Dialogues in Health 2 (2023) 100124

Contents lists available at ScienceDirect

Dialogues in Health

journal homepage: www.elsevier.com/locate/dialog

Long-term quality of life and work ability among severe COVID-19 survivors: A multicenter study

Anshul Jain [a,*], Prashant Gupta [b], Apurva Abhinandan Mittal [c], Narendra Singh Sengar [d], Rachna Chaurasia [e], Neeraj Banoria [f], Arvind Kankane [g], Arpita Saxena [h], Brijendra [a], Mrinal Sharma [i]

[a] Department of Anaesthesiology, Maharani Laxmi Bai Medical College, Jhansi 284128, India
[b] Department of Surgery, S.N Medical College, Agra 282002, India
[c] Department of Anaesthesiology & Critical Care, S.N Medical College, Agra 282002, India
[d] Department of Nephrology, Maharani Laxmi Bai Medical College, Jhansi 284128, India
[e] Department of Radiodiagnosis, Maharani Laxmi Bai Medical College, Jhansi 284128, India
[f] Department of Surgery, Maharani Laxmi Bai Medical College, Jhansi 284128, India
[g] Department of Neurology, Maharani Laxmi Bai Medical College, Jhansi 284128, India
[h] Department of Anaesthesiology, S.N Medical College, Agra 282002, India
[i] Department of Anaesthesiology, S.N Medical College, Agra 284128, India

ARTICLE INFO

Keywords:
Quality of life
Workability
COVID-19
Sleep quality

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19), is known for its variable severity and high infectivity. Though fewer than 15% of infected cases develop severe disease, a major proportion had prolonged stay in the intensive care unit (ICU). Prolonged ICU stay is known to have a long-term impact on behavior and quality of life.[8] Therefore, it is likely that patients discharged after severe COVID-19 have issues that persist for long term. The current study aimed to assess the long-term impact of severe COVID-19 on the Quality of life (QOL), sleep pattern, behavior, and workability.

Methods: The current multicenter study adopted a cross-sectional design to analyze data from two tertiary care COVID-19 dedicated hospitals. All experimental procedures were approved by the ethics committee of the M.L.B Medical College. Participants were 20–60 age group who had been admitted to the ICU because of severe COVID-19 and had elapsed at least one and a half year since their discharge. After informed written consent the participants were assessed for: EUROHIS-QOL 8-item index; Workability Score; Quality of sleep; The major depression inventory (MDI) questionnaire; Generalized anxiety disorder 7 item scale (GAD-7); Current global health status score: an innovative subjective scale (1 –10) to determine the current global health status when 5 is the status before COVID-19.

Findings: 491 participants were assessed, the median follow-up time after discharge from the hospital was 561·0 days (range, 548–580 days). The mean duration of ICU stay was 8.72 ± 2.85 days. There was significant reduction in the prevalence of obesity, diabetes, and hypertension as compared with discharge time. The mean of EUROHIS-QOL score, workability score, current global health status score was 3.28 ± 0.98, 6.87 ± 0.85, 4.53 ± 1.36 respectively. The mean MDI and anxiety scores were 4.12 ± 1.45 and 18.63 ± 3.28, respectively.

Interpretation: Severe COVID-19 survivors have new-onset psychological disorders and sleep disturbances. Long term quality of life and work ability remains poor after prolong ICU admission secondary to severe COVID-19.

1. Introduction

The year 2020 marked the beginning of the coronavirus disease 2019 (COVID-19), the first pandemic of the 21st century. COVID-19, caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is known for its variable severity and high infectivity [1,2]. Even after measures such as lockdown and strict mask application, the vaccination drive pandemic is far away from the ending point. By the end of 2021, more than 300 million people were infected with SARS-CoV-2 globally [3]. Indian epidemiology of COVID-19 resembles global epidemiology in terms of spread and clinical features [4,5].

At the end of December 2021, the cumulative number of COVID-19 cases in India was over 30 million, with over four Lakh deaths, most of which occurred in the second wave caused by the delta variant of

* Corresponding author at: AH-2/9 Veerangna Nagar, Jhansi 284128, India.
E-mail address: dranshuljain81@gmail.com (A. Jain).

http://dx.doi.org/10.1016/j.dialog.2023.100124
Received 13 May 2022; Received in revised form 10 March 2023; Accepted 10 March 2023
Available online 14 March 2023

SARS-CoV-2 [5]. Though fewer than 15% of infected cases develop severe disease and land in a critical state, as the number of infected cases raised the number of serious cases raised too. The average length of hospital stay for patients with severe COVID-19 ranged from 17 to 30 days [6,7]. A major proportion of severe patients had prolonged stay in the intensive care unit (ICU). Prolonged ICU stay is known to have a long-term impact on behavior and quality of life [8]. The disability that remains after surviving the critical illness is known as post-intensive care syndrome (PICS) and it comprises impairment in cognition, mental health, and physical function after critical illness [9]. Therefore, it is likely that patients discharged after severe COVID-19 require health assistance in the future.

It is important to estimate the long-term outcomes of severe COVID-19 survivors to predict the burden on the healthcare system in the near future. In India, the first wave of COVID-19 affected over 5 million patients, peaking between the second week of August and September 2020. Many patients discharged with severe COVID-19 have been discharged for more than one and a half year, and they form the subject in whom the actual long-term impact of severe COVID-19 could be assessed. Quality of life (QoL), workability, sleep-related measures, and psychiatric outcomes are primary in defining the well-being of critically ill survivors [8,10].

The current study aimed to assess the long-term impact of severe COVID-19 on the QOL, sleep pattern, behavior, workability, overall satisfaction rating, and to suggest the adequate reference of the problems identified.

