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ORIGINAL ARTICLE

Effect of Chair-stand Exercise on Improving Urinary and Defecation Independence in Post-stroke Rehabilitation Patients with Sarcopenia

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Objectives: There is a lack of evidence regarding the association between whole-body exercise and independence in urination and defecation. This study aimed to evaluate the effect of chair-stand exercise on improving urination and defecation independence in post-stroke patients with sarcopenia. **Methods:** A retrospective study was conducted on stroke patients admitted to a community rehabilitation hospital between 2015 and 2021. Patients diagnosed with sarcopenia who required assistance with bladder and bowel management were included. The primary outcomes were the Functional Independence Measure (FIM) scores for urination (FIM-Bladder) and defecation (FIM-Bowel) at discharge. Multiple regression analysis was used to examine the association between chair-stand exercise and the outcomes, adjusting for potential confounders. **Results:** Of 586 patients, 187 patients (mean age 79.3 years, 44.9% male) were included in the urination analysis, and 180 patients (mean age 79.3 years, 44.4% male) were included in the defecation analysis. Multiple regression analysis showed that the number of chair-stand exercises was independently positively associated with FIM-Bladder at discharge (β=0.147, P=0.038) and FIM-Bladder gain (β=0.168, P=0.038). Similarly, the number of chair-stand exercises was independently positively associated with FIM-Bowel at discharge (β=0.149, P=0.049) and FIM-Bowel gain (β=0.166, P=0.049). **Conclusions:** Chair-stand exercise was positively associated with improved urination and defecation independence in post-stroke patients with sarcopenia. Incorporating whole-body exercises, such as chair-stand exercise, in addition to conventional rehabilitation programs may help improve voiding independence, reduce incontinence, and enhance quality of life in these patients.

Key Words: cognitive function; convalescent rehabilitation; dysphagia; motor function; stroke

INTRODUCTION

Incontinence and non-independence of urination and defecation are important sequelae of stroke. Risk factors for urinary incontinence include age, body mass index (BMI), smoking, diabetes, pregnancy, hysterectomy, poor general health, and stroke.[1,2] Risk factors for fecal incontinence include age, obesity, poor general health, physical inhibition, and stroke.[3,4] Poststroke constipation is a common complication during inpatient rehabilitation.[5–7] Older adults with incontinence are at increased risk of depression, social isolation, falls, loss of independence, and institutionalization.[8–10]

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In addition, poor incontinence control can significantly affect an individual's quality of life (QOL), not only in terms of physical function, but also in terms of social relationships.[11–14] The relationship between incontinence symptom intensity and QOL underscores the importance of improving bladder control in older adults.[9]

Sarcopenia is negatively associated with activities of daily living (ADL) and QOL. It is caused by aging, disease, low activity, and poor nutrition, and is diagnosed by loss of skeletal muscle mass, muscle strength, and physical function.[15] Sarcopenia is estimated to affect between 1% and 29% of community-dwelling older adults,[16,17] particularly in patients undergoing rehabilitation, where the prevalence of sarcopenia is about 50%.[16] Sarcopenia is also associated with adverse outcomes such as decreased physical activity, falls, fractures, dysphagia, and death.[18–20] It has also been reported that the presence of sarcopenia on admission to a convalescent rehabilitation ward is negatively associated with greater independence in urination and defecation at discharge.[21] Therefore, prevention, diagnosis, and treatment of sarcopenia are important.

Exercise therapy can improve physical function in older adults, such as muscle strength and balance, and ADL, such as age-related functional decline, walking speed, and stair climbing.[22,23] In older adults with sarcopenia, a comprehensive exercise program combining resistance exercise and other forms of exercise such as balance, endurance, and aerobic exercise improves muscle mass, strength, and physical function.[24,25] Among exercise therapies, chair-stand exercise has been reported to be positively associated with improvements in sarcopenia and ADLs.[26] Therefore, exercise therapy is important for all older adults.[26–29] However, there is a lack of evidence linking exercise therapy to improved urination and defecation control.[30–32]

Given that sarcopenia is negatively associated with independence in urination and defecation, it is expected that exercise therapy would be effective in improving independence in urination and defecation. Therefore, we conducted a retrospective study in post-stroke patients with sarcopenia to determine the effect of chair-stand exercise on improving independence in urination and defecation.

