-related SARI to require high-flow oxygen, but only one received critical care support, compared with almost all 49–69-year-olds necessitating high-flow oxygen and critical care support with invasive ventilation.
ICU, intensive care unit; SARI, severe acute respiratory infection; SF-36, 36-item short form; XR, X-ray.

Table 2 Type of comorbidities by age group (in SF-36 cohort)

Comorbidities	Age groups			P values
	<49	49–69	>69	
Hypertension	6 (27.3%)	35 (44.3%)	32 (50.0%)	p=0.18
Chronic cardiac heart disease (not hypertension)	1 (4.6%)	11 (13.9%)	25 (39.1%)	p<0.001
Chronic pulmonary disease (not asthma)	2 (9.1%)	12 (15.2%)	14 (21.9%)	p=0.39
Asthma (physician diagnosed)	4 (18.2%)	13 (16.5%)	8 (12.5%)	p=0.72
Chronic kidney disease	0	2 (2.6%)	11 (17.2%)	p=0.003
Moderate or severe liver disease	1 (4.6%)	1 (1.3%)	1 (1.6%)	p=0.52
Chronic neurological disorder	0	6 (7.6%)	7 (10.9%)	p=0.26
Obesity (as defined by clinical staff)	1 (4.6%)	19 (24.1%)	3 (4.7%)	p=0.001
Diabetes	4 (26.1%)	22 (27.9%)	10 (15.6%)	p=0.52
Rheumatological disorder	1 (12.5%)	3 (25.0%)	2 (16.7%)	p=0.86
Smoking:				
Current	4 (22.2%)	3 (4.4%)	1 (1.8%)	p=0.001
Former	0	15 (22.1%)	18 (32.1%)	
Never	4 (22.2%)	30 (44.1%)	16 (28.6%)	
No of comorbidities	Age<49	49–69	>69	Total
0	13	19	8	40
1	6	21	19	46
2	3	19	16	38
3	1	16	14	31
4	1	2	8	11
5	0	2	0	2
6	0	1	0	1

Shows the comorbidities by type and stratified by age group. Comorbidities were substantial in our cohort, with over 78.2% of the over 49s having more than 2. As expected, the number of comorbidities increased with age. The most common comorbidity was hypertension (n=73; 43.2%). The second-most common comorbidity was chronic cardiac heart disease (37, 21.8%), followed by chronic pulmonary disease (n=28; 16.5%), asthma (n=25; 14.8%), and diabetes without complications (25, 15.15%), respectively.
%, percentage; n, number; SF-36, 36-item short form.

to another facility, increased care package, domiciliary oxygen, and temporary community bed requirement were also more commonly required in the >69 age group (table 1).

HRQoL outcomes

We examined the physical and mental components 1 year post hospitalisation. The sample was compared with population data. Mean SF-36 scores for the normative population and patients, stratified by age, are summarised in table 3. Lower scores on the SF-36 reflect poorer health. Overall, all age groups reported poorer health on all domains of the SF-36 except for pain. Across all age groups, there was a significant (p<0.05) reduction in nearly all HRQoL SF-36 domains, after 1 year of convalescence following hospitalisation for COVID-19-related SARI. There was little comparative difference of individual SF-36 domains between age groups except for a significant difference in *physical functioning* and the *physical component* summary between age>69 and both age<49 and age 49–69 (table 4).

Relationship between physical and mental well-being with CFS and NEWS

There was positive correlation between CFS and the *physical component* of SF-36 HRQoL, p<0.05 (table 5).

DISCUSSION

This is the largest COVID-19 HRQoL cohort study in a hospitalised UK population, assessing the longer term impact on HRQoL of COVID-related SARI survivors and focusing on the impact of age and frailty on well-being.