2. Methodology

2.1. Study design and participants

The current multicenter study adopted a cross-sectional design to assess QOL and other parameters. All experimental procedures were approved by the ethics committee of the M.L.B Medical College and S.N Medical College. Informed written consent was obtained from all participants. Participants were 20–60 age group who were admitted to the intensive care unit (ICU) because of severe COVID-19 and had elapsed eighteen months since their discharge from the hospital. The current study combines data from two tertiary care COVID-19 dedicated teaching hospital with over 200 ICU beds situated approximately 250 km apart. Both, the centres adopted World Health Organization COVID-19 disease severity classification for the categorization of COVID-19 [11].

2.2. Sample size

In the current study, all eligible participants were admitted to a dedicated COVID-19 hospital ICU between July 2020 and September 2020 in both study centers and were discharged before October 15, 2020. Only participants in whom SARS-CoV-2 was detected by reverse transcription-polymerase chain reaction (RT-PCR) were included in the study.

2.3. Exclusion criteria

Participants who gave negative consent for the study, those who denied reporting to the study center, those with laboratory-confirmed repeat SARS-CoV-2 infection, and those with any of the following conditions at the time of admission: pregnancy, patients undergoing dialysis, patients with cancer undergoing chemotherapy, end stage liver disease, and patients with a history of open heart surgery, patient with mild and moderate COVID-19 admitted to ICU for some other reason.

ICU admission criteria and defining criteria for severe COVID-19 are common for both hospitals and include any of the following:

1. Clinical signs of pneumonia (fever, cough, and breathlessness) plus one of the following: respiratory rate > 30 breaths/min, severe respiratory distress, or oxygen saturation (SpO_2) < 90% on room air;
2. Signs of multi-organ involvement include altered sensorium, decreased urine output, heart rate > 120/min, cold extremities, or low blood pressure (systolic BP < 90 mmHg or diastolic BP < 60 mmHg);
3. Laboratory evidence of coagulation abnormalities, thrombocytopenia, acidosis (pH < 7·25), lactate level > 2 mmol/L, or hyperbilirubinemia.

2.4. Intervention and evaluation

A study center was created in the Department of Anesthesiology and Critical Care of both the hospitals and a dedicated medical team comprising anesthesiologist, physician and neurologist was created for this study. Team accessed medical records of subjects of the subjects who were discharged between July 2020 to 15th October 2020 from the dedicated COVID-19 hospital. The study team attempted to make appointments for all eligible participants. Participants were asked to report to dedicated study center. The participants had to undergo brief medical examinations and medical interviews by a dedicated medical team.

The following parameters were assessed:

1. EUROHIS-QOL 8-item index: this index was used to assess QoL. EUROHIS-QOL 8-item index, a shortened version of the WHOQOL-BREF scale, is a validated score for the assessment of QOL [12–14]. EUROHIS-QOL 8-item index measures general, physical, psychological, social, and environmental domains of QOL. The study participants were asked to answer the questions of the EUROHIS-QOL index, every question was given a score ranging from 1 (very poor) to 5 (very good). The mean EUROHIS-QOL score was derived by adding all individual scores and dividing the sum by 8 [10] (Table 1). Higher score suggest better QOL.
2. Workability Score: the first item of the well-established workability index, the workability score, is a subjective scale that rates the ability to work on a 0–10 response scale, where 0 stands for complete inability to work and 10 relates to workability at lifetime best [15] (Table 1).
3. Quality of sleep: Three components of the Pittsburgh sleep quality (PSQ) index were used to assess sleep quality. The PSQ is a validated index with seven components determined by 19 self-rated questions [16,17]. Global PSQI score was quantified as per the instructions of PSQI and it ranges between 0 (no difficulty in sleep) and 21 (severe difficulty in sleep). The participant who were consuming any medication (before having COVID-19) for psychiatric or sleep-related issues, were excluded from the scoring. Participants who had been prescribed any psychiatric or sleep related medication on regular basis after COVID-19 were also excluded from the scoring and were notified separately. Participants who were taking any on counter sedative were included for the analysis of quality of sleep as per PSQ. Authors quantify frequency of bad dreams separately too in complete set of participants.
4. Psychological evaluation: the major depression inventory (MDI) questionnaire was used to assess depression (if any). The MDI generates a score of 0–50, where a score up to 20 is considered normal, 21–25 is suggestive of mild depression, 26–30 signifies moderate depression, and scores exceeding 30 suggest severe depression [18]. Generalized anxiety disorder 7 item scale (GAD-7) was used to assess anxiety in the participants. The GAD-7 generates a score of 0–21, categorized as normal (0–4), mild (5–9), moderate (10–14), or severe anxiety (>14) [19]. If the participant was consuming any psychiatric medication, the participant was excluded from the psychological evaluation and notified separately.
5. Satisfaction Rating: the authors developed a subjective Likert scale to determine the overall satisfaction rating of current health status when 5 is the status before COVID-19. Participants were required to grade their current global health status on a scale ranging from 1 to 10 (Table 1). The score was called as current global health score (CGHS).
6. Addiction: all participants were interviewed for alcohol, tobacco chewing, and smoking.
7. Physical examination: the participants were examined for height, weight, body mass index (BMI), pulse rate, and blood pressure. Patients taking any hypertensive medication were quantified, and

Table 1
Scoring methods and their details used in current study.

EUROHIS-QOL 8-item index					
Question 1	How would you rate your quality of life:				
Response	very poor	poor,	neither poor nor good	good, or	very good?
Score	1	2	3	4	5
Question 2	How satisfied are you with your health:				
Response	very dissatisfied	dissatisfied	neither satisfied nor dissatisfied	satisfied	Very satisfied
Score	1	2	3	4	5
Question 3	Do you have enough energy for everyday life:				
Response	not at all	a little	moderately	mostly	completely
Score	1	2	3	4	5
Question 4	How satisfied are you with your ability to perform your daily living activities:				
Response	very dissatisfied	dissatisfied	neither satisfied nor dissatisfied	satisfied	very satisfied
Score	1	2	3	4	5
Question 5	How satisfied are you with yourself: very dissatisfied, dissatisfied, neither satisfied nor dissatisfied, satisfied, or very satisfied?				
Response	very dissatisfied	dissatisfied	neither satisfied nor dissatisfied	satisfied	very satisfied
Score	1	2	3	4	5
Question 6	How satisfied are you with your personal relationships ?				
Response	very dissatisfied	dissatisfied	neither satisfied nor dissatisfied	satisfied	very satisfied
Score	1	2	3	4	5
Question 7	Have you enough money to meet your needs ?				
Response	not at all	a little	moderately	mostly	completely
Score	1	2	3	4	5
Question 8	How satisfied are you with the conditions of your living place ?				
Response	very dissatisfied	dissatisfied	neither satisfied nor dissatisfied	satisfied	very satisfied
Score	1	2	3	4	5
EUROHIS-QOL mean score = Total Score/8					

