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Mobilization and Rehabilitation Practice in ICUs During the COVID-19 Pandemic

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Abstract

Background: Mobilization and acute rehabilitation are essential in the intensive care unit (ICU), with substantial evidence supporting their benefits. This study aimed to characterize ICU mobilization practices during the COVID-19 pandemic for patients with and without COVID-19.

Methods: This was a secondary analysis of an international point prevalence study. All ICUs across the world were eligible to participate and were required to enroll all patients in each ICU on the survey date, 27 January 2021. The primary outcome was the achievement of mobilization at the level of sitting over the edge of the bed. Independent factors associated with mobilization, including COVID-19 infection, were analyzed by multivariable analysis.

Results: A total of 135 ICUs in 33 countries participated, for inclusion of 1229 patients. Among patients who were not receiving mechanical ventilation (MV), those with COVID-19 infection were mobilized more than those without COVID-19 (60% vs. 34%, $p < 0.001$). Among patients who were receiving MV, mobilization was low in both groups (7% vs. 9%, $p = .56$). These findings were consistent irrespective of ICU length of stay. Multivariable analysis showed that COVID-19 infection was associated with achievement of mobilization in patients without (adjusted odds ratio [aOR] = 4.48, 95% confidence interval [CI] = 2.71-7.42) and with MV (aOR = 2.13, 95% CI = 1.00-4.51). Factors that prevented mobilization were prone positioning in patients without MV and continuous use of neuromuscular blockade and sedation agents in patients with MV, whereas facilitating factors were the presence of targets/goals in both groups.

Conclusion: Mobilization rates for ICU patients across the globe are severely low, with the greatest immobility observed in mechanically ventilated patients. Although COVID-19 is not an independent barrier to the mobilization of patients with or without MV, this study has highlighted the current lack of mobility practice for all ICU patients during the COVID-19 pandemic.

(299 words)

Keywords

barrier, COVID-19, ICU, mechanical ventilation, mobilization, rehabilitation

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Introduction

Studies have shown that early mobilization and acute rehabilitation can be beneficial to patients in the intensive care unit (ICU) by reducing length of ICU and hospital stay, increasing ventilator-free days, and improving physical function.[1,2] Mobilization also has synergistic and enhanced effects when combined with other essential practices, such as pain, sedation, and delirium management and spontaneous awakening and breathing trials, as outlined in the ABCDEF bundle.[3] For decades, several campaigns have successfully facilitated the introduction and integration of mobilization with other ICU practices to overcome barriers and establish a culture of using an evidence-based approach to critically ill patients.[4]

Recent point prevalence studies have reported mobilization practices in the ICU and identified specific barriers, including the presence of mechanical ventilation (MV).[5-7] In addition to overcoming major barriers, improving the timing and intensity of mobilization is important to optimizing its effectiveness for ICU patients.[8,9] However, COVID-19 introduced an additional potential barrier to acute rehabilitation and mobility in the ICU that could also impede efforts to mobilize non-COVID patients.[10,11] Our previous studies showed that the ICU structure and policy (eg, ICU staffing and allocation of beds for COVID-19) were significantly associated with the implementation of evidence-based ICU care.[12,13] However, the patient-related barriers and differences in barriers between patients with and without COVID-19 infection have not been addressed.

Therefore, we conducted a secondary analysis of an international one-day point prevalence study that focused on mobilization and rehabilitation practices in ICUs for patients with and without COVID-19 infection, including timing, intensity, and the role of MV, and investigated the patient-related risk factors.

Methods

This was a secondary analysis of the worldwide one-day point prevalence study performed on 27 January, 2021.[12] The ethics committee of Saiseikai Utsunomiya Hospital approved the study, which was registered in the University Hospital Medical Information Network (UMINID: 000040405).

Full details of the study methods on the point prevalence day are described in the initial publication.[12] Briefly, all ICUs in the world were eligible without any exclusion criteria. The study was performed based on the Ethical Guidelines for Medical and Health Research Involving Human Subjects in Japan,[14] which stated that ethical approval at each participating institution was not necessary because the data contained no information that could potentially identify the participating ICUs or individual patients. The ICUs could also participate in this study after obtaining approval from the local ethical review board as needed. ICU recruitment commenced on 8 January and continued until the survey date (27 January 2021). An invitation letter containing the registration URL was circulated to ICUs through local societies, national or local networks, and personal networks, including social networking services, in collaboration with regional/national coordinators. At each registration, the name of the ICU, the hospital, the country, and the name and contact address of one representative in the ICU were enrolled to prevent duplicating registration from one ICU and to verify the data source.

