ORIGINAL PAPER

Nagoya J. Med. Sci. **85**. 93–102, 2023
doi:10.18999/nagjms.85.1.93

Negative impact of behavior restriction amidst a clustered COVID-19 infection on immobility syndrome in older patients negative for COVID-19: report from a chronic care hospital in Japan

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ABSTRACT

Previous studies have reported on associations between immobility syndrome and the COVID-19 pandemic. However, little is known about the aggravation of this syndrome in older patients negative for COVID-19 infection amidst behavior restriction due to a clustered COVID-19 infection. Patients hospitalized one month before a clustered COVID-19 infection occurred in our hospital were recruited. Rehabilitation therapy was suspended for 25 days during behavior restriction. The ability of daily living of the patients was evaluated with the functional independence measure and Barthel index. Chronological changes in the functional independence measure and Barthel index scores were evaluated monthly, beginning one month before the clustered COVID-19 infection to one month after re-initiation of rehabilitation therapy. Patients with minimum scores in the functional independence measure (18) and Barthel index (0) prior to the clustered COVID-19 infection were excluded. Functional independence measure scores of 73 older patients and the Barthel index scores of 48 patients were analyzed. The mean total functional independence measure score amidst the behavior restriction significantly changed from 36.3 to 35.1 ($p = 0.019$), while statistical significance was not detected in the mean motor subtotal (from 21.6 to 20.9 with $p = 0.247$) or cognitive subtotal functional independence measure scores (from 14.6 to 14.2 with $p = 0.478$). During the behavior restriction, the mean Barthel index scores declined from 25.8 to 23.2 without statistical significance ($p = 0.059$). Behavior restriction due to a clustered COVID-19 infection may aggravate immobility syndrome in older patients who are negative for COVID-19.

Keywords: immobility syndrome, older adults, COVID-19, functional independence measure, Barthel index

Abbreviations:
COVID-19: coronavirus disease 2019
FIM: functional independence measure

Received: February 17, 2022; accepted: March 31, 2022

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BI: Barthel index
ADL: activities of daily living

INTRODUCTION

The coronavirus disease 2019 (COVID-19) has been a global health concern since the first case of COVID-19 was reported in Wuhan.[1] Severe acute respiratory syndrome coronavirus 2 is the representative symptom related to the COVID-19 infection, and the associated mortality rates are higher in older patients and those with cardiovascular disease, chronic respiratory disease, and diabetes mellitus.[2] COVID-19 infection can result in various symptoms, including decline of physical and cognitive function.[3] Rehabilitation therapy is required from the acute phase to the recovery phase to ameliorate the declining status of patients positive for COVID-19.[3-11]

A nationwide lockdown was implemented to help cope with COVID-19 infection. Daily activities of the population possibly negative for COVID-19 were restricted to prevent the spread of COVID-19. Medical services that were not urgent were temporarily suspended. As a result, both the healthy population and those with underlying diseases were introduced to the immobility syndrome.[12-17] As a secondary medical issue, the COVID-19 pandemic can impair the quality of daily living among those negative for COVID-19.

However, to the best of our knowledge, little is known about the impact of suspension of rehabilitation therapy on immobility syndrome in older patients who are negative for COVID-19 infection. The aim of this study was to explore the aggravation of immobility syndrome in older patients negative for COVID-19, which can result from suspended rehabilitation therapy in cases of clustered COVID-19 infection.

PATIENTS AND METHODS

Study design

This study is a retrospective cohort study. This study was approved by the ethical committee of Hikari Hospital. This study complied with the Declaration of Helsinki. All the clinical data was anonymized in this study.

Behavior restriction related to a clustered COVID-19 infection

A clustered COVID-19 infection occurred at our chronic care hospital, which was administrated by public health authorities to help prevent the spread of the infection. All patients positive for COVID-19 were transferred to a hospital specializing in the treatment of COVID-19. Rehabilitation therapy was ceased as per instructions from the public health authorities until two weeks had passed since the last patient positive for COVID-19 was confirmed. Thus, rehabilitation therapy was suspended for 25 days, during which areas in the wards were categorized into red and green zones. The patients' activities were restricted to their rooms and a dining hall (categorized as a red zone) (Figure 1).