Work Ability Score										
Current Work Ability compared with lifetime best on 0-10 response scale										
0	1	2	3	4	5	6	7	8	9	10
Unable to work										Work Ability at its best

Current global health score				
1	2	3	4	5
Worst	Very Bad	Bad	Mild Deterioration	Same as before COVID-19
6	7	8	9	10
Fair	Good	Very good	Extremely good	Life time best

Work Ability Score Grading: poor for scores of 0–5, moderate for scores of 6–7, good for scores of 8–9 and excellent for a score of 10 points.

their data were not included in the statistical analysis of pulse rate and blood pressure.

8. Laboratory investigation: an optional blood sample for glycosylated hemoglobin (HbA1c) was taken from participants who mentioned themselves as non-diabetic or cured of COVID-19 related diabetes. An HbA1C level of 6·5 mg/dl was used as the cut-off point.

Hospital records of all participants were accessed to find out the comorbidities and demographic details at the time of admission and discharge.

2.5. Statistical analysis

Continuous variables were expressed either as mean ± 2 standard deviation (SD) or median (interquartile range (IQR)) values; categorical variables were expressed as proportions and percentages (%). The BMI at the time of hospital admission was compared with the current BMI using a paired *t*-test. The prevalence of hypertension and diabetes was compared using the chi-squared test. Statistical significance was set at $P < 0{\cdot}05$. The covariance analysis was performed using Pearson's test.

All statistical tests were performed using Statistical Package for the Social Sciences (SPSS) software for MAC OS (version 22; IBM SPSS Inc., Chicago, IL, USA).

3. Results

A total of 737 patients diagnosed with severe COVID-19 who were admitted to a dedicated COVID-19 intensive care unit between July 2020 and September 2020 and for whom more than 18 months had elapsed since discharge as on 10th April 2022 were selected for the study. A total of 647 patients met the inclusion criteria, among which 79 patients were excluded based on the exclusion criteria. The remaining 568 participants were called for participation, out of which 32 passed away after discharge, 14 declined to participate and 17 eligible participants could not be contacted, providing a final number of 491 participants, as shown in the Strobes flow diagram (Fig. 1). The median follow-up time after discharge from the hospital was 561·0 days (range, 548–580 days). The mean duration of hospital stay was 14·51 ± 5·37 days, and ICU stay was 8·72 ± 2·85. As per the records, diabetes was the commonest associated medical ailment at the time of both admission and discharge.

At the time of the study, 66.80% ($n = 328$) (male: 192; female: 136) participants were taking medical treatment for at least one medical ailment. Hypertension was the most common ailment for which participants were taking medication. The demographic variables and the prevalence of diabetes, obesity, and hypertension at the time of admission to the hospital; discharge from the hospital and at the time of the study are shown in Table 2. Statistical analyses revealed a significant reduction in the prevalence of obesity and diabetes when compared with admission data. However, prevalence of hypertension was reduced when compared with discharge data.

The mean EUROHIS-QOL score of the participants was 3·28 ± 0·98 (Table 3). The mean score was comparable in both centers and between sexes. The EUROHIS score was higher in the younger age group (18–40) than the overall mean. The mean workability score was found to be 6·87 ± 0·85 and was negatively correlated with age, GAD, and anxiety scores. The maximum proportion of the participants fell in the category of moderate workability (65·37%); 16·49% ($n = 91$) of participants had poor workability (Table 3a). The duration of hospital stay had no impact on QOL and workability scores. However, the duration of ICU stay exhibits inverse relationship with QOL and Workability score so is invasive mechanical ventilation. Duration of mechanical ventilation pose significant negative impact on the QOL and work ability (Table 3b). Seventy nine out of eighty-six subjects (91.8%) who had reported QOL score < 2 were treated with invasive mechanical ventilation.

Analysis of sleep quality revealed that 6.51% ($n = 32$) of participants (female: 14, male: 18) had been prescribed some sedative or other psychiatric medication post COVID-19. Twelve participants (2.44%) were taking sedatives prior to ICU admission. The difference was highly significant. The global PQSI score among the remaining participants was 9·96 ± 3·31, the sleep score was found to be higher in females than in all mean, and the difference was found to be statistically significant. The quality of sleep was found to be poor in participants with a duration of hospitalization of more than 20 days and in older adults. (Table 4) PQSI score exhibit negative relationship with the duration of ICU stay too. The prevalence of bad dreams was found to be very high, with 71·84% (324 of 491) of participants having bad dreams at least once a week. The prevalence of poor sleep was higher among women.

Psychological evaluation was also performed in the same subgroup ($n = 459$), and the mean MDI and anxiety scores were 4·12 ± 1·45 and 18·63 ± 3·28, respectively (Table 4). Women had a higher mean MDI score than the overall mean, and the difference was statistically significant. Anxiety and depression scores were also found to be higher in older adults (age > 50 years) and were negatively correlated with sleep quality. The covariance analysis revealed a negative correlation between QOL and age (Correlation coefficient: - 0.57) and a positive correlation with workability (Correlation coefficient: 0.34).