Data collection from each participating ICU required two steps. First, soon after the registration, the ICU representative was asked to provide information related to their hospital and ICU, such as the presence of a protocol specific to early mobility and exercise, by the survey date of 27 January, 2021. Then, on the survey date, each representative in the participating ICU received the URL that linked to the questionnaire. Through that link, they provided data pertaining to the characteristics of the ICU patients and the details of rehabilitation provided on the survey date. They were asked to complete one questionnaire for each patient in the ICU on the survey date. For example, if three patients were in the ICU, the questionnaire needed to be completed three times. Patient data collected included the presence of COVID-19 infection; the length of ICU stay on the survey date; age; gender; body mass index (BMI); use of medical devices, such as MV, extracorporeal membrane oxygenation (ECMO), continuous renal replacement therapy (CRRT), or left ventricular unloading device; continuous use of neuromuscular blockade, vasoactive, analgesia, or sedation agents; prone positioning; and the application of a target/goal of rehabilitation to ICU patients on the survey date. The details of rehabilitation were composed of the highest rehabilitation intensity achieved on the day; the most important perceived barrier to implementing a rehabilitation level of sitting at the edge of the bed or greater; and the implementation of other supportive ICU care, such as pain assessment, a spontaneous awakening and breathing trial, sedation and delirium management, family engagement, or an ICU diary. Representatives could answer the questionnaire between 27 and 30 January, 2021. All processes, including the registration; data collection related to the participating hospitals and ICUs prior to the survey date; and data collection on patient characteristics, rehabilitation details, and other supportive measures, were completely managed online through Google Form (Google Inc.).

Mobilization Scoring

Rehabilitation intensity was assessed on the ICU Mobility Scale (0-10, with 10 indicating highest mobilization level).[15] For this study, mobilization was defined as the rehabilitation level of sitting at the edge of the bed (3 on this scale) or greater. Therefore, implementation of mobilization meant that a patient achieved a level 3 or higher on the survey day. Our primary outcome was a level 3 or higher mobilization. Independent factors associated with mobilization for patients with and without MV, including the impact of a COVID-19 infection, were also investigated. The secondary outcomes were 1) level of achievement on the ICU Mobility Scale and the median ICU Mobility Scale score according to the ICU length of stay (LOS) of the patient on the survey date, 2) the most important perceived barrier preventing mobilization, and

3) the implementation of mobilization along with other supportive ICU care, such as pain assessment, spontaneous awakening and breathing trials, sedation assessment, delirium assessment, family engagement, and ICU diary. Furthermore, we also investigated the achievement of each level of the ICU Mobility Scale, the most important perceived barrier, and relative risk of mobilization failure according to the presence of ECMO, CRRT, and prone positioning.

Statistical Analysis

We separated patients into two categories based on whether they had MV, and then compared the primary outcome in each category between those with and without COVID-19 infection. We also described the secondary outcomes for each group. The non-normally distributed continuous data were described as medians with interquartile range (IQR). Categorical data, including dichotomous and ordinal variables, are presented as numbers and/or percentages for each category. No data were missing. Multivariable logistic regression analysis was used to investigate the independent factors associated with the implementation of mobilization in the presence and absence of COVID-19 infection and other covariates. To determine the most important perceived barriers to mobilization, we analyzed the data from patients who were not mobilized or who achieved a level of 0, 1, or 2 on the ICU Mobility Scale. We calculated the relative risks for not achieving mobilization in the presence and absence of MV, ECMO, CRRT, and/or prone positioning with a 95% confidence interval (CI).

All statistical analyses were two-sided, and a p value <0.05 was set as statistically significant with the use of EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan)[16] and R (R Project, Vienna, Austria).

Results

A total of 135 ICUs with 1229 patients in 33 countries participated (Supplemental Table 1). Among patients ***without*** MV, 207 (17%) had COVID-19 infection and 321 (26%) did not have COVID-19 infection. Among those who ***were receiving*** MV, 395 (32%) had COVID-19 infection and 306 (25%) did not. In both patient categories, the ICU LOS on the survey date, age, sex, BMI, use of medical devices and drugs, and application of prone positioning and its duration differed between patients with and without COVID-19 infection (Table 1). Specific protocols for early mobility and exercise were applied more frequently to patients without COVID-19 infection, regardless of MV (Table 1). However, rehabilitation with a target/goal was provided more often to patients with COVID-19 infection if they did not receive MV but more often to patients without COVID-19 if MV was in place (Table 1).