MATERIALS AND METHODS

Participants and Settings

The study was conducted in a 135-bed community rehabilitation hospital, including three convalescent rehabilitation units (45 beds each). The study focused on stroke patients admitted to the hospital for the first time between January 2015 and December 2021. The study included patients who were identified as having sarcopenia on admission and who needed assistance with bladder and bowel management. Patients were excluded if they refused to participate, had incomplete data, were not fully conscious, had significant swelling or hydration changes, or had a pacemaker. The observation period for each patient was from the date of admission to the date of discharge.

Data Collection

At admission, data collection included: patient age, sex, medical conditions as assessed by the Charlson Comorbidity Index (CCI),[33] premorbid ADL as assessed by the Modified Rankin Scale (mRS),[34] history of stroke, type of stroke, BMI, swallowing ability as assessed by the Food Intake Level Scale (FILS),[35] nutritional assessment as assessed by the Geriatric Nutritional Risk Index (GNRI), and level of paralysis as assessed by the Brunnstrom Scale (BRS), among other baseline details. Tests of higher brain function were used to test for higher brain dysfunction, such as attention deficit and aphasia. Information on the use of balloon catheters and laxatives was also collected from medical records. Within the first 72 h of admission, BMI, skeletal muscle, and fat mass were assessed by bioelectrical impedance analysis (BIA) using the InBody S10 device (InBody S10; InBody, Tokyo, Japan), handgrip strength (HG), and the Functional Independence Measure (FIM)[36] to assess physical and cognitive abilities. HG was measured using a Smedley hand dynamometer (TTM, Tokyo, Japan) with the non-dominant or non-paralyzed hand in a standing or sitting position with the arm extended, taking the best of three attempts. BIA measurements were performed with proper hydration, 4 h after a meal, with the patient resting in bed for 1 h prior to testing, and without recent fever, tremor, or acute illness. The FIM evaluation also included the FIM-Toileting and FIM-Transfer to the toilet, two FIM sub-items that may be relevant to voiding.

Sarcopenia Diagnosis

The diagnosis of sarcopenia, according to the 2019 guidelines of the Asian Working Group for Sarcopenia,[18] requires the presence of both reduced skeletal muscle mass index (SMI) determined by BIA and reduced muscle strength assessed by HG, with thresholds tailored to the Asian elderly population. A validated multifrequency BIA device was used to measure skeletal muscle and fat mass. SMI was calculated by dividing skeletal muscle mass by height in meters squared. The cutoff values for SMI to define sarcopenia were less than 7.0 kg/m^2 for men and less than 5.7 kg/m^2 for women. The cutoff values for HG to define sarcopenia were less than 28 kg for men and less than 18 kg for women.

Chair-stand Exercise

In addition to the usual rehabilitation program, patients were given “chair-stand exercises” as full-body resistance training. The chair-stand exercises involved the use of a standard chair, a platform, and a wheelchair, with the seat height adjusted to each patient’s body size, ranging from 40 to 50 cm. Supportive equipment such as parallel bars and handrails were used as needed. Rehabilitation therapists provided assistance to those who had difficulty standing independently. Sessions lasted 20 min, during which individuals performed sit-to-stand movements up to 120 times, maintaining a rhythm of approximately one sit-to-stand cycle every 8 s. The intensity of the exercise was individualized, with the number of repetitions increasing progressively to increase muscle strength and endurance. These exercises were significantly slower and gentler than other full-body workouts for older adults, at 20%–30% of the maximum number of repetitions per repetition. The number of chair-stand exercises was determined by each assigned therapist based on the severity of symptoms, the patient’s motivation, and the amount of pain and assistance required. Each patient was encouraged to participate in as many standing exercises as possible. These exercises were considered a safe and effective method for increasing muscle mass and strength in older adults with diminished physical abilities.[37)]