Current global health status score revealed a mean score of 4·03 ± 1·29; 72.91% ($n = 358$) of participants reported deterioration in their overall health compared with their pre-COVID-19 health status and scored less than five. 17.51% ($n = 86$) participants reported no differences and scored 5. (Table 3). The remaining 9.57% of participants ($n = 47$) reported improvement in the overall health. Maximum number of participants ($n = 139$) falls in the category of score 3. Age wise distribution of CGHS yields inverse relationship and there was no difference between the CGHS of male and female participants. (Fig. 2).

At the time of study a total of 131 participants were taking at least one antihypertensive medication, as per which the prevalence of known hypertensives was 26·68%. Cardiovascular examination of the remaining patients revealed a mean heart rate of 92·37 ± 6.81; males had a higher pulse rate than females, and the difference was found to be statistically significant. A total of 5.70% ($n = 28$) participants had tachycardia at the time of examination. The incidence of tachycardia was found to be higher in females than males (5·59% vs. 6·93%). The mean blood pressure of the cohort was higher in the male population than in the female population, and 12 (males: 7; females: 5) participants met the criteria for hypertension. Notifying them as having hypertension resulted in an overall prevalence of hypertension of 29·12%. (Table 2), which was significantly lower than the prevalence of hypertension at the time of discharge. However, when compared to admission data the change was not statistically significant. As per addiction details at the time of the study, 72 participants (males: 57; females: 15) were alcoholics, 24 (males: 20; females: 4) were smokers, and 44 (males: 25; females: 19) were tobacco chewers. When the study time data were compared with hospital records, there was a significant reduction in all types of addiction (Table 5).

Diabetes was a known ailment in 108 participants; from the remaining 383, 289 opted for HbA1C estimation, among which 24 were found to have diabetes. Applying the same prevalence rate (8·3%) for the remaining participants resulted in a total number of 140 patients with suspected diabetes, yielding a prevalence of 28·51%, which was significantly less when compared to the prevalence at the time of hospitalization and discharge.

4. Discussion

ICU admission is known to cause long-term psychological and health issues. Under the current scenario, severe SARS-CoV-2 infection is the most common cause of ICU admission and is often associated with a prolonged ICU stay. According to various studies, ICU admission may be required in 3 to 8% of COVID-19 cases [5,20–21]. The current study evaluated the long-term sequelae of severe COVID-19 one and half year after discharge. The multicenter approach of the current study eliminates center-related bias. The authors chose to perform an observational study over a prospective study because they do not want to interfere with the course of the disease, as in the case of a prospective study, the advice given will modify the course of the disease. In the current study authors assessed measured

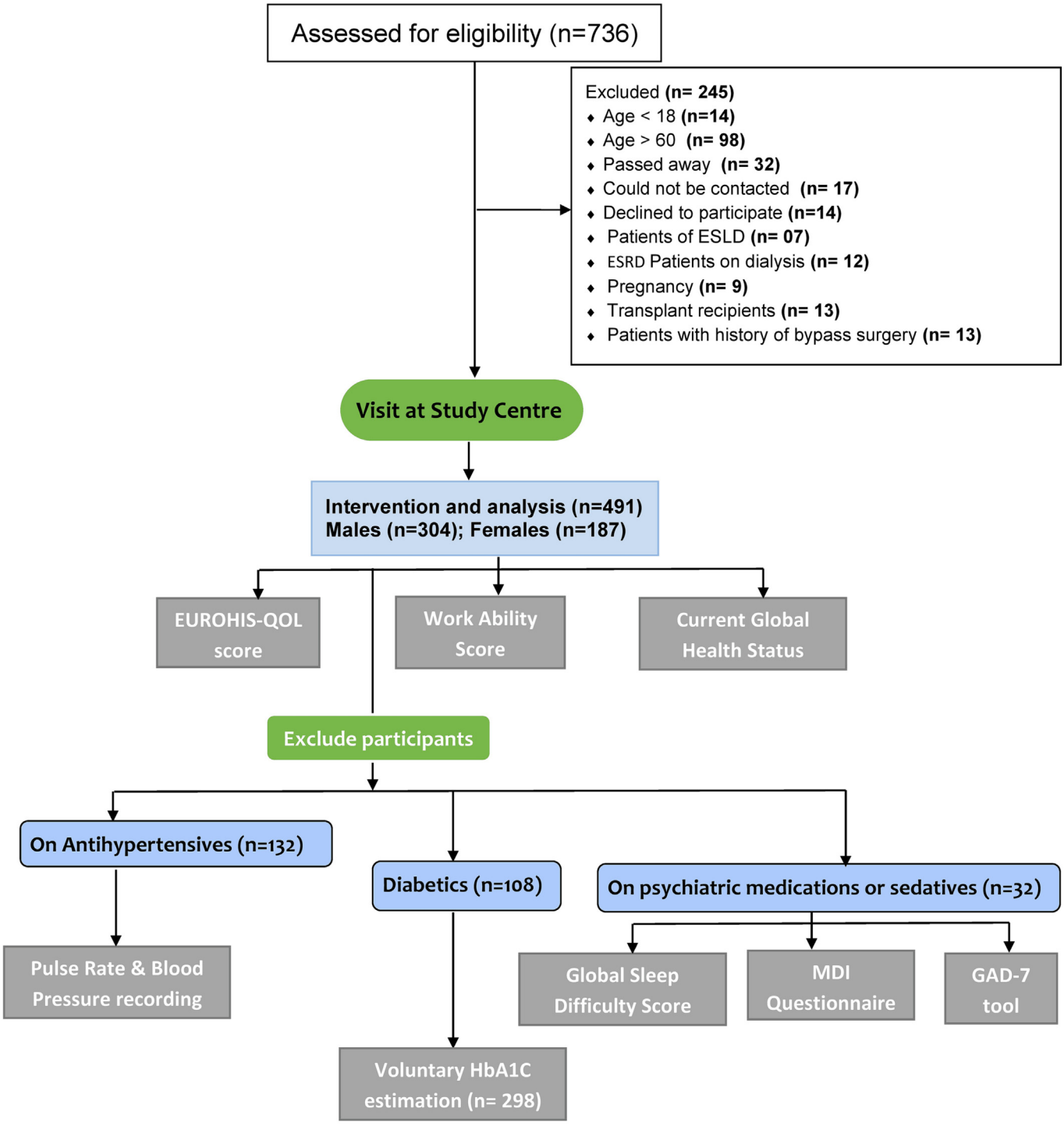

Fig. 1. Strobes flow diagram.

multiple parameters, innovative scales to assess the long-term health sequelae and QOL in ICU discharge patients who recovered from severe COVID-19.