Among patients ***without*** MV, those with COVID-19 had a higher rate of mobilization than those without COVID-19 (60% vs. 34%, $p<0.001$). Those with COVID-19 also had a higher median mobility level on the ICU Mobility Scale (3 [IQR = 1-5] vs. 1 [IQR = 0-3], $p<0.001$; see Supplemental Table 2). For patients with a mobilization level ≥ 3, the predominant levels were 4 (standing) to 6 (marching in place) in patients with COVID-19 (Supplemental Figure). On the other hand, in patients ***with*** MV, mobilization rates were quite low in those with and without COVID-19 and did not differ significantly (7% vs. 9%, $p=.564$). Though there was a statistical difference, the median mobility level was 0 (nothing or passive exercise) in both groups. The achievement of each mobility level in patients with MV was similar between the two categories (Supplemental Figure). In univariate analysis, the presence of COVID-19 infection was associated with mobilization achievement only in patients ***without*** MV (odds ratio [OR] = 2.91, 95% CI = 2.02-4.17, $p<0.001$). Multivariable analysis showed that the presence of COVID-19 infection was significantly associated with the implementation of mobilization in both patients ***without*** (OR = 4.48, 95% CI = 2.71-7.42, $p<0.001$) and ***with*** MV (OR = 2.13, 95% CI = 1.00-4.51, $p=.049$; Table 2). Regarding the other independent factors, prone positioning was a barrier to mobilization (OR = 0.40, 95% CI = 0.21-0.74) and the presence of a specific protocol for mobility and a target/goal were facilitating factors (OR = 1.94, 95% CI = 1.29-2.92 and OR = 1.58, 95% CI = 1.06-2.35, respectively) for patients ***without*** MV. In contrast, for patients ***with*** MV, the continuous use of neuromuscular blockade and sedation agents were barriers (OR = 0.18, 95% CI = 0.03-0.87 and OR = 0.26, 95% CI = 0.11-0.58, respectively) and the presence of a target/goal was a facilitating factor (OR = 9.06, 95% CI = 4.07-20.2; Table 2).

The achievement of mobilization did not differ across ICU days, regardless of the presence of COVID-19 and MV (Figure 1). Among patients without MV, those with COVID-19 received greater rehabilitation intensity than those without COVID-19, regardless of LOS. However, level of intensity did not change with increasing LOS. Among patients with MV, rehabilitation intensity was extremely low and did not differ with COVID-19 status or LOS. Although patient numbers were distributed differently between the groups across the ICU day, these trends were consistent.

Respiratory factors (eg, hypoxemia, strong ventilator settings, tachypnea) were common barriers to mobilization of patients with COVID-19 (Table 3), whereas factors related to consciousness (eg, existing consciousness disorder, deep sedation, delirium), circulation (eg, hyper- or hypotension, tachy- or bradycardia, arrhythmia, use of vasopressors), and device presence (eg, existing catheter, drain, dialysis, mechanical ventilation, or ECMO) were barriers for patients without COVID-19 (Table 3). These trends were similar in the patients ***with*** and ***without*** MV. In patients ***without*** MV, subjective symptoms (eg, respiratory distress, pain, fatigue, patient refusal) and factors associated with COVID-19 (eg, restrictions on medical staff being in close contact, restrictions on rehabilitation, and infection control) were listed as other frequent barriers to mobilization of patients with COVID-19. In patients ***with*** MV, factors related to consciousness were the most predominant barriers for both patients with and without COVID-19 infection.

Table 1. Demographics of the ICU Patients.