One of the first important findings from our study is that in patients admitted with COVID-related SARI, even after 1 year of convalescence and recovery, is a significant reduction across all HRQoL domains, especially in the physical domain. A 2021 systematic review of prior COVID-19 HRQoL peer-reviewed literature[28] included 4408 patients across 21 studies. Only a few were prospective cohort studies assessing HRQoL, typically between 2

Table 3 SF-36 mean (SD) compared with normality (normative population data)

SF-36 domains	Age<49	Age 49–69	Age>69
Physical functioning	63.69 (30.9)	55.19 (31.8)	37.78 (32.6)
Normality	89.45 (p<0.001)***	71.85 (p<0.001)***	46.4 (p<0.05)*
Role limitations due to physical health	54.35 (47.5)	42.31 (44.9)	32.07 (43.2)
Normality	89.3 (p<0.01)**	72.7 (p<0.01)**	49.35 (p<0.01)**
Role limitations due to emotional problems	65.3 (44.5)	53.8 (45.3)	52.3 (47.2)
Normality	91.85 (p<0.01)**	84.7(p<0.01)**	75.4 (p<0.01)**
Energy/fatigue	46 (24.6)	41.1 (26.6)	41.6 (27.1)
Normality	58.35 (p<0.05)*	55.15 (p<0.01)**	48.6 (p<0.05)*
Emotional well-being	62 (24.3)	65.49 (23.2)	68.98 (21.5)
Normality	72.55 (p<0.05)*	73.15 (p<0.01)**	74.5 (p<0.05)*
Social functioning	60.42 (35.3)	58.9 (33.1)	51.1 (36.6)
Normality	85.5 (p<0.01)**	76.9 (p<0.01)**	67.85 (p<0.01)**
Pain	61.3 (36.7)	57.05 (29.8)	54.4 (31.4)
Normality	77.4 (p<0.05)*	63.45 (p=0.062)	55.15 (p=0.86)
General health	53.69 (24.9)	47.7 (26.02)	44.56 (23.3)
Normality	71.85 (p<0.01)**	61.4 (p<0.01)**	55.3 (p<0.01)**

SF-36 mean (SD) compared with normality (normative population data): across all age groups, there was a significant and persistent reduction in nearly all HRQoL SF-36 domains after one year of convalescence and recovery following hospitalisation for COVID-19 SARI.
**P<0.05, **p<0.01 and ***p<0.001,when compared against normative UK population data for age.
HRQoL, health-related quality of life; SARI, severe acute respiratory infection; SF-36, 36-item short form.

and 12 weeks post hospitalisation, with none 6 months or beyond.

To have a comparator to draw some potentially useful conclusions, our SF-36 data were compared with normative population data. Furthermore, the nature of the question was to discern whether there was any relative difference with age and frailty on the background of growing evidence from clinical studies showing the direct impact of COVID-19 on longer term HRQoL. Although other factors could have an impact on HRQoL, one of this study's virtues is that it can provide some baseline post-COVID-19 data for future studies to compare to. Longitudinal data are increasingly invaluable to our understanding of the support needed to improve health and social care accordingly. One such study by Cinel *et al* reported a significant worsening of EQ-5D domains (ie, mobility, self-care, usual activities, pain, and anxiety) compared with normative data, with no significant

Table 4 Impact of age on HRQoL domains (using SF-36); mean (SD)

SF-36 domains	Age<49	Age 49–69	Age>69	P value
Physical functioning	63.69 (30.9)	55.19 (31.8)	37.78 (32.6)	0.0012**
Role limitations due to physical health	54.35 (47.5)	42.31 (44.9)	32.07 (43.2)	0.11
Role limitations due to emotional problems	65.3 (44.5)	53.8 (45.3)	52.3 (47.2)	0.48
Energy/fatigue	46 (24.6)	41.1 (26.6)	41.6 (27.1)	0.75
Emotional well-being	62 (24.3)	65.49 (23.2)	68.98 (21.5)	0.41
Social functioning	60.42 (35.3)	58.9 (33.1)	51.1 (36.6)	0.36
Pain	61.3 (36.7)	57.05 (29.8)	54.4 (31.4)	0.66
General health	53.69 (24.9)	47.7 (26.02)	44.56 (23.3)	0.33
Physical component summary	43.3 (12.56)	38.64 (12.37)	33.72 (11.93)	0.025*
Mental component summary	44.0 (13.2)	43.64 (12.97)	46.01 (12.93)	0.71

Impact of age on HRQoL domains (using SF-36): there was little comparative difference of individual SF-36 domains between age groups except for a significant difference in physical functioning and the physical component summary between age>69 and both age<49 and age 49–69.
*P<0.05 and **p<0.01, when compared against differing study cohorts for age (mean (SD)).
HRQoL, health-related quality of life; SF-36, 36-item short form.

