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Original Article

Factors associated with low physical performance among older inpatients

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ABSTRACT

Background/Purpose: To explore the factors associated with low physical performance among older inpatients.

Methods: This cross-sectional study included 167 older inpatients aged 65 years and above (median: 83 years, women: 50.9%). We assessed physical performance using the Short Physical Performance Battery (SPPB). Low physical performance was identified by a SPPB score of four or lower. Measured variables included muscle strength, kyphosis, joint range of motion (ROM), and clinical characteristics. Separate stepwise logistic regression analysis between genders was performed to assess the relationship between low physical performance and the measured variables.

Results: In men, knee-extensor muscle strength was associated with low physical performance. The odds ratio (OR) with a 95% confidence interval (CI) for knee-extensor muscle strength (per 0.1 Nm/kg) and low physical performance was 0.59 (0.45–0.77). In women, knee-extensor muscle strength, handgrip strength (per 1.0 kgf), and hip-extension ROM (per 5°) were associated with low physical performance. The OR of knee-extensor muscle strength, handgrip strength, and hip-extension ROM for the low physical performance were 0.73 (0.54–0.99), 0.83 (0.69–0.99), and 0.26 (0.13–0.53), respectively.

Conclusions: Factors associated with low physical performance in women were knee-extensor muscle strength, handgrip strength, and hip-extension ROM; and knee-extensor muscle strength in men.

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INTRODUCTION

Hospitalization for acute illnesses is common among older adults, especially those who are frail. A previous study reported that 49.3% of individuals aged 70 and older had been hospitalized for five years.[1] Fried et al. reported that 59% of frail older adults were hospitalized during the three-year follow-up.[2] Moreover, the prevalence of frailty among older adults was linked to age.[3]

Hospitalization is associated with disability in older adults.[1] Hospitalization-related disability has been observed in 20–30% of older inpatients.[1] Disability is caused by deconditioning due to bed rest, malnutrition, and inflammation. Moreover, deconditioning leads to physical dysfunction, such as muscle weakness, joint contracture, and balance disorder in older inpatients. Thus, management of physical functioning is very important to prevent disability in older inpatients.

An older individual's ability to walk, stand, and maintain balance is associated with his or her prognosis. Low physical performance increases the risk of disability and mortality[4,5] in both community-dwelling older adults and older inpatients.[6] Muscle weakness, kyphosis, and comorbidity are associated with poor physical performance among community-dwelling older adults.[7-9] Medical conditions were associated with poor physical performance among older inpatients.[10] However, research on physical performance in older inpatients is limited.

The aim of this study was to explore the factors associated with low physical performance in older inpatients. We hypothesized that musculoskeletal factors would have a greater influence on physical performance than medical factors would.

METHODS

Participants

The participants of this cross-sectional study comprised inpatients admitted to the Department of Rehabilitation Medicine, Kawasaki Municipal Tama Hospital, Kanagawa, Japan, from July 2013 to October 2015, for acute medical illnesses. The inclusion criteria were age 65 years or older, the ability to ambulate a few meters without physical assistance, and obtained informed consent. Exclusion criteria included central neurological disease, acute orthopedic disease, advanced cancer, and contraindications of exercise therapy as per the American College of Sports Medicine's Guidelines for Exercise Testing and Prescription, eighth edition.[11] All the data was collected at the time of discharge. The present study was carried out in accordance with the Declaration of Helsinki, and the study protocol was reviewed and approved by the Kawasaki Municipal Tama Hospital Institutional Committee on Human Research.

Measures

Physical performance

Physical performance was measured using the Short Physical Performance Battery (SPPB), consisting of a four-meter usual-paced walk, a standing balance test, and a chair standing time test, that is, the time taken to stand up and sit down from a chair five times.[5,12] The SPPB demonstrates good validity. The scores range between 0–12, with lower scores indicating an increased risk for disability and mortality.[5,12] Low physical performance (1, yes; 0, no) was defined indicated by an SPPB score of 4 or lower, according to Volpato et al.[6]

Muscle strengths

To record muscle strength, handgrip and knee-extensor muscle strength were assessed as indices of upper and lower limb strength, respectively. Handgrip strength was measured with a standard adjustable-handle Jamar dynamometer (Bissell Healthcare, Grand Rapids, MI, USA) set at the second position. Handgrip strength was calculated as the highest value of three trials; we calculated the mean of the highest value of the right and left hand handgrip strength (kgf).[13] Knee-extensor muscle strength was measured with a hand-held dynamometer (μTas MT-1; ANIMA, Tokyo, Japan). All patients sat on a bench, and the dynamometer was fixed to a rigid bar. Knee-extensor muscle strength was calculated as the highest value of three trials; we calculated the mean of the highest value of the right and left knee-extensor strength divided by the individual's body weight (Nm/kg).

