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Original Article

## Six-Month Quality of Life in COVID-19 Intensive Care Unit Survivors



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**Objectives:** Because there is increasing evidence of serious deterioration in long-term quality of life (QoL) in coronavirus 2019 (COVID-19) intensive care unit (ICU) survivors, the authors identified predictors of poor quality of life in these patients.

**Design:** Prospective cohort study.

**Setting:** Research hospital repurposed into a COVID-19 center.

**Participants:** Consecutive patients admitted in COVID-19 ICUs between March and June 2020.

**Interventions:** An SF-36 questionnaire, which included physical and mental items, was used six months after patient's discharge.

**Measurements and Main Results:** A total of 403 patients were managed in the ICU, with a hospital mortality of 181 of 403 (44.9%), and 16 (4.0%) patients died within six months. Among the 125 questionnaire responders, only 32.0% and 52% had a normal quality of life in terms of the physical and mental component of health. Multivariate analysis identified low-molecular-weight heparin treatment in the ICU as the only modifiable factor associated with an increase in physical component of QoL odds ratio (OR) 3.341 (95% confidence interval 1.298-8.599),  $p = 0.012$ , and age  $\geq 52$  years OR 0.223 and female sex OR 0.321 were significantly associated with a decrease in the physical component. Medical history of cerebrovascular insufficiency was significantly associated with a decrease in mental component of QoL OR 0.125, and the only factor associated with an increase in the mental health component was body mass index  $\geq 27.6$  kg/m<sup>2</sup> OR 7.466.

**Conclusions:** In COVID-19 ICU survivors the authors identified treatment with low-molecular-weight heparin as a predictor of improved physical component of QoL at 6 months.

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**Key Words:** COVID-19; quality life; SARS-CoV-2; low molecular weight heparin; critical care; Intensive Care; mortality; quality of life

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LONG-TERM consequences of coronavirus 2019 (COVID-19) still are seldom reported<sup>1-6</sup> and include fatigue and muscle weakness,<sup>3,6</sup> dyspnea with minimal exertion,<sup>4,5</sup> sleep disturbance, anxiety, and depression.<sup>1</sup> Sonnweber et al. reported that 100 days after discharge a relevant percentage of COVID-19 patients had persisting symptoms and lung function impairment, along with pulmonary abnormalities.<sup>7</sup>

Therefore, emerging evidence suggests a persistent and serious deterioration in quality of life (QoL) of COVID-19 survivors and this represents a serious medical and social problem.

Long-term full recovery after ICU discharge has been an issue of great interest for intensive care specialists in the last decade; causes, diagnoses, and treatment of postintensive care syndrome (PICS) have been widely discussed.<sup>8</sup> PICS describes a variety of health disorders occurring often among patients who survive critical illness and intensive care.<sup>9</sup> It generally is accepted that patients with PICS require long-term medical and social rehabilitation.<sup>10</sup> PICS patients showed a significantly worse QoL, along with higher risk of sudden death, compared with the general population.<sup>11</sup> However, there still are few data regarding the features of PICS in COVID-19 survivors. Furthermore, predictors of QoL are poorly investigated.

In this study, the authors present a large case series of COVID-19 ICU survivors. The authors' aim was to assess QoL of these patients at a six-month follow-up. Furthermore, the authors tried to identify modifiable risk factors and outcome predictors.

## Methods

### *Study Design and Participants*

Consecutive COVID-19 patients admitted into the ICUs of a single center between March and June 2020 were enrolled with approval of the Ethics Committee (No. 2/21/1 on 02.16.2021). All patients signed a written consent before answering the questionnaire. Exclusion criteria were cardiac arrest before or at the moment of ICU admission ( $n = 13$ ), transferred to another hospital irrespective of the reason ( $n = 88$ ), and preliminary diagnosis of COVID-19 not confirmed after additional examination ( $n = 66$ ).

The primary endpoint of the study was QoL six months after hospital discharge. The authors estimated QoL through the SF-36 questionnaire, which includes items about physical and mental health.