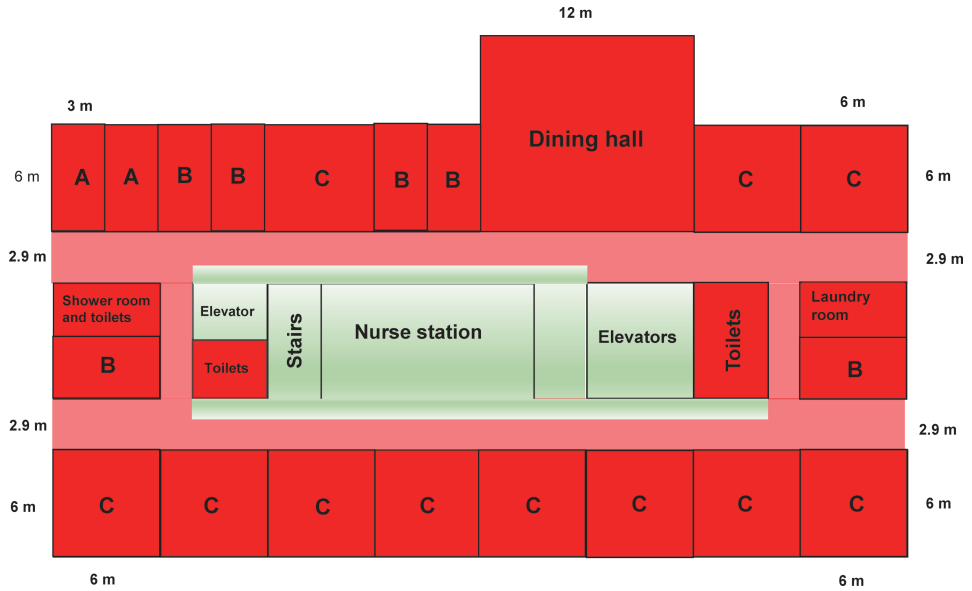

Fig. 1 A map of the ward zones during the clustered COVID-19 infection in our hospital
The area around a nurses' station was categorized as a green zone while the patients' rooms and the dining hall were categorized as red zones (A: room for a single patient, B: room for two patients and C: room for four patients).

Patients

Patients hospitalized one month before the clustered COVID-19 infection occurred in our hospital were enrolled in this study. Patients who were transferred to other institutes due to COVID-19 infection were excluded from the study, along with those who did not undergo rehabilitation therapy. Patients who died due to underlying diseases were not enrolled.

Clinical information of the patients

Baseline characteristics that were compared are listed in Table 1. The patients could undergo rehabilitation therapy comprising a maximum of six units (one unit is equal to at least 20 minutes of rehabilitation therapy) per day within the computation period (this period is defined according to the disease for which rehabilitation therapy is prescribed. For example, the computation period is defined as six months from the onset date for patients with stroke in Japan); after the computation period, the patients could undergo only 13 units of therapy per month.

Table 1 Characteristics of the patients in this study

	Patients (n = 73)
Sex (male:female)	33 (45.2%):40 (54.8%)
Age (years old) Minimum – maximum (mean)	62–97 (83.3)
Heights (m) Minimum – maximum (mean)	1.31–1.80 (1.54)