Outcomes

The primary outcome was defined as the sphincter control items of the FIM at discharge from a convalescent ward: urination (FIM-Bladder) and defecation (FIM-Bowel). The FIM is divided into two sections: the motor domain (FIM-motor), which includes 13 items, and the cognitive domain (FIM-cognitive), which includes 5 items; both the FIM-Bladder and FIM-Bowel fall into the FIM-motor category. The FIM total score ranges from 18 to 126, the FIM motor score from 13 to 91, and the FIM cognitive score from 5 to 35. Sphincter control is assessed by the timely contraction of the sphincter at appropriate times for urination or defecation. Scoring considered both the frequency of incontinence and the amount of assistance required, with the lower score being recorded. Clothing manipulation before and after urination, wiping the buttocks, and transferring the patient were not included in the evaluation. Tasks were rated on a 7-point ordinal scale from 1 (complete assistance) to 7 (complete independence), with lower scores indicating greater dependency. The secondary outcomes were the FIM-Bladder gain and the FIM-Bowel gain. The FIM-Bladder gain and FIM-Bowel gain were calculated by subtracting the admission scores from the discharge scores of FIM-Bladder and FIM-Bowel, respectively.

Sample Size Calculation

The sample size was calculated using data from our previous study,[38)] the results of which showed that the standard deviations of FIM-Bladder and FIM-Bowel of patients on hospital admission were 2.46 and 2.25, respectively. If the true difference in means between patients with low and high frequency of chair-stand exercise is 1.00, we would need to study 83 and 81 participants in each group, respectively, to reject the null hypothesis that the population means of the experimental and control groups are equal with a power of 0.80. The Type I error probability associated with this test of the null hypothesis was 0.05.

Statistical Analysis

All analyses were performed with SPSS version 21 (IBM, Armonk, NY, USA). Results were reported as mean±standard deviation (SD) for parametric data, median [interquartile range; IQR] for nonparametric data, and number (percentage) for categorical data. Based on the median daily frequency of chair-stand exercise, patient backgrounds were compared between two groups: the high-frequency chair-stand exercise (HF) group and the low-frequency chair-stand (LF) exercise group. FIM-Bladder at discharge and FIM-Bowel at discharge and FIM-Bladder gain and FIM-Bowel gain were compared between the HF group and the LF group using the Mann–Whitney U test. Multiple regression analysis was used to examine the association between FIM-Bladder at discharge and chair-stand exercise and between FIM-Bladder gain and chair-stand exercise. Multiple regression analysis was also used to examine the association between FIM-Bowel at discharge and chair-stand exercise and between FIM-Bowel gain and chair-stand exercise. The covariates used for adjustment as potential confounders of outcomes were age, sex, length of hospital stay, premorbid mRS, CCI, HG, SMI, lower limb BRS, rehabilitation therapy, FIM-Total, aphasia, higher brain dysfunction, voiding management at admission (FIM-Bladder or FIM-Bowel), FIM-Transfer to the toilet on admission, and FIM-Toileting on admission, all of which are reported to be clinically relevant to rehabilitation outcomes. Multicollinearity was assessed using Variance Inflation Factor (VIF), with VIF less than 10 considered as no multicollinearity; $P<0.05$ was considered statistically significant.

Ethics

The study was approved by the Institutional Review Board of Kumamoto Rehabilitation Hospital, Kumamoto, Japan (approval number 222–230414). Participants were free to withdraw from the study at any time via an opt-out option. Written informed consent was not obtained because of the retrospective nature of the study. The study was conducted in accordance with the principles of the Declaration of Helsinki and ethical standards for medical and health research involving human subjects.

RESULTS

One thousand and eighteen stroke patients were consecutively admitted to our convalescent wards between 2015 and 2021. Of these, 586 patients were selected after the exclusion of 432 patients: 116 patients who were non-compliant with the BIA, 36 patients with severe impaired consciousness, and 280 patients with missing data. A further 329 patients without sarcopenia were excluded, leaving 257 patients with sarcopenia to be included. For the analysis of urination, 187 patients were included in the final analysis after the exclusion of 70 patients with FIM-Bladder scores of 6 or higher on admission. For the analysis of defecation, 180 patients were included in the final analysis after the exclusion of 77 patients with FIM-Bowel scores of 6 or higher on admission (**Fig. 1**).