Criteria for ICU admission are specified in the Supplement (Supplemental Table 1). Treatment in the ICU is detailed in the Supplement (Supplemental Table 2). Prescription of low-molecular-weight heparin (LMWH) or unfractionated heparin was made at the discretion of the attending physician. Collected data (Supplemental Table 3) consisted of demographic characteristics (age, sex, body mass index [BMI]), comorbidities according to Charlson comorbidity index<sup>12</sup> and detailed in the Supplement, PaO<sub>2</sub>/F<sub>i</sub>O<sub>2</sub> levels and laboratory parameters at time of ICU admission, patient's condition at admission (national early warning score<sup>13</sup>) and Sequential Organ Failure Assessment (SOFA) score. Also, days on ventilator, days in the ICU, and hospital stay were considered. Computed tomography was evaluated by the same team of radiologists using the same criteria—each of the five lung lobes was scored visually for the degree of lung involvement, using a pointscale: no involvement; 1%-to-25% involvement; 26%-to-49% involvement; 50%-to-75% involvement; and 76%-to-100% involvement.

The six-month follow-up period started at hospital discharge. Experienced staff made up to three attempts to contact the patients through the phone. If the patient agreed to fill in the survey (available in the Supplement), the login and password to the unique record of the questionnaire were sent to the participant. Moreover, the authors attached the consent form to the email, asking kindly to fill it in and send it back.

The analysis of QoL was carried out through SF-36 Health Status Survey. SF-36 refers to nonspecific questionnaires designed to measure health and QoL at the individual level in clinical practice and is used widely in the United States and European countries. It is composed of 11 questions and 36 items that cover eight domains of health (Supplemental material). Health domains (multiple-item subscales) evaluate physical function (limitations in physical activities because of health problems), social functioning (limitations in social activities because of physical or emotional problems), role limitations due to physical problems, role limitations due to emotional problems, mental health, bodily pain, vitality (energy and fatigue), and general health perception (psychologic distress and well-being). The overall score on each SF-36 subscale ranges from 0 to 100, and a higher score indicates a better QoL. Scores for the different subscales were converted and pooled using a scoring key (Z-scores) and then two total measurements were calculated by combining the subscale scores—physical and mental components of QoL.<sup>14</sup> A reference level of 50 points was adopted for physical and mental health components, as calculated for the United States population<sup>15</sup> and validated in Australia, France, and Italy. SF-36 uses norm-based scoring algorithms for all eight subscales (T-score transformation with mean,  $50 \pm 10$  [SD]). Subsequently, patients were divided into two groups based on physical and mental components as follows: (1) fewer than 50 points (decreased QoL), and (2) 50 or more points (normal QoL).

### *Statistical Analysis*

The Shapiro-Wilk test was used to assess the normality of data. Descriptive statistics were used to describe the sample; continuous variables were described using mean and standard deviation (SD). For nonnormal distributions, such as medians and interquartile ranges (IQR), categorical variables were described using frequency and percentages.

Group differences (normal versus reduced QoL) were explored using Mann-Whitney U test for continuous variables (with the values of the statistics of the criterion U and Z). Categorical variables were analyzed using Fisher's exact test. The Spearman rank correlation coefficient was used as a hypothesis test to study the relationship between variables. The risk of outcome in univariate analysis was assessed using the odds ratio (OR) and its 95% confidence interval (CI) for each predictor studied. In multivariate analysis, adjusted OR was calculated using binary logistic regression in order to take into account the influence of confounders (eg, age, gender, comorbidity, and ongoing therapy). Predictors were included in the regression model based on the forward stepwise (Wald) method. To assess the quality of various quantitative indicators

as predictors of QoL, the authors used the receiver operating characteristic analysis with the assessment of Area Under the Curve (AUC) parameter and its 95% CI. The cut-off value was chosen in order to achieve the optimal sensitivity/specificity ratio according to the results of the receiver operating characteristic analysis (Youden's J statistic). All analyses were carried out using SPSS Software version 25 and MedCalc Statistical Software version 19.5.6. The significance level was set at 0.05.