Weights (kg) Minimum – maximum (mean)	27.3–69.4 (43.9)
Body mass index (kg/m^2) Minimum – maximum (mean)	11.3–28.9 (18.4)
Days from the admission date to the onset of the clustered COVID-19 (days)	24–1256 (302.5)
Rehabilitation prescription	
Within computation period	21 (28.8%)
Extended from computation period	3 (4.1%)
Post computation period	49 (67.1%)
Rehabilitation therapy	
For cerebrovascular disease	31 (42.5%)
For immobility syndrome	23 (31.5%)
For motor disorder	19 (26.0%)
Underlying disease	
Cardiovascular	3 (4.1%)
Cancer	4 (5.4%)
Dehydration	2 (2.7%)
Decubitus	3 (4.1%)
Infection	21 (28.7%)
Neuromotor	8 (10.9%)
Orthopedics	11 (15.0%)
Pulmonary	1 (1.3%)
Stroke	17 (23.2%)
Others	10 (13.6%)
Feeding	
Central venous	4 (5.4%)
Oral	53 (72.6%)
Tubal	19 (26.0%)
Medication	
Number of medications regularly prescribed	0–12 (5.5)
Antiarrhythmic	37 (50.6%)
Anticonvulsant	8 (10.9%)
Anticoagulant/antiplatelet	31 (42.5%)
Anti-dementia	2 (2.7%)
Antidiabetic	9 (12.3%)
Hypnotic	19 (26.0%)
Proton pomp inhibitor/H2 blocker	35 (47.9%)

Rehabilitation evaluation

The patients were evaluated monthly by rehabilitation therapists using the functional independence measure (FIM) and Barthel index (BI).

The FIM is used to evaluate patients' activities of daily living (ADL) and consists of two sections: the motor subtotal score (eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bladder management, bowel management, bed/chair/wheelchair transfer, toilet

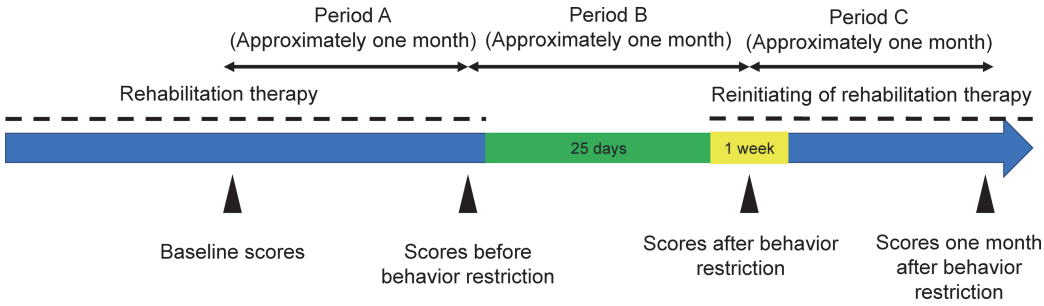

Fig. 2 The definition of periods A, B, and C

transfer, tub/shower transfer, locomotion of walk/wheelchair/walk and wheelchair, and locomotion of stairs) and the cognitive subtotal score (comprehension, expression, social interaction, problem solving, and memory). The minimum and maximum scores for FIM are 18 and 126, respectively.

The BI is used to evaluate the ability of patients to perform daily activities and has ten subdivision items: feeding, bathing, grooming, dressing, bowel control, bladder control, toilet use, transfer, mobility, and stair use. The minimum and maximum BI scores are 0 and 100, respectively.

The FIM and BI approximately one month before the onset of clustered COVID-19 infection were defined as the baseline scores. The FIM and BI scores of patients were also assessed before and after the behavior restriction related to the clustered COVID-19 infection. The FIM and BI scores after the behavior restriction related to the clustered COVID-19 were evaluated within one week after reinitiating rehabilitation therapy. The FIM and BI scores were also followed one month after reinitiating rehabilitation therapy. Period A was defined as that from baseline evaluation to the evaluation before the behavior restriction, and period B was defined as that between the evaluation just before the behavior restriction to evaluation after the behavior restriction. Period C was defined as that between the evaluation after the behavior restriction to evaluation one month after reinitiating rehabilitation therapy (Figure 2). The change in the FIM and BI scores in period A, B, and C were calculated and statistically analyzed. Patients with a baseline FIM score of 18 and/or those with a baseline BI score of 0 were respectively excluded from the study (ie, patients with a baseline FIM score of 18 and baseline BI score of 0 were excluded in both evaluation of FIM and BI scores, meanwhile, patients with a baseline FIM score of 20 and baseline BI score of 0 were included only for the evaluation of the FIM score).