Variable	All ICU patients		Patients without mechanical ventilation		Patients with mechanical ventilation	
	COVID-19 (n = 602)	Non-COVID-19 (n = 627)	COVID-19 (n = 207)	Non-COVID-19 (n = 321)	COVID-19 (n = 395)	Non-COVID-19 (n = 306)
ICU LOS on the survey date (days), median [IQR]	9 [2-10]	5 [2-10]	7 [4-12]	4 [2-7]	10 [5-17]	7 [3-12]
Age (years), n (%)						
< 50	107 (18)	190 (30)	45 (22)	106 (33)	62 (16)	84 (27)
50–59	132 (22)	90 (13)	43 (21)	49 (15)	89 (23)	41 (13)
60–69	193 (32)	120 (19)	59 (29)	46 (14)	134 (34)	74 (24)
70–79	146 (24)	136 (22)	50 (24)	76 (24)	96 (24)	60 (20)
≥ 80	24 (4)	91 (15)	10 (5)	44 (14)	14 (4)	47 (15)
Male, n (%)	425 (70)	391 (62)	138 (67)	201 (63)	287 (73)	190 (62)
BMI (kg/m^2), n (%)						
< 18.5	10 (2)	84 (13)	6 (3)	39 (12)	4 (1)	45 (15)
18.5–24.9	150 (25)	310 (49)	61 (29)	177 (55)	89 (23)	133 (43)
25–29.9	218 (36)	155 (25)	75 (36)	64 (20)	143 (36)	91 (30)
30–34.9	140 (23)	54 (9)	41 (20)	32 (10)	99 (25)	22 (7)
≥ 35	84 (14)	24 (4)	24 (12)	9 (3)	60 (15)	15 (5)
Use of medical device, n (%)						
Extracorporeal membrane oxygenation[a]	30 (5)	18 (3)	6 (3)	6 (2)	24 (6)	12 (4)
Renal replacement therapy	56 (9)	66 (11)	7 (3)	29 (9)	49 (12)	37 (12)
Left ventricular unloading device (Impella®, IABP)	1 (0)	10 (2)	0 (0)	4 (1)	1 (0)	6 (2)
Use of neuromuscular blockade, n (%)[b]	159 (26)	19 (3)	------------	------------	159 (40)	19 (6)
Use of vasoactive drugs, n (%)	186 (31)	208 (33)	8 (4)	57 (18)	178 (45)	151 (49)
Use of analgesia agents, n (%)	358 (59)	291 (46)	30 (14)	88 (27)	328 (83)	203 (66)
Use of sedation agents, n (%)	356 (59)	233 (37)	16 (8)	34 (11)	340 (86)	199 (65)
Benzodiazepine usage, n (%)	222 (37)	22 (4)	11 (5)	9 (3)	211 (79)	13 (4)
Patients receiving prone positioning, n (%)	209 (34)	17 (3)	65 (31)	6 (2)	144 (36)	11 (4)
Duration of prone positioning (hours), n (%)						
0–5.9	58 (10)	11 (2)	37 (18)	6 (2)	21 (5)	5 (2)
6–11.9	38 (6)	2 (0)	16 (8)	0 (0)	22 (6)	2 (1)
12–24	113 (19)	4 (1)	12 (6)	0 (0)	101 (26)	4 (1)
Patients received rehabilitation in ICU with specific protocol for early mobility and exercise, n (%)	238 (40)	346 (55)	78 (38)	172 (54)	160 (41)	174 (59)
Patients received rehabilitation with a target/goal, n (%)	261 (43)	296 (47)	131 (63)	158 (49)	130 (33)	138 (45)

[a]Of 48 patients, 38 received veno-venous extracorporeal membrane oxygenation and 10 received veno-arterial extracorporeal membrane oxygenation.
[b]Patients without mechanical ventilation were not included because use of neuromuscular blockade was not applicable.
Abbreviations: BMI, body mass index; IABP, intra-aortic balloon pumping; ICU, intensive care unit; IQR, interquartile range; LOS, length of stay.

When supportive ICU care other than mobilization was provided to patients ***without*** MV, over half of those with COVID-19 infection also received mobilization, whereas only 25–41% of those without COVID-19 infection were mobilized. Among patients ***with*** MV, mobilization was low (3-18%) regardless of whether they had COVID-19 infection (Supplemental Table 3).

The presence of MV, ECMO, or CRRT or placement in prone positioning decreased the likelihood of mobilization, except for the patients with COVID-19 who received prone positioning for less than 6 h (Supplemental Table 4). However, these impacts were greater in patients with COVID-19 infection than in those without COVID-19 (Supplemental Table 5).

Discussion

Our study revealed an overwhelming culture of immobility across ICUs. Rates of mobilization were higher among non-mechanically ventilated ICU patients who had COVID-19

Table 2. Independent Factors Associated With the Implementation of Mobilization.