## Results

Out of 4,565 patients admitted to the hospital during the first pandemic wave, 403 were transferred to the ICU. Mean age of ICU patients was  $62 \pm 15.3$  (range 21–97 y) and 231 of 403 (57.3%) were men. In-hospital mortality rate of ICU patients was 44.9% (181/403 patients died). Further 16 of 403 patients (4.0%) died after hospital discharge (Fig 1).

Out of the 125 survivors who signed the informed consent (74 men, 59.2%), 40 (32.0%) had a normal QoL in terms of physical health component, with differences between gender as follows: 32/74 (43.2%) men versus eight/51 (15.7%) women ( $p = 0.002$ ); 65 patients (52.0%) had a normal QoL in terms of mental health component, with no differences between gender: 38/74 (51.4%) men versus 27/51 (52.9%) women ( $p = 0.9$ ).

Overall median SF-36 physical QoL level was 43.7 (IQR: 31.7–52.7), with significant differences between men 48.3 (IQR: 36.6–53.7) and women 34.8 (IQR: 28.5–47.2),  $p < 0.001$ . No differences in mental SF-36 QoL values were found in terms of gender; men had 50.3 (IQR: 42.4–55.2), and women had 52.7 (IQR: 39.9–56.6),  $p = 0.7$ .

Comorbidities, patient characteristics, prescribed therapy, and their association with six-month QoL are showed in Table 1 and Table 2. Patients were comparable in terms of lung involvement at computed tomography and hospital stay before transfer to the ICU (Table 2); frequency of antibiotic

prescription,  $\text{PaO}_2/\text{F}_i\text{O}_2$  levels, and laboratory parameters at the time of admission to the ICU did not differ significantly in patients with normal and decreased QoL (Supplemental Table 3).

Univariate predictors of low physical component of health were female sex, old age, Charlson morbidity index, and absence of treatment with enoxaparin. Age (AUC: 0.707, 95% CI 0.611–0.803,  $p < 0.001$ ) had the best results (in terms of predicting value) among quantitative predictors of patients' physical health. The optimal cut-off point was 52 years (OR: 0.266, 95% CI 0.118–0.596; sensitivity–57.5%, specificity–75.3%); patients older than 52 years had a 3.8-fold lower chance of a normal physical component of QoL six months after COVID-19 than the younger ones (Fig 2, A). The Charlson comorbidity index was a weak predictor of the physical component of health (AUC: 0.628, 95% CI 0.526–0.730,  $p = 0.021$ ) (Fig 2, A). A multivariate analysis showed that treatment with LMWH in the ICU (adjusted OR: 3.341 [95% CI 1.298–8.599],  $p = 0.012$ ), but not with unfractionated heparin, was the only significant factor associated with increased odds of a normal QoL in terms of the physical health component. Age  $\geq 52$  years (adjusted OR: 0.223 [95% CI 0.091–0.546],  $p = 0.001$ ) and female sex (adjusted OR: 0.321 [95% CI 0.123–0.824],  $p = 0.020$ ) were significantly associated with a decrease in the physical health component (Fig 3). To understand how LMWH could increase the percentage of patients with normal physical QoL, the authors analyzed the relationship between LMWH treatment and development of thrombotic complications ( $p = 0.9$ ), Acute Respiratory Distress Syndrome (ARDS) ( $p = 0.1$ ), and stroke ( $p = 0.3$ ). The authors found a significant association ( $p = 0.047$ ) only when assessing the composite outcome ARDS and/or stroke (36.1% v 45.9%).