Table 5 Correlation between physical and mental well-being vs clinical CFS and NEWS (in SF-36 cohort)

	Physical component	Mental component	CFS	NEWS
Physical component	1.00	–	–	–
Mental component	0.36*	1.00	–	–
CFS	−0.37*	−0.03	1.00	–
NEWS	−0.06	0.17	−0.08	1.00

The correlations between the variables (correlation coefficients) of Clinical Frailty Score (CFS) and National Early Warning Score (NEWS) vs 2 domains of the HRQoL SF-36 questionnaire identified as significant compared with normative population data, independent of age.
*P<0.05 compared SF-36 physical component domain.
HRQoL, health-related quality of life; SF-36, 36-item short form.

improvement by 3 months across all EQ-5D domains, except for insomnia.[29] Another small longitudinal study of ventilated COVID-19-related SARI survivors, by Corenzo *et al*, reported early mild/moderate functional impairment and reduced HRQoL at 1 month.[30] By 6 months, mobility, self-care, and ADLs all improved, but pain, depression, and anxiety worsened.[30] As with Cinel *et al*, they further reported symptoms of PTSD soon after discharge from hospital.[30] Such longitudinal data indicate that with time, although physical functioning may potentially improve, the impact on mental functioning persists or even worsens.

Concerningly, however, our data show the pervasive impact of COVID-19 long after resolution of the acute infection, due to a persistent plethora of both physical and psychosocial factors. This is invaluable data given most COVID-19 HRQoL studies have been relatively small, and not necessarily focused on previously hospitalised COVID-19 survivors. Furthermore, despite the impact of COVID-19 in the UK, there have been limited HRQoL COVID-19 studies to date assessing the impact versus UK normative data. Additionally, most HRQoL studies have focused on younger cohorts,[29 30] which is limiting given the obvious differential impact on ageing populations. Despite this bias, Nandasena *et al*[28] reported that seven of 21 COVID-19 studies identified age as a factor associated with lower HRQoL. This is especially relevant to places like the UK, where age and frailty were key factors to decisions over treatment escalation. Again, our study provides novel comparative age-related data in this regard.

The SF-36 questionnaire was our preferred test due to its overall robustness, although Rowen *et al*[31] highlight that models mapping SF-36 onto EQ-5D in a UK cohort have similar predictive value. SF-36 survey was the preferred health questionnaire tool used instead of others, such as the EQ-5D, as it was felt to have a more detailed review of mental components as it was suspected that COVID-19 had a significant impact on the psychological quality of life as well as physical. Nandasena *et al*[28] report that one-third of COVID-19 HRQoL studies utilised SF-36, and when compared with normative population data, there was a worsening in all eight subscales. Furthermore, like our study findings, the *physical domain* was the most affected in those studies, though other less comparable studies do report more impact on non-physical domains. An explanation for this could be that most of these other studies included a significantly higher population of non-hospitalised and younger survivors, who inherently have fewer physical symptoms than hospitalised SARI patients. It is likely, therefore, that especially in older, frailer survivors, who made up a more considerable number in our study cohort, physical decline was differentially important to their overall well-being. This was similarly reported by Case *et al*, who observed in mainly Latin-X COVID-19 patients, older age was significantly associated with poorer physical function, pain interference and social function.[32]