Variables	Patients without mechanical ventilation		Patients with mechanical ventilation	
	Odds ratio [95% CI]	*P* value	Odds ratio [95% CI]	*P* value
Univariable analysis				
Presence of COVID-19 infection	2.91 [2.02-4.17]	<.001	0.82 [0.47-1.41]	.474
Multivariable analysis				
Presence of COVID-19 infection	4.48 [2.71-7.42]	<.001	2.13 [1.00-4.51]	.049
ICU LOS on the survey date (days)	0.99 [0.98-1.01]	.321	0.99 [0.98-1.01]	.383
Age (years)[a]				
< 50	(Reference)		(Reference)	
50–59	1.00 [0.56-1.79]	.988	1.39 [0.46-4.16]	.556
60–69	0.52 [0.29-0.93]	.027	1.27 [0.46-3.50]	.645
70–79	0.75 [0.44-1.29]	.306	1.39 [0.47-4.07]	.550
≥ 80	0.79 [0.40-1.58]	.508	1.22 [0.35-4.24]	.756
Male	1.35 [0.90-2.01]	.146	1.13 [0.57-2.27]	.760
BMI (kg/m^2)[a]				
18.5–24.9	(Reference)		(Reference)	
< 18.5	0.64 [0.30-1.34]	.238	1.19 [0.32-4.45]	.798
25–29.9	0.84 [0.52-1.36]	.487	1.05 [0.50-2.20]	.906
30–34.9	1.05 [0.57-1.91]	.883	0.31 [0.09-1.08]	.066
≥ 35	0.90 [0.38-2.10]	.802	0.47 [1.33-1.69]	.250
Extracorporeal membrane oxygenation	0.09 [0.01-0.81]	.032	0.43 [0.05-4.02]	.461
Renal replacement therapy	0.78 [0.34-1.80]	.561	0.57 [0.19-1.70]	.316
Continuous use of neuromuscular blockade[b]	--------------------	-------	0.18 [0.03-0.87]	.033
Continuous use of vasoactive drugs	0.71 [0.34-1.80]	.561	0.79 [0.40-1.54]	.484
Continuous use of analgesia agents	0.95 [0.58-1.55]	.822	0.79 [0.34-1.82]	.573
Continuous use of sedation agents	0.56 [0.26-1.18]	.126	0.26 [0.11-0.58]	.001
Prone positioning	0.40 [0.21-0.74]	.004	1.67 [0.63-4.38]	.300
Presence of a specific protocol for early mobility and exercise	1.94 [1.29-2.92]	.002	1.73 [0.87-3.45]	.121
Presence of a target/goal	1.58 [1.06-2.35]	.023	9.06 [4.07-20.2]	<.001

Abbreviations: BMI, body mass index; CI, confidence interval; ICU, intensive care unit; LOS, length of stay.
Mobilization is defined as the rehabilitation level of sitting at edge of bed, or level 3 or more of the ICU Mobility Scale (Hodgson C et al Heart and Lung 2014;43:19-24). ICU Mobility Scale 0: nothing (lying in bed, passive exercise); 1: sitting in bed, exercises in bed; 2: passively moved to chair (no standing); 3: sitting over edge of bed; 4: standing; 5: transferring bed to chair; 6: marching in place (at bedside); 7: walking with assistance of two or more people; 8: walking with assistance of one person; 9: walking independently with a gait aid; 10: walking independently without a gait aid.
The covariates were as follows; the ICU length of stay on the survey date, age, male, body mass index, extracorporeal membrane oxygenation, renal replacement therapy, continuous use of neuromuscular blockade, vasoactive drugs, analgesia, sedation, prone positioning, a specific protocol for early mobility and exercise, and presence of a target/goal. There was no multicollinearity between variables according to the variance inflation factors.
[a]The following variables were changed to factors and used in the multivariable logistic regression analysis: age and body mass index.
[b]The covariate of continuous use of neuromuscular blockade was omitted from the multivariable analysis for patients without mechanical ventilation.

infection than among those who did not have COVID-19. However, more than 90% of patients ***with*** MV were completely immobile, regardless of whether they were positive or negative for COVID-19. These trends did not differ based on patients' LOS on that date. Multivariable analysis showed that the presence of COVID-19 infection was not a major barrier to mobilization. Moreover, provision of other evidence-based supportive ICU care did not overcome the barrier of MV. The presence of any MV, ECMO, RRT, or prone positioning hindered the implementation of mobilization.

The presence of COVID-19 infection was not a major barrier to mobilization. In contrast, MV remains a major barrier to mobilization, even though the safety and feasibility of mobilization in patients with MV have been well demonstrated.[17,18] Evidence-based supportive ICU care, such as the ABCDEF bundle, is recommended for promoting mobilization,[4,19] but performance of these supportive cares did not lead to mobilization of patients with MV in this study. Recent studies have shown that the achievement of mobilization in patients with MV has increased slowly up to 30% owing to current recommendations and campaigns.[5] However, in our study, mobilization of patients with MV support, both those with and without COVID-19 infection, was substantially lower than that in most studies conducted over the last decade even though the populations differed between the studies.[6,7,20] Thus, it is clear that beneficial ICU practices such as mobility are quite vulnerable to negative progress. Intense lung protective ventilation strategies, such as heavy sedation,[21] continuous neuromuscular blockade, and prone positioning,[22] which have been introduced to patients more often since the start of the COVID-19 pandemic, were detected as barriers to mobilization in this study and could unintentionally translate to a culture of immobility.