Univariate predictors of reduced mental health were cerebrovascular insufficiency, low BMI (AUC: 0.676, 95% CI 0.545–0.806,  $p = 0.013$ ) (Fig 2, B), and treatment with hydroxychloroquine. A multivariate analysis showed that the only predictor associated with increased odds of a normal QoL in

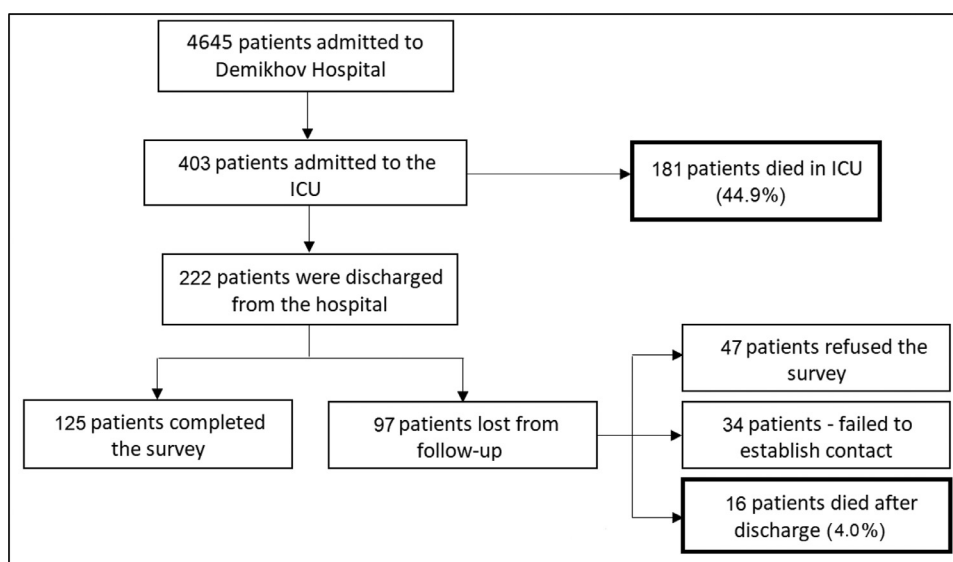


Fig 1. Flow chart of the study. ICU, intensive care unit.

Table 1  
Frequency of Comorbid Conditions in Patients With Normal/Reduced Physical and Mental Components

Comorbid Condition	Patients With a Normal Physical Component n = 40	Patients With a Reduced Physical Component n = 85	p Value	Patients With a Normal Mental Component n = 65	Patients With a Reduced Mental Component n = 60	p Value
Chronic obstructive pulmonary disease	3 (7.5%)	12 (14.1%)	0.4	4 (6.2%)	11 (18.3%)	0.053
Cerebrovascular insufficiency	8 (20.0%)	30 (35.3%)	0.1	13 (20.0%)	25 (41.7%)	0.01
Peripheral arterial disease	22 (55.0%)	60 (70.6%)	0.1	43 (66.2%)	39 (65.0%)	0.9
Diabetes	6 (15.0%)	20 (23.5%)	0.3	12 (18.5%)	14 (23.3%)	0.5
Arterial hypertension	18 (45.0%)	53 (62.4%)	0.8	37 (56.9%)	34 (56.7%)	0.9
Chronic kidney disease	5 (12.5%)	19 (22.4%)	0.2	12 (18.5%)	12 (20.0%)	0.9
Myocardial infarction	4 (10.0%)	19 (22.4%)	0.1	10 (15.4%)	14 (23.3%)	0.4
Congestive heart failure	1 (2.5%)	4 (4.7%)	0.9	2 (3.1%)	3 (5.0%)	0.7
Liver failure	0 (0.0%)	3 (3.5%)	0.6	1 (1.5%)	2 (3.3%)	0.6
Diabetic organ damage	6 (15.0%)	16 (18.8%)	0.8	10 (15.4%)	12 (20.0%)	0.6
Peptic ulcer	2 (5.0%)	5 (5.9%)	0.9	5 (7.7%)	2 (3.3%)	0.4
Hemiplegia	0 (0.0%)	4 (4.7%)	0.3	0 (0.0%)	4 (6.7%)	0.051
Malignant neoplasms	1 (2.5%)	7 (8.2%)	0.4	2 (3.1%)	3 (5.0%)	0.7
Charlson comorbidity index	1 (IQR: 0-3)	2 (IQR: 1-5)	0.019	2 (IQR: 1-4)	2 (IQR: 1-5)	0.5