According to the current study, a substantial number of patients develop new psychiatric and sleep-related issues, a significant number of participants started sleep medications post-discharge. Sleep quality is poor among elder participants and those with prolong hospitalization. These findings are in accordance with those of previous studies [22–25]. Chaolin et al. performed the first long-term follow-up of SARS-CoV-2 infections and their ambidirectional cohort study, which enrolled 1733 patients with COVID-19 with varied severities from a single-center, among which 10 patients were in a severe category [22]. According to their interpretations, many COVID-19 survivors, experience fatigue or muscle weakness, sleep difficulties, anxiety, or depression. The finding correlates with the results published by *Mohamed Abdelghani* et al. who concluded sleep disturbances as a potential sequelae of COVID-19 [23]. Isolation remains an integral part of the treatment of COVID-19, and isolation results in anxiety, stress, and social confinement that could explain sleep problems even after mild or asymptomatic SARS-CoV-2 infection. ICU admission itself contributes to sleep disturbances by affecting the biological clock, as postulated in many studies [24,25]. Bad dreams and nightmares are known occurrences after a prolonged ICU stay, and the published literature has mentioned that up

Table 2
Demographic Variables and medical ailments at the time of study and at the time of admission.

Variable	At the time of admission	At the time of study	'p' Value#	At the time of discharge	'p' Value@
Age	52.21 ± 7.32	57.22 ± 8.53	NA	52.23 ± 7.31	NA
Male (n = 304)	48.35 ± 8.18	49.46 ± 8.02	NA	48.35 ± 8.18	NA
Female (n = 187)	54.13 ± 5.17	55.15 ± 5.21	NA	54.13 ± 5.17	NA
Height (in metres)	1.52 ± 0.21	1.51 ± 0.23	0.13	1.52 ± 0.21	NA
Weight (in kg)	67.23 ± 14.38	63.84 ± 18.46	0.023	66.83 ± 16.47	0.031
Mean ± 2SD					
BMI (Kg/m^2)	29.56 ± 9.87	26.18 ± 8.94	<0.0001	29.31 ± 10.09	<0.0001
Mean ± 2SD#					
Prevalence of Obesity (BMI > 30 kg/m2) in %	40.93 (n = 201)[a]	21.58% (n = 106)	0.0001	39.71 (n = 195)	0.0001
Hypertension	30.14% (n = 148)[a]	29.12% (n = 143)	0.48	33.19% (n = 163)	0.03
Diabetes	45.01% (n = 221)[a]	28.51% (n = 140)[b]	<0.0001	65.98% (n = 324)	<0.0001

#: Current value compared with that at the time of admission.
@: Current value compared with that at the time of discharge.
a: Known hypertensives (those who were taking antihypertensive medication)at the time of admission.
b: Sum of subjects who mentioned themselves to be diabetics at the time of study were categorized as diabetics and subjects whose HbA1C level exceeds 6.5 mg/dl.

Table 3
Distribution of EUROHIS QOL scoring and self-reported workability among participants.

Parameter	EUROHIS QOL score		Work ability Score	
	Mean ± 2SD	'p' value (Compared to over all mean)	Mean ± 2SD	'p' value (Compared to over all mean)
All participants	3.28 ± 0.98	NA	6.87 ± 0.85	NA
Distribution according to gender				
Male	3.31 ± 1.01	0.32	6.86 ± 0.81	0.12
Female	3.26 ± 0.91	0.54	6.92 ± 0.92	0.09
Distribution according to age				
18–40 years (n = 103)	3.51 ± 0.76	<0.001	6.99 ± 0.87	0.01
40–50 years (n = 187)	3.40 ± 0.91	0.06	6.82 ± 0.91	0.18
50–60 years (n = 201)	3.19 ± 1.04	0.051	6.79 ± 0.97	0.046
Distribution according to duration of hospital stay				
<10 days (n = 154)	3.24 ± 0.82	0.315	6.91 ± 0.82	0.29
10–20 days (n = 198)	3.33 ± 0.91	0.19	6.84 ± 0.78	0.37
>20 days. (n = 139)	3.30 ± 0.86	0.25	6.92 ± 1.06	0.30
Distribution according to duration of ICU stay				
<3 Days (n = 98)	3.49 ± 0.76	0.73	7.09 ± 0.89	0.3
3–7 Days (266)	3.12 ± 0.87	0.033	6.82 ± 0.91	0.18
>7 Days (n = 127)	2.91 ± 0.81	0.001	5.63 ± 0.99	<0.001
Distribution according to the history of mechanical ventilation				
Invasive mechanical ventilation used (109)	1.87 ± 0.92	0.001	5.42 ± 0.87	<0.001
Invasive mechanical ventilation not used (382)	3.39 ± 0.81	0.063	7.18 ± 0.90	0.01

Table 4
Distribution of Sleep Quality; MDI score; Anxiety score in participants who are not taking any psychological medication and its Relationship with demographic variables.