Table 1 summarizes the baseline characteristics and comparisons between the two groups of post-stroke sarcopenia patients according to their frequency of chair-stand exercise. The analysis of urination included 187 subjects, with a mean age of 79.3 years and 44.9% were male. The median [IQR] for FIM-Bladder at admission was 1 [1–2] in the Total group, 2 [1–3] in the HF group, and 1 [1–1] in the LF group. The median number of chair-stand exercises was 43.8. The median [IQR] number of chair-stand exercises was 74.0 [57.3–103.5] in the HF group and 19.5 [9.1–33.3] in the LF group. FILS, GNRI, BRS, FIM scores (total, motor, cognitive, toileting, transfer to the toilet), and HG were significantly higher in the HF group than in the LF group ($P<0.001$). Aphasia was present in 67 patients (35.8%) and higher brain dysfunction in 83 patients (44.4%), but no significant difference was observed between the two groups. Balloon catheters were used by 8 patients (4.3%) at admission: 2 in the HF group and 6 in the LF group.

The analysis of defecation included 180 subjects, with a mean age of 79.3 years, and 44.4% were male. The median number of chair-stand exercises was 43.1. The median [IQR] number of chair-stand exercises was 75.6 [57.3–103.5] in the HF group and 18.7 [8.7–33.0] in the LF group. The HF group had significantly higher scores in swallowing status (FILS), nutritional status (GNRI), paralysis severity (BRS), FIM (total, motor, cognitive, toileting, transfer to the toilet), and HG ($P<0.001$). Sixty-four patients (35.6%) had aphasia and 80 (44.4%) had higher brain dysfunction, but there was no significant difference between the two groups. Laxatives were used by 34 patients (18.9%) at admission: 17 in the HF group and 17 in the LF group.

Table 2 shows the bivariate analysis of outcomes between the HF and LF groups. Analysis of urination outcomes showed that FIM-Bladder at discharge was significantly higher ($P<0.001$) in the HF group: HF group, 6 [3–7]; LF group, 2 [1–4]. The FIM scores indicated that the majority of patients in the LF group required assistance with urination at discharge. FIM-Bladder gain was significantly higher ($P<0.001$) in the HF group: HF group, 2 [1–5]; LF group, 0 [0–3]. When comparing defecation-related outcomes, FIM-Bowel at discharge was significantly higher ($P<0.001$) in the HF group: HF group, 6 [3–7]; LF group, 2 [1–5]. Many patients in the LF group required assistance with defecation at discharge. FIM-Bowel gain was also significantly higher in the HF group ($P<0.001$).

Table 3 shows the results of the multiple regression analysis with FIM-Bladder at discharge and FIM-Bladder gain as dependent variables. No multicollinearity between variables was observed. All multiple regression analyses included the same covariates. Multiple regression analysis showed that the number of chair-stand exercises was independently positively associated with FIM-Bladder at discharge ($\beta=0.147$, $P=0.038$) and FIM-Bladder gain ($\beta=0.168$, $P=0.038$).

Table 4 shows the results of the multiple regression analysis with FIM-Bowel at discharge and FIM-Bowel gain as dependent variables. No multicollinearity was found between the variables. Multiple regression analysis showed that the number of chair-stand exercises was independently positively associated with FIM-Bowel at discharge ($\beta=0.149$, $P=0.049$) and FIM-Bowel gain ($\beta=0.166$, $P=0.049$).