We used SPSS Statistics software version 26 (IBM, Armonk, NY, USA); statistical significance was set at $P < 0.05$.

RESULTS

Baseline characteristics

Seventy-three patients (33 men and 40 women) were enrolled in this study. The characteristics of the patients are summarized in Table 1. The mean age of the patients was 83.3 years. The mean height and weight of the patients were 1.54 m and 43.9 kg, respectively. The mean body mass index was 18.4 kg/m^2. The mean duration from the date of admission to the onset of clustered COVID-19 infection was 302.5 days. At the time of the study, 31 patients were undergoing rehabilitation therapy for cerebrovascular disease, while 19 and 23 patients were undergoing rehabilitation therapy for motor disorder and immobility syndrome, respectively (Table 1).

Outcomes: FIM and BI

The baseline motor subtotal, cognitive subtotal, and total scores (minimum–maximum with mean score) of the patients were 13–53 (21.2), 6–33 (14.4), and 19–83 (35.6), respectively. The pre- and post-clustered COVID-19 infection motor subtotal, cognitive subtotal, and total scores were 13–53 (21.6), 6–33 (14.6), and 19–83 (36.3); and 13–53 (20.9), 6–33 (14.2), and 19–83 (35.1), respectively. The one month after post-clustered COVID-19 infection motor subtotal, cognitive subtotal, and total scores were 13–53 (20.9), 5–33 (13.7), and 18–84 (34.7) (Table 2).

The baseline, pre-, post-clustered, and one month after post-clustered COVID-19 infection BI scores (minimum–maximum with mean score) of the patients were 5–65 (25.6), 0–60 (25.8), 0–60 (23.2) and 0–75 (23.6) (Table 2).

Table 2 Baseline functional independent measure (n = 73) and Barthel index scores (n = 43)

Functional independent measure	
Minimum – maximum (mean)	
<Baseline>	
Motor	13–53 (21.2)
Cognitive	6–33 (14.4)
Sum	19–83 (35.6)
<Pre-cluster of COVID-19>	
Motor	13–53 (21.6)
Cognitive	6–33 (14.6)
Sum	19–83 (36.3)
<Post-cluster of COVID-19>	
Motor	13–53 (20.9)
Cognitive	6–33 (14.2)
Sum	19–83 (35.1)
<One month after post-cluster of COVID-19>	
Motor	13–53 (20.9)
Cognitive	5–33 (13.7)
Sum	18–84 (34.7)
Barthel index	
Minimum – maximum (mean)	
<Baseline>	5–65 (25.6)
<Pre-cluster of COVID-19>	0–60 (25.8)
<Post-cluster of COVID-19>	0–60 (23.2)
<One month after post-cluster of COVID-19>	0–75 (23.6)

Comparison of the score change of the mean FIM and mean BI in periods A, B and C

Figure 3 compares the mean FIM and mean BI scores in periods A, B, and C. There were statistically significant changes only in the total score of the mean FIM in period B ($p = 0.019$), but not that in period A or C ($p = 0.962$, and $p = 0.247$, respectively). There were no statistically significant changes in the mean motor subtotal score in periods A, B and C ($p = 0.409$, $p = 0.247$, and $p = 1.000$, respectively) or in the mean cognitive subtotal scores of the FIM in periods A, B, and C ($p = 1.000$, $p = 0.478$, and $p = 0.556$, respectively). Changes in the mean BI score in periods A, B, and C were not statistically significant ($p = 0.059$).