Variable		Global PSQI score	'p' value#	MDI Score	'p' value#	Anxiety Score	'p' value#
All participants (n = 459)		9.96 ± 3.31	NA	4.12 ± 1.45	NA	18.63 ± 3.28	NA
Males (= 286)		8.91 ± 2.97	0.21	4.09 ± 1.34	0.56	18.39 ± 3.99	0.03
Females (n = 173)		11.89 ± 3.08	0.042	4.82 ± 1.73	<0.01	19.03 ± 4.26	0.04
Hospital Stay	<10 days (n = 146)	6.81 ± 3.73	0.1	4.02 ± 1.02	0.96	18.36 ± 3.02	0.10
	10–20 days (n = 177)	7.80 ± 3.75	0.053	4.19 ± 1.33	0.26	18.32 ± 4.58	0.055
	>20 days (n = 126)	12.76 ± 4.92	0.032	4.17 ± 1.52	0.31	19.12 ± 4.92	0.007
Age	18–40 years (n = 98)	6.56 ± 3.86	0.03	3.98 ± 0.89	0.06	18.24 ± 2.90	0.02
	40–50 years (n = 172)	7.2 ± 3.47	0.78	4.03 ± 1.18	0.14	18.85 ± 3.92	0.15
	50–60 years (n = 189)	13.23 ± 3.66	0.002	4.26 ± 1.18	0.16	19.35 ± 5.42	0.001
Duration of ICU stay	<3 days	6.37 ± 2.98	0.07	3.86 ± 1.12	0.03	17.23 ± 2.17	0.001
	3–7 days	7.93 ± 3.15	0.021	4.17 ± 1.32	0.78	19.01 ± 3.21	0.12
	>7 days	14.24 ± 4.10	<0.001	4.93 ± 1.34	0.03	20.67 ± 3.69	<0.001
History of Mechanical ventilation	Yes	10.09 ± 3.27	0.03	4.86 ± 1.19	0.001	20.73 ± 3.41	<0.001
	No	9.23 ± 2.13	0.04	3.99 ± 1.04	0.03	17.62 ± 4.01	0.003

#: p value between the categorical mean compared to over-all mean.

to one-third of patients experience bad dreams even after 2 years of discharge [25]. Current study also demonstrates linear relationship between QOL and sleep quality, the same had been demonstrated in many previous studies [26,27].

Authors adopted the EUROHIS-QOL 8-item index for the assessment of quality of life. EUROHIS-QOL-8 item index is easy to interpret and exhibit good qualities in terms of consistency irrespective of the geographical distribution, sex and age. As per the findings QOL was found to be poor in elders, in whom invasive mechanical ventilation was used and in subjects with prolong ICU admission. The findings are in accordance to the published literature which had found poor quality of life even after ten years of discharge [27–28]. As per the results of current study too, authors

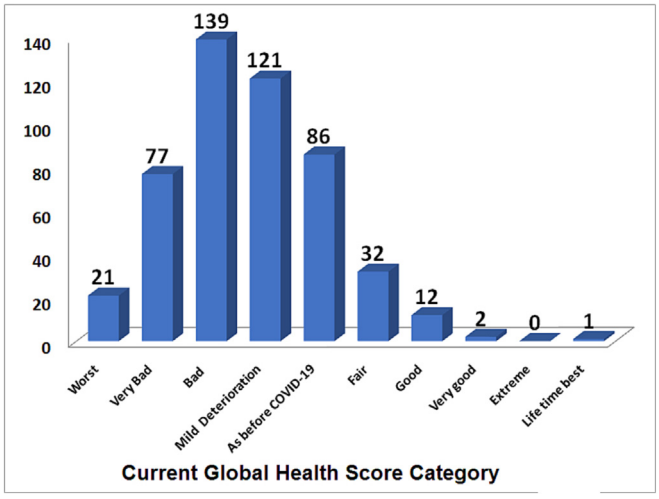

Fig. 2. Characteristics of current global health status among participants.

suggest to minimize the duration of invasive mechanical ventilation and the ICU stay.

In the current study, we used an innovative two-bidirectional generic scale to quantify the overall health status according to the patient. According to this scale, few subjects reported improvement in their overall health in comparison to their health before they developed COVID-19. The current study also revealed a reduction in the prevalence of obesity (BMI > 30 kg/m^2). These findings can be explained by the fact that the population is overall more oriented towards a healthy lifestyle. Second, media agencies are publishing significant research on the deleterious effect of obesity on COVID-19. This generated an overall positive response, which is evident in the population. Third, defeating severe COVID-19 itself generates a positive feeling, and participants are inclined towards a healthy lifestyle. This also explains the reduction in the proportion of alcohol users and smokers.

The reduction in the prevalence of diabetes can be explained by pathophysiology and management guidelines for severe COVID-19. Lim et al. (2021) reviewed COVID-19 and diabetes mellitus, and according to the review, COVID-19 itself predisposes individuals to hyperglycemia [29]. Severe inflammatory response also increases glycogenic hormones and insulin resistance and contributes to diabetes in severe SARS-CoV-2 infections [29–30]. Further, there is increasing evidences that SARS-Co-2 infections lead to new-onset diabetes mellitus [31,32]. Moreover, steroid therapy is an integral part of the management of severe COVID- 19, which is also a major contributor to diabetes in patients with COVID-19 [33,34]. The current study is the first study that tries to quantify the prevalence of hypertension and diabetes in severe COVID-19 survivors after 1 and a half years of discharge. According to the findings prevalence of hypertension was low at the time of admission and increased at the time of discharge and further reduced at the time of study. The finding can explained by the possibility that a large number of subjects may have undiagnosed hypertension at the time of admission as at the time of admission prevalence was quanitifed by subjects taking antihypertensive medication, secondly steroid therapy, stress of isolation may also contributory. Post discharge there is reduction in the prevalence of hypertension which could be due to relief from the anxiety and stress of severe disease and social isolation. Moreover. SARS-CoV-2 infection plays a direct role in the development of hypertension via several pathogenic mechanisms [35].

According to these findings, severe COVID-19 poses a long-term impact on workability, and >15% participants had reported poor workability, which can be explained by poor functional impairment and reduced mobility due to restricted pulmonary reserve. Destin et al. (2021) reviewed the long-and short-term sequelae of SARS-CoV-2 infection and concluded that mental health issues, mobility impairments, and pulmonary abnormalities were the most common long-term sequelae of SARS-CoV-2 infection [36].