DISCUSSION

This study evaluated the effect of chair-stand exercise on improvement in urination and defecation independence in post-stroke patients with sarcopenia. The results showed that

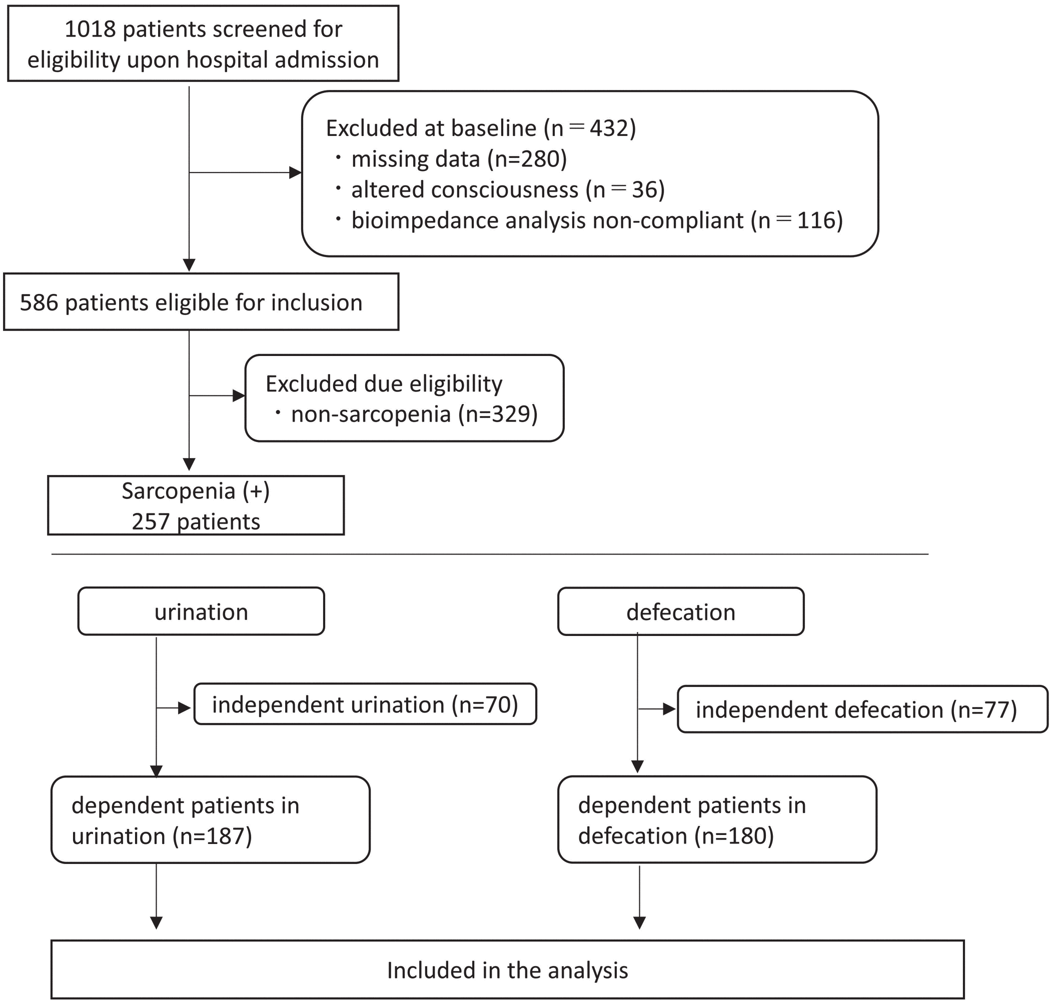

Fig. 1. Flowchart of participant screening and inclusion.

chair-stand exercise was positively associated with improved urinary independence and improved defecation independence in these patients.

Chair-stand exercise was positively associated with improved urinary independence. To the best of our knowledge, this is the first reported evidence of this association. The mechanism behind the positive association may be related to the ability of resistance exercise to boost muscle strength and mass. Sarcopenia entails a gradual decline in muscle mass, strength, and function, potentially resulting in incontinence and reduced autonomy in urination. Chair-stand exercises can increase muscle strength and mass,[26] thereby promoting improved urinary independence in patients with sarcopenia.[39] Furthermore, because chair-stand movements are directly related to ADLs, repeated practice of this exercise may have facilitated improvement in voiding movements. In addition, because FIM was used in this study to assess ADLs, gaining toileting skills would improve FIM scores. Because chair-stand exercise is significantly associated with improvement in FIM-Motor, it is likely that the ability to stop using diapers and use the toilet for bowel movements contributed to the improvement in urinary independence. Therefore, we consider that chair-stand exercises should be incorporated into routine rehabilitation programs for patients with decreased urinary independence.