Abbreviations: IQR, interquartile range.

terms of the mental health component was a BMI  $\geq 27.6$  kg/m<sup>2</sup> (adjusted OR: 7.466 [95% CI 1.950-28.582], p = 0.007), and cerebrovascular insufficiency at baseline (adjusted OR: 0.125 [95% CI 0.033-0.465], p = 0.002) was the only factor

associated with a decreased mental health component QoL (Fig 3). The negative effect of hydroxychloroquine treatment was not confirmed by the multivariate analysis, probably because patients receiving hydroxychloroquine had

Table 2  
Descriptive Statistics: Patient Characteristics and Prescribed Therapy in Patients With Normal/Reduced Physical and Mental Components

Parameter	Patients With a Normal Physical Component n = 40	Patients With a Reduced Physical Component n = 85	p Value	Patients With a Normal Mental Component n = 65	Patients With a Reduced Mental Component n = 60	p Value
<b>Medical and demographic parameters</b>						
Sex, female	8 (20.0%)	43 (50.6%)	0.002	27 (41.5%)	24 (40.0%)	0.9
Age, y	50.0 (IQR: 40.3-58.0)	58.0 (IQR: 51.0-65.5)	<0.001	54.0 (IQR: 48.5-62.0)	57.0 (IQR: 48.0-66.0)	0.2
Body mass index, kg/m <sup>2</sup>	28.1 (IQR: 25.1-31.8)	28.0 (IQR: 25.2-36.8)	0.8	29.4 (IQR: 27.0-37.6)	26.0 (IQR: 24.5-32.5)	0.013
Mechanical ventilation	2 (5.0%)	5 (5.9%)	0.9	3 (4.6%)	4 (6.7%)	0.7
<b>Characteristics of the severity of the condition on admission</b>						
SOFA, score	1.0 (IQR: 1.0-2.0)	1.0 (IQR: 1.0-2.0)	0.9	1.0 (IQR: 1.0-2.0)	1.5 (IQR: 1.0-2.0)	0.6
NEWS, score	7.0 (IQR: 5.0-8.0)	7.0 (IQR: 5.0-8.0)	0.7	7.0 (IQR: 5.0-9.0)	7 (IQR: 5.0-8.0)	0.4
CT, no involvement	3 (7.5%)	11 (12.9%)	0.5	5 (7.7%)	9 (15.0%)	0.3
CT, 1-25% involvement	3 (7.5%)	5 (5.9%)	0.7	6 (9.2%)	2 (3.3%)	0.3
CT, 26-49% involvement	11 (27.5%)	20 (23.5%)	0.7	18 (27.7%)	13 (21.7%)	0.5
CT, 50-75% involvement	19 (47.5%)	40 (47.1%)	0.9	30 (46.2%)	29 (48.3%)	0.9
CT, 76-100% involvement	4 (10.0%)	9 (10.6%)	0.9	6 (9.2%)	7 (11.7%)	0.8
<b>Length of stay, d</b>						
Intensive care unit stay	4.5 (IQR: 3.0-7.0)	5.0 (IQR: 3.0-7.0)	0.9	5.0 (IQR: 3.0-7.0)	4.0 (IQR: 3.0-7.0)	0.7
Hospital stay	16.0 (IQR: 12.3-18.0)	16.0 (IQR: 12.0-22.5)	0.7	16.0 (IQR: 13.0-19.5)	17.0 (IQR: 12.0-22.8)	0.7
<b>Prescribed therapy</b>						
Enoxaparin	29 (72.5%)	44 (51.8%)	0.03	42 (64.6%)	31 (51.7%)	0.2
Unfractionated Heparin	9 (22.5%)	27 (31.8%)	0.4	20 (30.8%)	16 (26.7%)	0.7
Tocilizumab	17 (42.5%)	31 (36.5%)	0.6	26 (40.0%)	22 (36.7%)	0.7
Hydroxychloroquine	28 (70.0%)	56 (65.9%)	0.7	50 (76.9%)	34 (56.7%)	0.022
Antiviral therapy	14 (35.0%)	27 (31.8%)	0.8	23 (35.4%)	18 (30.0%)	0.6

Abbreviations: CT, computed tomography; IQR, interquartile range; NEWS, National Early Warning Score; SOFA, Sequential Organ Failure Assessment.