Kyphosis

Kyphosis was measured by the kyphosis index. A flexicurve ruler was molded along the participant's spine when standing upright. We placed one end of the flexicurve ruler at the seventh cervical vertebra (C7), and the end at the lumbosacral joint. The curve obtained by the flexicurve ruler was traced onto graph paper. A straight line was then drawn from the level of C7 to the lumbosacral joint. We measured the thoracic width and thoracic length. The thoracic width was the distance between which the perpendicular from the straight line intersected the curve at the longest distance. The thoracic length was the distance from where the straight line from C7 intersected the curve. The kyphosis index was represented by the thoracic width divided by the thoracic length and multiplied by 100. A higher kyphosis index indicated greater kyphosis. This kyphosis measurement reported intra-rater and inter-rater reliability.[14] The kyphosis index was calculated as the mean value of three trials.

Joint range of motion

Joint range of motion (ROM) was assessed by the joint angle in the sagittal plane of the lower limb. We measured passive ROM in hip flexion, hip extension, knee flexion, knee extension, ankle dorsiflexion, and ankle plantarflexion.[15-17] Each measurement was performed thrice in each joint for both legs using a goniometer. We calculated the mean value of three measurements in each joint and the mean value of the right and left leg in each motion as a representative value of joint ROM.

Demographic and clinical characteristics

Medical records of the patients were used to obtain information about demographic data and clinical characteristics, including length of hospitalization, admission diagnosis, comorbidity, blood biochemical data, body mass index (BMI), cognitive function, and activities of daily living (ADL). Comorbidity was assessed using the Charlson index and also the prevalence of medical conditions like heart disease, chronic obstructive pulmonary disease (COPD), diabetes, and chronic kidney disease

(CKD). Blood biochemical data included haemoglobin, serum albumin, estimated glomerular filtration rate (eGFR), and C-reactive protein (CRP). BMI was stratified based on the criteria by the World Health Organization: underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), and obese (25 kg/m^2 or more).[18] Cognitive function was assessed by the Revised Hasegawa's Dementia Scale (HDS-R)[19] and ADL were measured by the total Barthel Index score.[20]

Statistical methods

The normality of the variables was assessed by the Shapiro Wilk test. Unpaired t-tests, the Mann-Whitney U test, and chi-squared tests were used to test for differences between patients with low physical performance and intermediate to high physical performance. We evaluated the factors associated with low physical performance using stepwise logistic regression analysis. In the multivariate analysis, we selected variables that are usually associated with low physical performance in the univariate analysis ($p < 0.10$) as independent variables. Analyses were performed separately for men and women, as gender difference in muscle strength level was reported consistently.[21] Statistical significance was defined as $p < 0.05$ for all analyses. Statistical analyses were performed with SPSS (version 21, IBM SPSS Japan, Tokyo, Japan).

RESULTS

Demographic variables, medical conditions, blood biochemical data, and measurement scores are presented in Table 1. Of the 453 potential patients, 167 patients (36.9%) were enrolled based on inclusion and exclusion criteria. The sample comprised 167 patients, with a median age of 83 years (interquartile range: 77–88) and 50.9% comprising women. The admission diagnoses were heart disease (47.3%), respiratory disease (20.4%), gastrointestinal disease (12.6%), kidney disease (6.6%), diabetes (3.0%), and others (10.2%) including urinary tract infection and dehydration. The median SPPB score was 6 (interquartile range: 3–11). Significant differences were observed in gender for the SPPB score, prevalence of COPD, eGFR, CRP, handgrip strength, and knee-extensor muscle strength ($p < 0.05$).

Patients with low physical performance were 36.5% overall, 26.8% of men, and 45.9% of women. Table 2 presents the comparison of patients' characteristics according to their physical performance classification. In men, significant differences were observed between groups for age, Charlson index, HDS-R, handgrip strength, knee-extensor muscle strength, hip-flexion ROM, and hip-extension ROM ($p < 0.05$). Similarly, in women, significant differences were observed between groups for age, length of hospitalization, HDS-R, handgrip strength, knee-extensor muscle strength, kyphosis index, hip-extension ROM, knee-extension ROM, ankle-dorsiflexion ROM, and ankle-plantarflexion ROM ($p < 0.05$).