The findings of the current study have a few limitations. First, the study was conducted only on approximately 500 participants, which is far less than the population that recovered from severe COVID-19. Second, a bidirectional generic scale was used for overall satisfaction rating of current health status that has not yet been validated. Third, the authors relied only on history and minimal physical examination and laboratory results and had not advised any investigations. Therefore, in view of these limitations, a multicenter study with laboratory and radiological investigations should be carried out to re-assess the results and provide more robust conclusions.

5. Conclusion

Severe COVID-19 survivors have new-onset psychological disorders and sleep disturbances. The prevalence of diabetes and hypertension and obesity in severe SARS-CoV-2 infection survivors reduced significantly, after 1 and a half years of discharge. Long term quality of life and work ability remains poor after prolong ICU admission secondary to severe COVID-19.

Source of funding

Government of Uttar Pradesh.

Table 5
Details of blood pressure; pulse rate and addiction.

Parameter	At the time of discharge/ admission#	At the time of follow-up			'P' Value*
		All participants	Male	Females	
Addiction (number of patients)					
Smoking	69	24	20	4	<0.001
Tobacco chewing	57	44	25	19	<0.001
Alcohol	99	72	57	15	<0.001
Cardiovascular Examination (Excluding those on anti-hypertensive medication)					
Mean blood pressure (mm of Hg) (mean ± 2SD)	98.23 ± 9.97 (n = 305)	102.41 ± 9.23 (n = 355)	104.27 ± 10.21 (n = 208)	96.57 ± 9.34 (n = 147)	0.46
Pulse Rate (bpm) Mean ± 2SD	97.63 ± 8.24	92.37 ± 6.81	95.28 ± 6.42	92.45 ± 7.39	0.024

#: Admission data was used for Addiction; Discharge data was used for cardiovascular examination.
*: At the time of admission/discharge vs mean value of all participants at the time of follow-up.

Contribution details

	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6	Author 7	Author 8	Author 9	Author 10
Concepts	✓	✓	✓	✓	✓		✓			
Design	✓	✓	✓	✓	✓		✓			
Definition of intellectual content	✓	✓	✓	✓	✓		✓			
Literature search	✓	✓	✓	✓	✓		✓			
Interviewing participant						✓		✓	✓	✓
Examination of participants						✓		✓	✓	✓
Data Acquistation						✓		✓	✓	✓
Data Analysis	✓	✓	✓	✓						
Manuscript preparation	✓	✓	✓	✓	✓	✓	✓			
Manuscript editing	✓	✓	✓	✓	✓	✓	✓			
Manuscript review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Guarantor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Sharma A, Tiwari S, Deb MK, Marty JL. Severe acute respiratory syndrome coronavirus-2 (-SARS-CoV-2): a global pandemic and treatment strategies. Int J Antimicrob Agents. 2020;56(2):106054. https://doi.org/10.1016/j.ijantimicag.2020.106054.

[2] Cascella M, Rajnik M, Aleem A, et al. Features, evaluation, and treatment of coronavirus (COVID-19) [Updated 2022 Feb 5]. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan Available from: https://www.ncbi.nlm.nih.gov/books/NBK554776/.

[3] https://covid19.who.int/. Accessed on 16th April 2022.

[4] Srivastava N, Baxi P, Ratho RK, Saxena SK. Global trends in epidemiology of coronavirus disease 2019 (COVID-19). Coronavirus Disease 2019 (COVID-19); 2020. p. 9–21. Published 2020 Apr 30. https://doi.org/10.1007/978-981-15-4814-7_2.

[5] Asrani P, Eapen MS, Hassan MI, Sohal SS. Implications of the second wave of COVID-19 in India. Lancet Respir Med. 2021 Sep;9(9):e93–4. https://doi.org/10.1016/S2213-2600(21)00312-X. Epub 2021 Jun 30. PMID: 34216547; PMCID: PMC8245060.

[6] Rees EM, Nightingale ES, Jafari Y, et al. COVID-19 length of hospital stay: a systematic review and data synthesis. BMC Med. 2020;18:270. https://doi.org/10.1186/s12916-020-01726-3.

[7] Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. EClinicalMedicine. 2021 Aug;38:101019. https://doi.org/10.1016/j.eclinm.2021.101019. Epub 2021 Jul 15. PMID: 34308300; PMCID: PMC8280690.

[8] Carr AJ, Gibson B, Robinson PG. Measuring quality of life: is quality of life determined by expectations or experience? BMJ. 2001;322(7296):1240–3. https://doi.org/10.1136/bmj.322.7296.1240.

[9] Ramnarain D, Aupers E, den Oudsten B, Oldenbeuving A, de Vries J, Pouwels S. Post intensive care syndrome (PICS): an overview of the definition, etiology, risk factors, and possible counseling and treatment strategies. Expert Rev Neurother. 2021 Oct;21(10):1159–77. https://doi.org/10.1080/14737175.2021.1981289. Epub 2021 Sep 22. PMID: 34519235.

[10] Cuthbertson BH, Roughton S, Jenkinson D, Maclennan G, Vale L. Quality of life in the five years after intensive care: a cohort study. Crit Care. 2010;14(1):R6. https://doi.org/10.1186/cc8848.

[11] World Health Organization. COVID-19 clinical management: living guidance, 25 January 2021. World Health Organization; 2021. https://apps.who.int/iris/handle/10665/338882 License: CC BY-NC-SA 3.0 IGO.

[12] Schmidt S, Mühlan H, Power M. The EUROHIS-QOL 8-item index: psychometric results of a cross-cultural field study. Eur J Public Health. 2006 Aug;16(4):420–8. https://doi.org/10.1093/eurpub/cki155. Epub 2005 Sep 1. PMID: 16141303.

[13] WHOQOL Group. The world health organization quality of life assessment (WHOQOL): development and general psychometric properties. Soc Sci Med. 1998;46:1569–85.

[14] THE WHOQOL GROUP. Development of the world health organization WHOQOL-BREF quality of life assessment. The WHOQOL group. Psychol Med. 1998;28:551–8.