Chair-stand exercise was positively associated with improved defecation independence. The mechanism for this association is likely to be similar to that associated with urinary independence. We believe that chair-stand exercise improved sarcopenia and indirectly contributed to improved defecation independence. A recent study found a 23% prevalence of fecal incontinence in patients with dysphagia, and sarcopenia was independently associated with fecal incontinence, suggesting the presence of "anal sarcopenia".[39] Therefore,

Table 1. Baseline characteristics of post-stroke patients with sarcopenia and comparison of LF and HF groups

Characteristic	Patients dependent in urination (FIM-Bladder≤5)				Patients dependent in defecation (FIM-Bowel≤5)			
	Total n=187	HF group n=94	LF group n=93	P value	Total n=180	HF group n=90	LF group n=90	P value
Age, years	79.3 ± 9.9	78.3 ± 9.9	80.3 ± 10.0	0.181[a]	79.3 ± 10.2	78.3 ± 10.1	80.3 ± 10.2	0.190[1)]
Sex (male)	84 (44.9)	47 (50.0)	37 (39.8)	0.187[b]	80 (44.4)	43 (47.8)	37 (41.1)	0.368[b]
Length of stay, days	123 [84–151]	121 [84–150]	126 [83–151]	0.730[c]	125 [84–151]	123 [86–152]	127 [82–151]	0.933[c]
Chair-stand exercise, frequency/day	43.8 [19.5–75.5]	74.0 [57.3–103.9]	19.5 [9.1–33.3]	<0.001[c]	43.1 [18.7–75.7]	75.6 [57.3–103.5]	18.7 [8.7–33.0]	<0.001[c]
CCI	3 [2–4]	3 [1–4]	3 [2–4]	0.080[c]	3 [2–4]	3 [1–4]	3 [2–4]	0.242[c]
Premorbid mRs	1 [0–3]	1 [0–3]	1 [0–3]	0.321[c]	1 [0–3]	1 [0–2]	1 [0–3]	0.128[c]
History of stroke	64 (34.2)	34 (36.2)	29 (31.2)	0.537[b]	61 (33.9)	33 (36.7)	28 (31.1)	0.431[b]
Stroke type								
Cerebral infarction	108 (57.8)	54 (57.4)	53 (57.0)	1.000[b]	103 (57.2)	52 (57.8)	51 (56.7)	0.880[b]
Cerebral hemorrhage	71 (39.4)	37 (39.4)	34 (36.6)	0.764[b]	68 (37.8)	35 (38.9)	33 (36.7)	0.758[b]
Subarachnoid hemorrhage	8 (2.8)	2 (2.1)	6 (6.5)	0.169[b]	8 (4.4)	2 (2.2)	6 (6.7)	0.139[b]