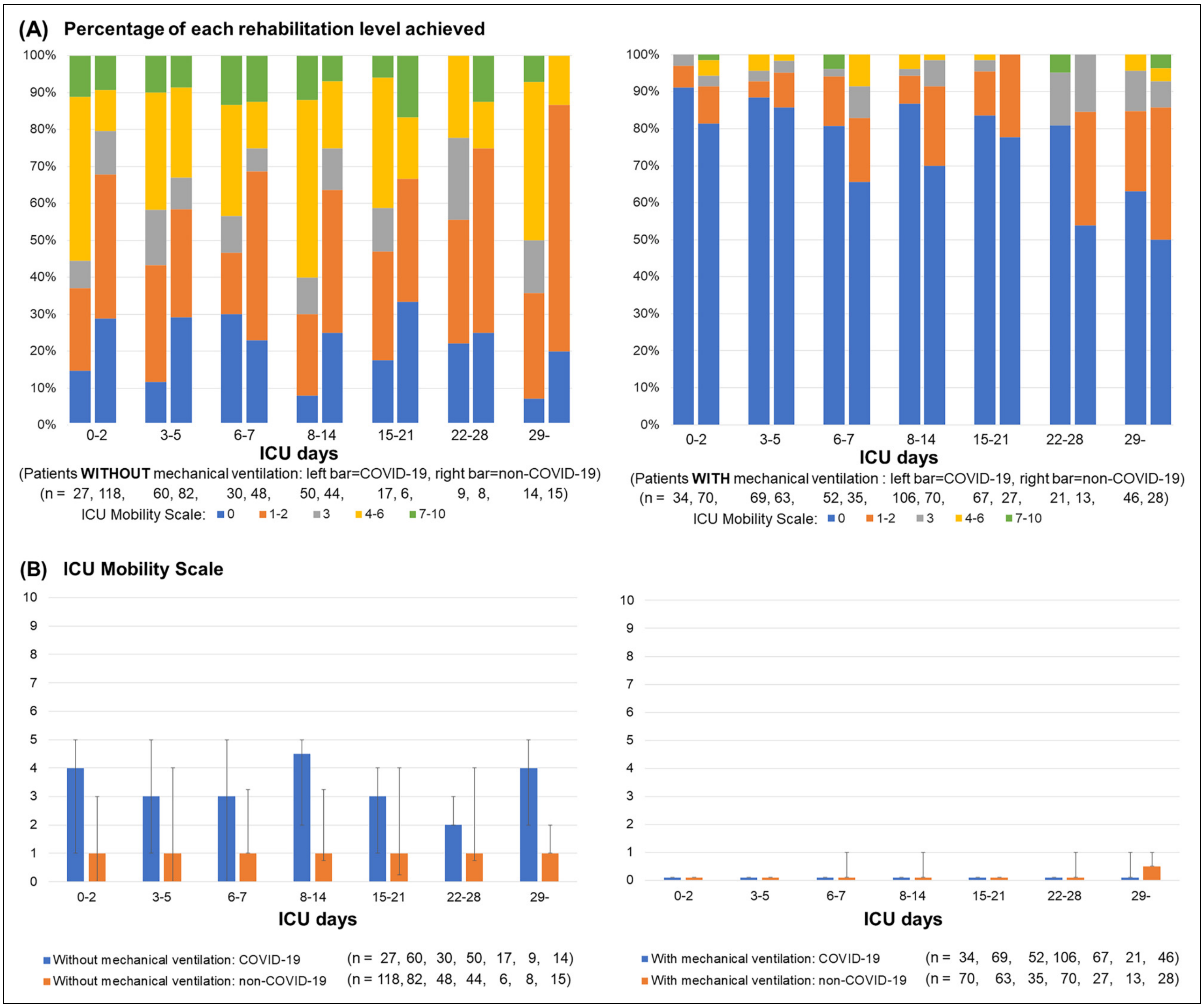

Figure 1. Rehabilitation level achieved is not dependent on ICU length of stay. Rehabilitation intensity is shown by ICU length of stay and presented as percentage (A) and median ICU Mobility Scale score (B). For both panels, left bar is COVID-19 and right bar is non-COVID-19. The ICU Mobility Scale is as follows: 0: nothing (lying in bed, passive exercise); 1: sitting in bed, exercises in bed; 2: passively moved to chair (no standing); 3: sitting over edge of bed; 4: standing; 5: transferring bed to chair; 6: marching in place (at bedside); 7: walking with assistance of two or more people; 8: walking with assistance of one person; 9: walking independently with a gait aid; 10: walking independently without a gait aid (Hodgson C et al Heart and Lung 2014; 43:19-24). In this study, mobilization was defined as a rehabilitation level of 3 or more on the ICU Mobility Scale.