[15] Ilmarinen Juhani. The work ability index (WAI). Occup Med. March 2007;57(2):160. https://doi.org/10.1093/occmed/kqm008.

[16] Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28:193–213.

[17] Popević MB, Milovanović APS, Milovanović S, Nagorni-Obradović L, Nešić D, Velaga M. Reliability and validity of the Pittsburgh sleep quality index-Serbian translation. Eval Health Prof. 2018 Mar;41(1):67–81. https://doi.org/10.1177/0163278716678906. Epub 2016 Nov 28. PMID: 27899687.

[18] Bech P, Rasmussen NA, Olsen LR, Noerholm V, Abildgaard W. The sensitivity and specificity of the major depression inventory, using the present state examination as the index of diagnostic validity. J Affect Disord. 2001 Oct;66(2–3):159–64. https://doi.org/10.1016/s0165-0327(00)00309-8. [PMID: 11578668].

[19] Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006 May 22;166(10):1092–7. https://doi.org/10.1001/archinte.166.10.1092. [PMID: 16717171].

[20] Phua J, Weng L, Ling L, et al. Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations [published correction appears in lancet Respir med. 2020 may;8(5):e42]. Lancet Respir Med. 2020;8(5):506–17. https://doi.org/10.1016/S2213-2600(20)30161-2.

[21] Team NCPERE. Vital surveillances: the epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) – China. China CDC Weekly. 2020;2(8):113–22.

[22] Huang C, Huang L, Wang Y, Li X, Ren L, Gu X, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. Lancet. 2021 Jan 16;397(10270):220–32. https://doi.org/10.1016/S0140-6736(20)32656-8. Epub 2021 Jan 8. PMID: 33428867; PMCID: PMC7833295.

[23] Abdelghani M, Alsadik M, Abdelmoaty A, Atwa S, Said A, Hassan M. Sleep disturbances following recovery from COVID-19: a comparative cross-sectional study in Egypt. East Mediterr Health J. 2022 Jan 31;28(1):14–22. https://doi.org/10.26719/emhj.22.006. [PMID: 35165874].

[24] Altman MT, Knauert MP, Pisani MA. Sleep disturbance after hospitalization and critical illness: a systematic review. Ann Am Thorac Soc. 2017;14(9):1457–68. https://doi.org/10.1513/AnnalsATS.201702-148SR.

[25] Roberts BL, Rickard CM, Rajbhandari D, Reynolds P. Patients' dreams in ICU: recall at two years post discharge and comparison to delirium status during ICU admission. A multicentre cohort study. Intensive Crit Care Nurs. 2006 Oct;22(5):264–73. https://doi.org/10.1016/j.iccn.2006.02.002. [Epub 2006 Mar 20. PMID: 16549347].

[26] Lo CM, Lee PH. Prevalence and impacts of poor sleep on quality of life and associated factors of good sleepers in a sample of older Chinese adults. Health Qual Life Outcomes. 2012 Jun 18;10:72. https://doi.org/10.1186/1477-7525-10-72. PMID: 22709334; PMCID: PMC3445836.

[27] Lee S, Kim JH, Chung JH. The association between sleep quality and quality of life: a population-based study. Sleep Med. 2021 Aug;84:121–6. https://doi.org/10.1016/j.sleep.2021.05.022. Epub 2021 May 27. PMID: 34147026.

[28] Rai R, Singh R, Azim A, Agarwal A, Mishra P, Singh PK. Impact of critical illness on quality of life after intensive care unit discharge. Indian J Crit Care Med. 2020 May;24(5):299–306. https://doi.org/10.5005/jp-journals-10071-23433. PMID: 32728319; PMCID: PMC7358873.

[29] Cuthbertson BH, Roughton S, Jenkinson D, Maclennan G, Vale L. Quality of life in the five years after intensive care: a cohort study. Crit Care. 2010;14(1):R6. https://doi.org/10.1186/cc8848. Epub 2010 Jan 20. PMID: 20089197; PMCID: PMC2875518.

[30] Lim S, Bae JH, Kwon HS, Nauck MA. COVID-19 and diabetes mellitus: from pathophysiology to clinical management. Nat Rev Endocrinol. 2021 Jan;17(1):11–30. https://doi.org/10.1038/s41574-020-00435-4. Epub 2020 Nov 13. PMID: 33188364; PMCID: PMC7664589.

[31] Wan L, Gao Q, Deng Y, et al. GP73 is a glucogenic hormone contributing to SARS-CoV-2-induced hyperglycemia. Nat Metab. 2022;4:29–43. https://doi.org/10.1038/s42255-021-00508-2.

[32] Govender N, Khaliq OP, Moodley J, Naicker T. Insulin resistance in COVID-19 and diabetes. Prim Care Diabetes. 2021;15(4):629–34. https://doi.org/10.1016/j.pcd.2021.04.004.

[33] Montefusco L, Ben Nasr M, D'Addio F, et al. Acute and long-term disruption of glycometabolic control after SARS-CoV-2 infection. Nat Metab. 2021;3:774–85. https://doi.org/10.1038/s42255-021-00407-6.

[34] Papachristou S, Stamatiou I, Stoian AP, Papanas N. New-onset diabetes in COVID-19: time to frame its fearful symmetry. Diabetes Ther. 2021;12(2):461–4. https://doi.org/10.1007/s13300-020-00988-7.

[35] Chen G, Li X, Gong Z, Xia H, Wang Y, Wang X, et al. Hypertension as a sequela in patients of SARS-CoV-2 infection. PloS One. 2021 Apr 28;16(4):e0250815. https://doi.org/10.1371/journal.pone.0250815. PMID: 33909683; PMCID: PMC8081193.

[36] Groff D, Sun A, Ssentongo AE, et al. Short-term and long-term rates of Postacute sequelae of SARS-CoV-2 infection: a systematic review. JAMA Netw Open. 2021;4(10):e2128568. https://doi.org/10.1001/jamanetworkopen.2021.28568.