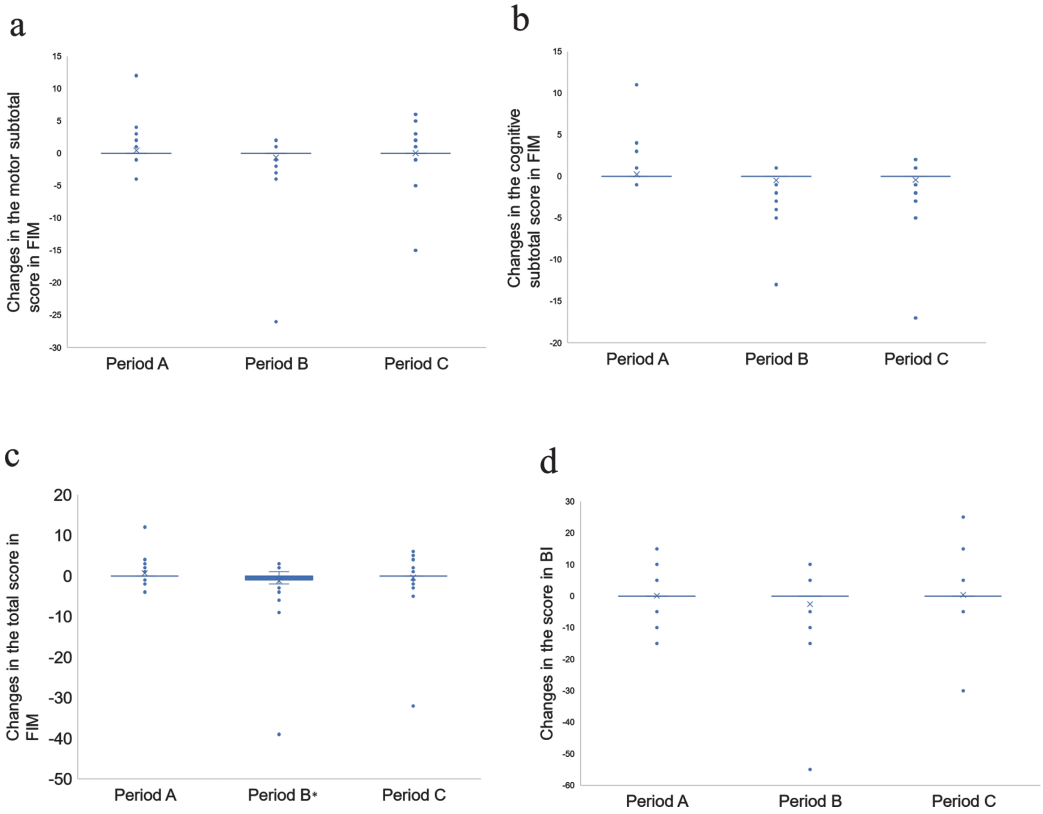

Fig. 3 Comparison of score changes of the mean FIM and mean BI scores in periods A, B, and C
Changes in the motor subtotal, cognitive subtotal, and total scores in the functional independence measure (FIM) (a, b, c) and Barthel index (BI) (d). The average value is shown with a x-mark. The median value is shown with a horizontal line. Statistical significance was detected in the total score of FIM in period B (*).

DISCUSSION

Herein, we reported the aggravation of immobility syndrome in older patients who were negative for COVID-19 during behavior restriction due to a clustered COVID-19 infection. The decline in the mean FIM and mean BI scores of the older patients in this study demonstrates the impact of suspension of rehabilitation therapy and restricted daily life as part of the protocol to prevent the spread of the COVID-19 infection. There was a statistically significant decline in the mean total score in the FIM of the patients during behavior restriction. To the best of our knowledge, this is the first report from a chronic care hospital that demonstrates the aggravation of immobility syndrome in older adults negative for COVID-19 as secondary medical issue related to the COVID-19 pandemic.

Previous studies have reported on hospitalization as a risk factor for a decline in ADL in older patients.[18-23] Kortebein et al reported decreased lower extremity strength after 10 days of bed rest. In their study, the participants were healthy sexagenarians.[24] The patients in our study were older than the participants in the study by Kirtebein et al; thus, we believe that environmental factors may have further affected our patients compared to those in the study by Kirtebein et al.