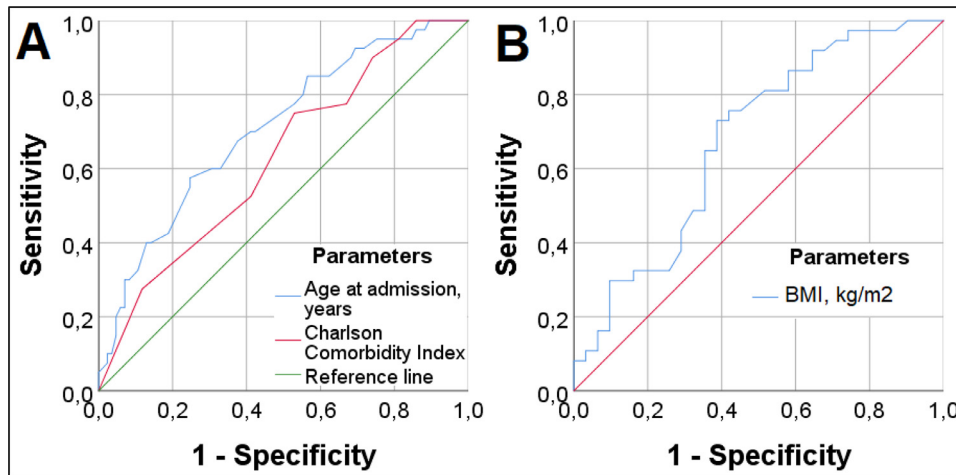


Fig 2. Receiver operating characteristic analysis: quantitative predictors of the physical (A) and mental (B) components of QoL. BMI, body mass index; QoL; quality of life.

significantly less frequent cerebrovascular insufficiency according to medical records (19/84, 22.6%) compared with patients who did not receive this treatment (19/41, 46.3%),  $p = 0.012$ . To better understand the counterintuitive finding on  $BMI \geq 27.6 \text{ kg/m}^2$  being associated with normal QoL in terms of the mental health component, the authors explored mortality in obese and nonobese patients (49.0% v 45.9%,  $p = 0.7$ ) and ARDS in obese and nonobese patients (41.8% v 26.3%,  $p = 0.016$ ).

When ventilated patients were excluded from the regression analysis, independent predictors did not change, with OR values and CI insignificantly changing. For the physical component, the modified predictors were age  $\geq 52$  years (adjusted OR: 0.286 [95% CI 0.117-0.703],  $p = 0.006$ ), female sex (adjusted OR: 0.271 [95% CI 0.101-0.725],  $p = 0.009$ ), and LMWH (adjusted OR: 3.343 [95% CI 1.282-8.718],  $p = 0.014$ ). For the mental component the modified predictors were  $BMI \geq 27.6 \text{ kg/m}^2$  (adjusted OR: 3.897 [95% CI 1.253-12.122],  $p = 0.019$ ) and history of cerebrovascular insufficiency (adjusted OR: 0.175 [95% CI 0.053-0.584],  $p = 0.005$ ).

Explorative correlation analysis revealed a significant positive weak relationship of the degree of lung involvement at computed tomography and BMI ( $r = 0.2$ ,  $p = 0.002$ ), length of stay in the ICU ( $r = 0.2$ ,  $p < 0.001$ ), and the C-reactive protein level at the time of the ICU admission ( $r = 0.2$ ,  $p = 0.001$ ).

**Discussion**

The majority (68%) of COVID-19 survivors had serious problems in terms of the physical component of health during the six-month follow-up according to SF-36 assessment. The authors identified LMWH treatment in the ICU as a strong and modifiable predictor of a better physical component of the QoL. Furthermore, 48% of patients reported serious problems in terms of the mental health component.