BMI, kg/m^2	20.6 [18.4–23.1]	20.7 [18.4–23.1]	20.6 [18.9–23.1]	0.995[c]	20.7 [18.5–23.0]	20.8 [18.5–22.8]	20.6 [18.9–23.1]	0.962[c]
FILS	7 [2–8]	7 [6–9]	4 [2–7]	<0.001[c]	7 [2–8]	7 [6–9]	3 [2–7]	<0.001[c]
GNRI	88.1 [80.9–94.7]	91.4 [83.5–98.5]	85.0 [79.8–91.4]	<0.001[c]	88.0 [80.1–94.6]	91.2 [83.5–98.3]	84.7 [79.5–90.9]	<0.001[c]
BRS								
Upper limb	3 [1–5]	4 [2–5]	2 [1–4]	0.001[c]	3 [1–5]	4 [2–5]	2 [1–5]	0.003[c]
Finger	3 [1–5]	4 [2–5]	2 [1–4]	<0.001[c]	3 [1–5]	4 [2–5]	2 [1–5]	0.001[c]
Lower limb	4 [2–5]	5 [2–5]	2 [1–5]	<0.001[c]	3 [1–5]	4 [2–5]	2 [1–5]	<0.001[c]
FIM								
Total	32 [21–48]	44 [30–58]	23 [19–33]	<0.001[c]	31 [24–46]	41 [29–53]	23 [19–33]	<0.001[c]
Motor	18 [13–28]	25 [16–40]	14 [13–18]	<0.001[c]	16 [13–26]	23 [16–35]	14 [13–18]	<0.001[c]
Transfer to the toilet	1 [1–1]	1 [1–3]	1 [1–1]	<0.001[c]	1 [1–2]	2 [1–3]	1 [1–1]	<0.001[c]
Toileting	5 [2–6]	2 [1–4]	1 [1–1]	<0.001[c]	1 [1–1]	1 [1–2]	1 [1–1]	<0.001[c]
Sphincter control	-	-	-	-	-	-	-	-
Bladder	1 [1–2]	2 [1–3]	1 [1–1]	<0.001[c]	-	-	-	-
Bowel	-	-	-	-	1 [1–2]	2 [1–2]	1 [1–1]	<0.001[c]
Cognitive	12 [7–18]	14 [11–20]	9 [6–15]	<0.001[c]	12 [7–17]	14 [10–20]	9 [6–15]	<0.001[c]
HG, kg	9.9 [0–15.4]	12.9 [8.0–19.3]	4.5 [0–12.9]	<0.001[c]	9.4 [0–15.2]	12.4 [7.5–19.3]	4.3 [0–12.8]	<0.001[c]
SMI, kg/m^2	5.1 [4.5–5.9]	5.3 [4.7–6.2]	5.1 [4.4–5.8]	0.084[c]	5.2 [4.6–5.9]	5.4 [4.7–6.2]	5.1 [4.4–5.7]	0.108[c]
Rehabilitation therapy, units/day	8.1 [7.2–8.5]	8.3 [7.7–8.6]	7.9 [6.7–8.3]	<0.001[c]	8.1 [7.2–8.5]	8.3 [7.7–8.6]	7.8 [6.7–8.3]	<0.001[c]
Aphasia	67 (35.8)	38 (40.4)	29 (31.2)	0.223	64 (35.6)	37 (41.1)	27 (30.0)	0.161
Higher brain dysfunction	83 (44.4)	45 (47.9)	38 (40.9)	0.378	80 (44.4)	43 (47.7)	37 (41.1)	0.453
USN	42 (22.5)	20 (21.3)	22 (23.7)	0.729	42 (23.3)	21 (23.3)	21 (23.3)	1.000
Use of balloon catheter	8 (4.3)	2 (2.2)	6 (6.5)	0.169	-	-	-	-
Laxatives	-	-	-	-	34 (18.9)	17 (18.9)	17 (18.9)	1.000