Female sex,[28] increasing age and comorbidity, and socioeconomic factors were frequently associated with reduced HRQoL.[28 33] However, we did not observe a difference in HRQoL outcome between the sexes, which may simply reflect that many of the other studies reporting a sex-related difference included study cohorts with a higher proportion of non-hospitalised females, with perceived differential impact on emotional domains[34] and socioeconomic considerations. With respect to disease severity, in a UK-based study looking at the impact of ward-based versus intensive care unit (ICU) care, over a mean follow-up period of 48 (29–71) days,[35] breathlessness and psychological distress were the most common symptoms reported, with a significant fall in EQ-5D scores, especially in those admitted to ICU.[35] Another 2022 UK-based study reports that HRQoL remains poor between 2 and 4 and then 7–14 months post discharge in symptomatic patients, although including both hospitalised and non-hospitalised COVID patients.[36] Another large study reports that a third report≥1 persistent physical symptoms at 6 months,[37] and in post-ICU patients persistent and significant impairment of physical function and global mental health scores at 6 months.[38]

Interestingly, Figueiredo *et al*[33] observed that improvements in HRQoL post discharge are independent of imaging improvement and disease severity at hospital admission. In our SF-36 cohort, only CFS, and not NEWS, correlated with the *physical component*. This alludes to the greater differential impact of comorbidity and frailty on HRQoL during recovery. There are many COVID-19 studies showing that patients with high NEWS are more likely to deteriorate or die but even a recent UK study indicated that NEWS underestimates in-hospital mortality in COVID-19 versus non-COVID-19 admissions.[39] So,

although NEWS has been widely used throughout the pandemic, it has largely only demonstrated moderate prognostic performance in patients with severe disease,[40] with our study findings consistent with this opinion.

In regard to any potential limitation of this study, one must address that there was no direct non-COVID comparative disease group. Nonetheless, the nature of the question was to discern whether there was any relative difference with age, frailty, and disease severity on HRQoL in patients with COVID-19. It is important to acknowledge that critical illness and hospitalisation in general will have a demonstrable impact on HRQoL and with the global health and socioeconomic impact of COVID-19, and hurried research into its impact on HRQoL may potentially overestimate the differential impact of this disease over all others. Moreover, given the inherent nature of studies into the well-being of surviving COVID-19 patients, we do not have baseline SF-36 or any HRQoL scores for individuals prior to admission. This makes interpretation of the comparative impact of COVID-19 on any individual's recovery more subjective; this may be particularly pertinent to the more mature and frailer cohort, with higher CFS and the number of comorbidities associated with worsening HRQoL. Of interest, a recent study report suggests that retroactively obtained pre-COVID-19 EQ-5D-5L responses were acceptable with respect to population norms and could allow for direct examination of COVID-19's impact on health-related QoL.[41] Also, relevance of HRQoL studies is inherently dependent on the comparison of questionnaire data against normative cohort population data,[42] which may lack social and geographical considerations.[43]

In conclusion, this study primarily adds to the growing understanding of the prolonged impact on HRQoL in survivors of COVID-19-related SARI following discharge from hospital. Moreover, this study clearly reflects persisting impairment of physical and psychological functioning at 1 year post discharge, despite the strengths of a comparatively well-funded NHS and social care networks. Furthermore, this study supports more recent reports of the relative impact of frailty, rather than age and presenting disease severity, on prognosticating poor clinical outcome and, ultimately, mortality from COVID-19. Follow-up of recovering COVID-19 patients must therefore include a comprehensive assessment for long-COVID detection and appropriate multidisciplinary and multiagency approaches towards improving their physical, psychological, and social functioning. Provision of physical rehabilitation and psychosocial support, and action on broader socioeconomic and societal considerations may well be necessary to hopefully restore COVID-19 survivors to a more normal level of overall well-being. Further clinical, epidemiological, and immunological studies, involving larger cohorts over a longer period of follow-up, are necessary to improve our understanding and preparation for potential future outbreaks. The findings of this study may be useful to researchers, policymakers, and clinicians to develop effective strategies to improve post-COVID-19 patient care.

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