The authors’ findings were worse than those reported in patients who outlasted septic shock. Hammond et al. reported 15%-to-30% of patients with moderate-to-severe problems in QoL six months after discharge.<sup>16</sup>

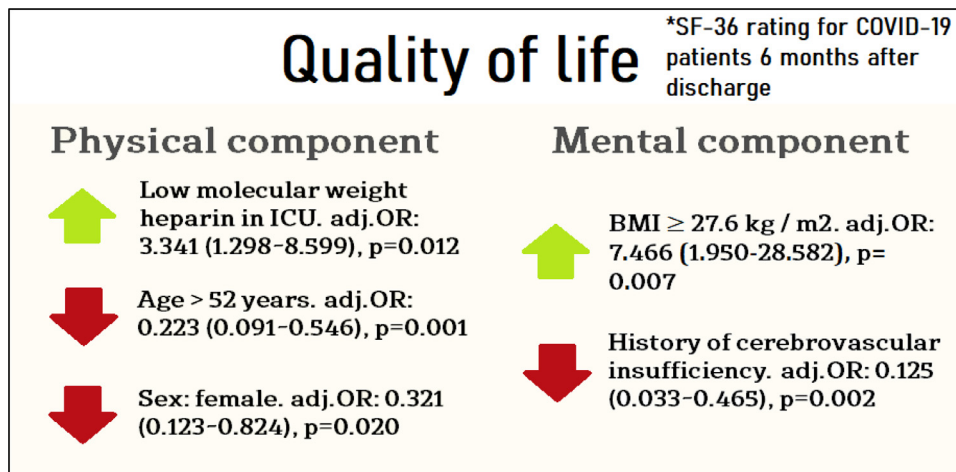


Fig 3. Predictors of physical and mental components of COVID-19 survivors quality of life at a multivariate analysis. BMI, body mass index; COVID-19, coronavirus 2019; ICU, intensive care unit; OR, odds ratio.

In the authors' study, six months after discharge approximately half of the patients reported problems in the mental health component of QoL. These features represent a serious challenge for patients, their families, and for the social system. Similarly, Prescott et al. recently reported a relatively high prevalence of mental health problems in patients with sepsis 90 days after discharge, including anxiety (32% of survivors), depression (29%), or posttraumatic stress disorder (44%).<sup>17</sup>

In this study, sex and age appeared to be the most significant predictors of QoL in terms of the physical component health—patients older than 52 had 4.5 times lower chances of a normal QoL than younger patients (adjusted OR: 0.223 [95% CI 0.091-0.546],  $p = 0.001$ ) and female sex was reported with three times decreased odds (adjusted OR: 0.321 [95% CI 0.123-0.824],  $p = 0.020$ ). The negative impact of advanced age on short-term clinical outcomes is intuitive and was demonstrated in previous studies,<sup>18,19</sup> including a recent study on six-months' QoL that was performed with the SF-36 scale in patients with COVID-19.<sup>20</sup> The authors set the age cutoff at >52 years, which was significantly lower than the one usually found in the literature (>65),<sup>21,22</sup> and this can be attributed to the specific Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus characteristics and to the impact of environmental factors in different countries.<sup>23</sup> The surprising findings of female sex being a predictor of poor outcome in terms of the physical component of QoL might be, at least in part, a consequence of the drawbacks of the SF-36 scale itself. Some aspects related to physical activity are a priori easier to perform for men than for women, and this could lead to an underestimation of the physical component of QoL in women. Furthermore, previous studies that identified female sex as a predictor of positive outcomes<sup>24,25</sup> considered short-term outcomes and not six-months' follow-up. Further studies are needed to clarify and confirm this important issue.