Severe infection control regulations and limitations on physical contact are potential reasons for the immobility we documented, especially in patients with COVID-19 infection.[11] Additionally, the frequent administration of benzodiazepines to patients with COVID19 infection, usually used to achieve deep sedation level, is a barrier to mobilization and contrary to recent guidelines.[23] However, a culture of immobility, possibly the recurrence of nonbeneficial culture, is a major public health problem for all ICU patients. We need to evaluate the impact of such culture on short- and long-term outcomes and seek appropriate solutions. Interestingly, mobilization was achieved more frequently in patients with COVID-19 if the period of prone positioning was 0 to 6 h than if the duration was longer. Although practitioners might tend to apply prone positioning for up to 6 h when patients are in a less severe respiratory state, the duration of prone positioning is still controversial, especially as a treatment for COVID-19.[24] The short duration of prone positioning or intermittent prone positioning combined with mobilization during the interval might warrant evaluation in a future study, as does the effect of short-term prone positioning on pulmonary function.

Mobilization was achieved at a higher rate in patients with COVID-19 infection than in those without, as long as MV was not in place. This finding could result from differences in disease severity. Except in severe cases, COVID-19 tends to be a disease with single-organ failure, primarily respiratory failure,[25] whereas other diseases seen in the ICU, such as sepsis, trauma, burn, and post-cardiopulmonary arrest syndrome,

Table 3. Most Important Perceived Barriers Preventing Mobilization.

	All ICU patients		Patients without mechanical ventilation		Patients with mechanical ventilation	
Variables	COVID-19	Non-COVID-19	COVID-19	Non-COVID-19	COVID-19	Non-COVID-19
Number of patients who did not receive mobilization on the survey date[a]	449	491	83	212	366	279
Factors associated with lack of mobilization, n (%)						
Consciousness[b]	206 (46)	173 (35)	5 (6)	53 (25)	201 (55)	120 (43)
Subjective symptoms[c]	31 (7)	29 (6)	22 (27)	18 (8)	9 (2)	11 (4)
Respiratory-related factors[d]	118 (26)	42 (9)	30 (36)	15 (7)	88 (24)	27 (10)
Circulatory-related factors[e]	17 (4)	77 (16)	4 (5)	32 (15)	13 (4)	45 (16)
Devices placed[f]	32 (7)	70 (14)	1 (1)	30 (14)	31 (8)	40 (14)
Medical staff[g]	6 (1)	16 (3)	3 (4)	8 (4)	3 (1)	8 (3)
COVID-19–related factors[h]	27 (6)	2 (0)	16 (19)	1 (0)	11 (3)	1 (0)
Other	12 (3)	82 (17)	2 (2)	55 (26)	10 (3)	27 (10)

[a]Mobilization is defined as the rehabilitation level of sitting over edge of bed, or level 3 or more of the ICU Mobility Scale (Hodgson C et al Heart and Lung 2014;43:19-24). ICU Mobility Scale 0: nothing (lying in bed, passive exercise); 1: sitting in bed, exercises in bed; 2: passively moved to chair (no standing); 3: sitting over edge of bed; 4: standing; 5: transferring bed to chair; 6: marching in place (at bedside); 7: walking with assistance of two or more people; 8: walking with assistance of one person; 9: walking independently with a gait aid; 10: walking independently without a gait aid.
[b]Consciousness factors: existing consciousness disorder, RASS: ≤ -3 or $\geq +2$, deep sedation, delirium, etc.
[c]Subjective symptoms: respiratory distress, Behavioral Pain Scale (BPS) > 3 or Numeric Pain Rating Scale (NRS) > 5, fatigue, patient refusal, etc.
[d]Respiratory factors: SpO_2 <90%; FIO_2 >0.6; respiratory rate >30 times/min, ventilator unsynchronized, etc.
[e]Circulatory factors: systolic blood pressure <90 or >180 mm Hg; mean blood pressure <65 or >110 mm Hg; heart rate <50 or >120 beats/min; new arrhythmias; additional administration of vasopressors, etc.
[f]Devices: existing catheter, drain, dialysis, mechanical ventilation, or extracorporeal membrane oxygenation, etc.
[g]Medical staff factors: lack of staff, holidays, many examinations, poor time adjustment, etc.
[h]COVID-19–related factors: restrictions for medical staff on physical contact with patients, restrictions on rehabilitation, infection control, etc.
Abbreviation: ICU, intensive care unit.