Parametric data are presented as mean ± SD; nonparametric data as median [IQR]; categorical data as number (percentage).
Rehabilitation therapy: physical, occupational, and speech therapy; USN, unilateral spatial neglect.
[a] *t*-test; [b] chi-square test; [c] Mann–Whitney U test

Table 2. Bivariate analysis of outcomes between HF and LF groups

	Total	HF group	LF group	P value [a]
Urination				
Not independent on admission	n=187	n=94	n=93	
FIM-Bladder on admission	1 [1–2]	2 [1–3]	1 [1–1]	<0.001
FIM-Bladder on discharge	3 [1–6]	6 [3–7]	2 [1–4]	<0.001
FIM-Bladder gain	2 [0–4]	2 [1–5]	0 [0–3]	<0.001
Defecation				
Not independent on admission	n=180	n=90	n=90	
FIM-Bowel on admission	1 [1–2]	2 [1–2]	1 [1–1]	<0.001
FIM-Bowel on discharge	4 [1–6]	6 [3–7]	2 [1–5]	<0.001
FIM-Bowel gain	2 [0–4]	2 [1–5]	1 [0–3]	<0.001

Data given as median [IQR].
[a] Mann–Whitney U test.

Table 3. Multivariate analysis for FIM-Bladder at hospital discharge and FIM-Bladder gain

Factor	FIM-Bladder on discharge		FIM-Bladder gain	
	β	P value	β	P value
Age	−0.137	0.038	−0.157	0.038
Sex	−0.243	0.006	−0.277	0.006
Length of stay	0.102	0.120	0.117	0.120
Premorbid mRS	−0.170	0.010	−0.194	0.010
CCI	0.008	0.889	0.010	0.889
HG	0.138	0.091	0.158	0.091
SMI	0.102	0.222	0.116	0.222
Lower-limb BRS	0.152	0.041	0.173	0.041
Rehabilitation therapy	−0.038	0.526	−0.044	0.526
FIM-Total	0.434	0.001	0.496	0.001
FIM-Bladder on admission	0.130	0.138	−0.442	0.000
FIM-Transfer to toilet on admission	−0.153	0.158	−0.174	0.158
FIM-Toileting on admission	−0.040	0.673	−0.046	0.673
Higher brain dysfunction	−0.034	0.572	−0.039	0.572
Aphasia	0.046	0.461	0.053	0.461
Chair-stand exercise	0.147	0.038	0.168	0.038

it is possible that the chair-stand exercise improved muscle strength of the whole body and lower extremities, resulting in improved strength of the pelvic floor muscle group, abdominal pressure, and other muscle groups involved in bowel movements.[6,39] In addition, the repetitive movements associated with orthostatic exercises have a direct impact on movements associated with voiding, such as transferring to the toilet and toileting, which may also be a factor in improving FIM scores.

Whole-body exercise may be effective in improving urination and defecation independence. Resistance training, balance exercise, and aerobic exercise have been shown to improve muscle strength and walking ability in older patients with sarcopenia,[24] and improving physical function may lead to improved independence in urination and defecation.[37,39] Furthermore, given that chair-stand exercises are low-intensity resistance exercises that are easy to perform and do not require special equipment or space, these patients should be actively encouraged to perform this exercise in addition to their daily program of conventional rehabilitation.[23]

This study has several limitations. First, it was conducted in a single community-based rehabilitation hospital in Japan, which may limit the generalizability of the findings. Second, because of the retrospective nature of the study, it may have

Table 4. Multivariate analysis for FIM-Bowel at hospital discharge and FIM-Bowel gain

Factor	FIM-Bowel on discharge		FIM-Bowel gain	
	β	P value	β	P value
Age	−0.159	0.025	−0.176	0.025
Sex	−0.207	0.025	−0.230	0.025
Length of stay	0.095	0.182	0.105	0.182
Premorbid mRS	−0.153	0.030	−0.170	0.030
CCI	−0.001	0.991	−0.001	0.991
HG	0.124	0.149	0.138	0.149
SMI	0.136	0.124	0.151	0.124
Lower-limb BRS	0.154	0.047	0.171	0.047
Rehabilitation therapy	−0.069	0.286	−0.076	0.286
FIM-Total	0.445	0.445	0.494	0.003
FIM-Bowel on admission	0.072	0.072	−0.517	0.000
FIM-Transfer to toilet on admission	−0.182	0.099	−0.202	0.099
FIM-Toileting on admission	−0.054	0.621	−0.060	0.621
Higher brain dysfunction	0.029	0.654	0.032	0.654
Aphasia	−0.003	0.062	−0.004	0.062
Chair-stand exercise	0.149	0.049	0.166	0.049

been influenced by unexplained confounding factors, such as medical treatment during the study period. Third, incontinence was not diagnosed according to medical diagnostic criteria. In this study, the FIM-Bladder and FIM-Bowel subscales of FIM were used to assess urinary and defecation independence, which may not accurately assess the degree of independence of incontinence. In the future, high-quality prospective multicenter studies should be conducted to elucidate the causal relationship between chair-stand exercise and improvement in urination and defecation independence.

CONCLUSION

Chair-stand exercise was positively associated with urination and defecation independence in stroke patients with sarcopenia. To improve voiding independence and incontinence and further improve QOL, whole-body exercises such as chair-stand exercise should be performed by these patients in addition to their conventional rehabilitation programs.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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