In our study, the FIM mean motor score improved during period A due to rehabilitation therapy; however, the FIM mean motor score declined during period B though statistical significance was not detected. Cessation of rehabilitation therapy and restricted life space may have resulted in aggravation of motor function decline in the patients. A decline in cognitive function, which was also observed in our study, has also been described as a negative impact of restricted life environment related to lockdown measure.[16] Cessation of rehabilitation therapy also negatively affected the maintenance or amelioration of cognitive function in our patients. The reason for which statistical significance was not detected in the decline of the mean motor and cognitive subtotal score of FIM might have been related to the limited number of the patients in this study.

The change in the BI score in period B was not statistically significant. The discrepancy in the statistical results between the FIM and BI scores is notable. Generally, the FIM reflects patients' ADL, while the BI reflects the ability to perform daily activities. Our patients lived in a restricted space for 25 days due to zoning management for the wards, resulting in restrictions in ADL, which may have resulted in significantly declined FIM scores. While statistical significance was not detected in the change in the BI scores in period B, the tendency for statistical significance was demonstrated with a p-value of 0.059. This may mean that the ability to perform ADL indicated by the BI score may decline when ADL are restricted or not performed. As the responsiveness of FIM is considered superior to that of BI,[25] the aggravated immobility syndrome in our patients following suspension of rehabilitation therapy may be indicated by the statistical significance of the changes in FIM. The FIM scores continued to decline even one month after reinitiating rehabilitation therapy, while the recovery in the BI score was observed. This finding also might result from the superiority of FIM to that of BI. As the decline of the FIM scores in period C was smaller than that in period B, the reinitiated rehabilitation therapy must have contributed toward improving the ability of daily living of the patients. However, the declined ability of the patients one month after reinitiating rehabilitation therapy remained worse than the ability evaluated one month before the behavior restriction.

Telerehabilitation therapy has become an alternative treatment to conventional rehabilitation during COVID-19 pandemic. The usefulness of telerehabilitation therapy in hospitals and in the domestic environment has been described.[5,17,26-28] However, the efficacy of telerehabilitation therapy in older patients with a mean FIM cognitive score of 15.0 remains questionable. Thus, further research is warranted to establish simple and effective telerehabilitation therapy for older patients. Rehabilitation therapy should be planned and implemented based on the cognitive function of older individuals. Continuous rehabilitation therapy with standard infection control precautions during the clustered COVID-19 infection in our hospital may have prevented the aggravation of immobility syndrome in our patients; however, rehabilitation therapy was suspended, and patient space was restricted as per instructions by the public health authorities to prevent the spread of clustered COVID-19 infection. We believe that rehabilitation therapy was ceased partially because, at the time of the study, there was still a lack of evidence or reports concerning the risk for aggravation of immobility syndrome in older patients negative for COVID-19 as a secondary negative impact of the COVID-19 pandemic.

The threat of COVID-19 infection persists with the spread of various viral subtypes.[29] Based on this article, medical staff should be aware not only of the threat of COVID-19 infection, but also of indirect and secondary negative impact related to the COVID-19 pandemic.

Limitations

This study had some limitations. First, this study was performed at a single chronic care hospital. The number of recruited patients was limited, which may have affected the discrepancy in the statistical results of the changes in FIM and BI scores. In addition, although patient

ADL were evaluated using FIM and BI, multiple rehabilitation therapists evaluated the patients' performance. Thus, subjective bias cannot be completely excluded, and inter-rater variation may exist. No concrete method to prevent the aggravation of immobility syndrome in older patients with clustered COVID-19 infection was proposed in this study. Therefore, further research regarding this issue is warranted.

CONCLUSION

Behavior restriction due to a clustered COVID-19 infection may result in the aggravation of immobility syndrome in older patients negative for COVID-19. Medical staff should be aware of this secondary risk amidst the COVID-19 pandemic. Rehabilitation therapy oriented to older people negative for COVID-19 should be established to prevent the aggravation of immobility syndrome.

ACKNOWLEDGMENTS

We appreciate all the stuff in Hikari Hospital for their collaboration. We would like to thank Editage (www.editage.com) for English language editing.

CONFLICT OF INTEREST

None.

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