are frequently complicated by multi-organ failure, often from the beginning.[26-29] As noted by the differences in the perceived barriers to mobilization, respiratory- and COVID-19–associated factors were common barriers to mobilization of patients with COVID-19 infection, whereas consciousness, circulatory, and device factors were barriers for patients without COVID-19, potentially reflecting a variety of disease severities and involvement of multiple organs. Even when MV was in place, differences in perceived barriers were consistently observed. Comparing patients with COVID-19 to other ICU patients admitted for respiratory failure might be necessary to accurately assess the impact of the COVID-19 pandemic. However, substantial evidence supports mobilization as being essential care for all ICU patients, regardless of disease etiology.[1,30] Furthermore, a variety of approaches to overcome barriers have been suggested.[31] For example, optimal use of analgesia and sedation,[32] close monitoring of delirium,[33] interrupted sedation,[34] and a combination of these[23] would be helpful to overcome barriers related to consciousness, which are high among patients with MV. Mobilization practices should be optimized according to situations and barriers, irrespective of COVID-19 infection, the kind of disease, and its severity. Mobilization culture is also expected to facilitate other essential ICU care, such as pain, sedation, and delirium management, in accordance with the recommendations.[23]

The timing of mobilization in the clinical course of a disease is essential for optimization. Recent systematic reviews have shown conflicting results. One showed beneficial effects if mobilization was initiated within 72 h of ICU stay,[8] and the other showed no difference in patient outcomes between mobilization initiated within 7 days of ICU stay and later initiation.[35] These results potentially indicate the importance of initiating mobilization early rather than later. However, we found a consistently low rate of mobilization on any given ICU day. Many ICU patients might be missing the optimal timing for mobilization to maximize its effects. Given the current literature[31,36] and the results of our study, applying a protocolized system and setting a target or goal for the patient under the leadership of a specialized mobilization team would improve mobilization rates and timing. Furthermore, the dosing of mobilization, including intensity, frequency, and duration, is another essential component to be addressed in future studies. Although intensive dosing is associated with patient independence, we found that the intensity provided was very low for patients with and without COVID-19 infections, especially if they received MV.

We acknowledge several limitations. First, the one-point prevalence study cannot show a causal relationship or capture the overwhelming impact of the COVID-19 pandemic because its effects on a given area could differ at any specific time. Second, the study design potentially included a large selection bias, which could limit the generalizability of the results. In addition, important confounders, such as illness severity and disease type in patients without COVID-19 infection, were not collected in this study. Third, some data were obtained as categorical variables, such as perceived barriers; therefore, the study could lack specificity. On the other hand, the study also had several strengths. We included patients both with and without COVID-19 infection and a relatively large number of patients compared to that in a previous one-point prevalence study related to early mobilization. To examine whether patients in the ICU receive suitable early mobilization, a point prevalence study should be conducted sequentially with a certain interval. Alternatively, a multicenter prospective observational study with more patients is needed.

Conclusions

In a worldwide survey with more than 1200 patients in 135 ICUs, we found that presence of COVID-19 infection was not a major barrier to mobilization. However, more than 90% of patients with and without COVID-19 who received MV were kept in bed and not given an opportunity to mobilize. This point prevalence study exposes an urgent and critical unmet need in the general approach to ICU care of mechanically ventilated patients.

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Author Contributions

Study conception and design: KL, KN, HK, PN, EWE, SRK, SI, and ON; statistical analysis or interpretation of data: KL, KN, HK, PN, EWE, SRK, and KT; drafting the manuscript: KL, KN, HK, PN, EWE, SRK, and KT; critical review and revision of the manuscript for important intellectual insight: KN, HK, ME, PN, EWE, SRK, KT, SI, and ON; study supervision: PN, EWE, SRK, KT, SI, and ON. All authors drafted the manuscript from important intellectual viewpoints and approved the final version. Furthermore, all authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The corresponding author, KL, confirmed that all authors meet authorship criteria according to ICMJE.

Research Data

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests for the submitted work. Some authors report potential conflicts of interest outside of this submitted study. KL reports personal fees from MERA and is a core research member of TXP Medical Co., Ltd completely outside of the submitted work. HK receives a salary from the Japanese Society for Early Mobilization (non-profit society) as a chair (full time) outside of the submitted work. EWE reports grants from the National Institutes of Health, Veteran's Administration, and Bioxcel, as well as personal fees from Pfizer, Orion, and Lilly outside of the submitted work.

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Ethical Approval

Not applicable, because this article does not contain any studies with human or animal subjects.

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Supplemental Material

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