Furthermore, treatment with LMWH in the ICU was an independent and modifiable predictor of improvement in the physical component of QoL six months after hospital discharge. This was in line with existing evidence that severe SARS-Cov-2 pneumonia is a consequence of systemic inflammatory response and microvascular pulmonary thrombosis. Therefore, anticoagulant therapy is confirmed to be an essential and mandatory component of COVID-19 treatment.<sup>26-28</sup> Surprisingly, the authors failed to confirm a similar beneficial effect for unfractionated heparin. This might be explained by the pleiotropic pharmacologic effects of LMWH<sup>29</sup> or by the use of a relatively low-dose unfractionated heparin. The authors' findings were in agreement with Sholzberg et al., who recently found a better survival associated with high-dose heparin in moderately ill patients with COVID-19.<sup>30</sup> Furthermore, even if the authors used a multivariate model to minimize the effect of confounders, they cannot exclude that the small sample size and the severity of the patient's condition at admission (SOFA, National Early Warning Score (NEWS) scores, as well as gender, age, and comorbidity), confounded the findings (eg, prescription of unfractionated heparin to the most severe patients). This also could be explained by a

selection bias induced by the clinician who might be more tempted to use LMWH in patients who do well compared with others who might need an invasive procedure for example, due to their worse clinical status. All other medications, such as tocilizumab, hydroxychloroquine, and antivirals (lopinavir–ritonavir and oseltamivir), showed no benefits in terms of the physical component of QoL in the authors' cohort.

In contrast with reported evidence linking obesity with poor mental QoL outcomes in COVID-19 survivors, the authors' data suggested that a BMI  $\geq 27.6$  kg/m<sup>2</sup> might be a predictor of good outcome in the mental health component of QoL (adjusted OR 7.466 [95% CI 1.950-28.582],  $p = 0.007$ ).<sup>31</sup> Although counterintuitive, the authors' findings were not in contrast with previous literature on the relationship between the mental health component of QoL and BMI. Chen et al.<sup>32</sup> found that obesity in COVID-19 patients was an independent predictor of a decline in the physical health component, but not the mental one. Hańczewski et al.<sup>33</sup> found that after laparoscopic appendectomy the mental health component of QoL was 72.0 versus 79.5 in patients with BMI  $\leq 25$  versus  $>25$ . Unsurprisingly, the authors confirmed that cerebrovascular insufficiency was significantly associated with a decrease in the mental health component of QoL.<sup>34</sup> Steffens et al. already described an association between depressive symptoms and cerebrovascular disease in the elderly general population.<sup>35</sup>

### Limitations

This study had strengths and limitations. It was a single-center study, with several patients lost to follow-up; and, therefore, its external validity is limited. The sickest patients, many with serious comorbidities, would have succumbed given the relatively high mortality rate of the study cohort. Therefore, even though comorbidities did not surface as independent negative predictors, they certainly cannot be ignored. The authors also acknowledge that they did not register this (nonrandomized) study in an international registry. Moreover, the authors failed to collect and include in the model several in-hospital clinically relevant data and treatments. Finally, the authors did not investigate if young patients were able to return to their "before-COVID-19" job. The authors were not able to describe the causes of death after hospital discharge and did not assess all possible domains of QoL (eg, memory loss). At the same time, the studied population was relatively large and only a few midterm outcome studies including the QoL questionnaire have been performed so far in COVID-19 survivors. Moreover, decrease in QoL in COVID-19 ICU survivors is a topic of great interest because it represents a social and medical problem, and modifiable risk factors and predictors are not known so far. Therefore, the authors also underline the originality of their findings.

### Conclusion

Only 32% of Russian ICU survivors did not report serious problems with the physical health component six months after discharge, and 52% had no problems related to the mental

health component. LMWH treatment in the ICU was the only modifiable predictor in the physical health component in critically ill patients with COVID-19 six months after discharge. Age older than 52 and female sex were independent risk factors for worse physical outcomes. None of the investigated drugs had an impact on the six-month mental health outcomes. BMI  $\leq 27.6$  kg/m<sup>2</sup> and cerebrovascular impairment at admission were independent risk factors for adverse outcomes in terms of the mental health component of QoL.

### Conflict of Interest

None.

### Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.jvca.2021.08.036.

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