Table 3 presents the results of logistic regressions. Among men, as independent variables for multivariate analysis, age, Charlson index, heart disease, COPD, HDS-R, handgrip strength, knee-extensor muscle strength, hip-flexion ROM, hip-extension ROM, ankle-dorsiflexion ROM, and ankle-plantar flexion ROM were selected ($p < 0.10$). In the multivariate analysis, knee-extensor muscle strength was associated with low physical performance. The odds ratio (OR) with a 95% confidence interval (CI) of knee-extensor muscle strength (per 0.1 Nm/kg) for the low physical-performance group was 0.59 (0.45–0.77; $p < 0.001$). Among women, as independent variables for multivariate analysis, age, heart disease, BMI, HDS-R, handgrip strength, knee-extensor muscle strength, kyphosis index, hip-flexion ROM, hip-extension ROM, knee-extension ROM, ankle-dorsiflexion ROM, and ankle-plantarflexion ROM were selected ($p < 0.10$). In the multivariate analysis, knee-extensor muscle strength, handgrip strength, and hip-extension ROM were associated with low physical performance. The OR, with a 95% CI of knee-extensor muscle strength (per 0.1 Nm/kg), handgrip strength (per 1.0 kgf), and hip-extension ROM (per 5 degrees) for the low physical-performance group were 0.73 (0.54–0.99; $p=$ 0.042), 0.83 (0.69–0.99; $p < 0.039$), and 0.26 (0.13–0.53; $p < 0.001$), respectively.

DISCUSSION

This study revealed that musculoskeletal factors, such as muscle strength and joint range of motion, are associated with low physical performance in older inpatients. In addition, gender differences were found in factors affecting low physical performance.

Factors associated with low physical performance in this study were consistent with prior research. Several previous studies have reported knee-extensor muscle strength as a predictor for physical performance in older adults across several levels of physical well-being.[22] However, previous studies show that the relevance of grip strength differs according to the participant's characteristics and settings. Therefore, it is not surprising that the relevance of grip strength and physical performance differ between genders in the present study. Regarding hip-extension ROM, the relationship to walking speed has been identified from the biomechanical perspective using the three-dimensional motion analysis. Kerrigan et al. reported that older adults with a higher likelihood of falling had significantly slower walking speed and smaller hip extension ROM than "non-fallers"[23] In short, reduced walking speed may have been affected by restricted hip extension ROM. However, only a few studies demonstrate the relationship between physical performance and joint ROM.

Gender differences in relative factors associated with low physical performance are likely to have been affected by differences in muscular strength. Several studies indicate that women had significantly weaker handgrip strength[21] and knee-extensor muscle strength[24] than men. Therefore, the present results of the significant gender difference in handgrip and knee-extensor muscle strength are consistent with previous studies. Previous studies also found that deterioration in handgrip strength[25] and muscle mass of upper limbs[26] due to aging was more severe for men as compared to women. Thus, handgrip strength affects men and women's physical performance differently. Further, hip-extension ROM was only associated with women's physical performance. Ko et al. reported that the hip ROM for the sagittal plane in older women who walked was less compared to that of men.[27] However, it is difficult to make direct comparisons with this study, because we measured ROM when patients were stationary. Nonetheless, gender differences may exist owing to the influence of hip-extensions in older inpatients.

This study is significant as it provides evidence for the role of musculoskeletal impairments in older inpatients' low physical performance. Considering that relative factors such as muscle strength and joint ROM can be improved through exercise therapy for older adults, including resistance

Table 1. Characteristics of participants and comparisons of men and women

	All (N=167)	Men (N=82)	Women (N=85)	P
Age, median (IQR)	83.0 (77.0-88.0)	81.0 (77.0-87.0)	84.0 (77.0-89.0)	0.062
Length of hospitalization, median (IQR)	13.0 (9.0-19.0)	14.0 (9.0-19.0)	12.0 (8.0-18.0)	0.226
Charlson index, median (IQR)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	0.727
Prevalence of medical conditions				
Heart disease, N (%)	77 (46.1%)	35 (42.7%)	42 (49.4%)	0.383
COPD, N (%)	13 (7.8%)	10 (12.2%)	3 (3.5%)	0.037
Diabetes, N (%)	44 (26.3%)	24 (29.3%)	20 (23.5%)	0.400
CKD, N (%)	31 (18.6%)	21 (25.6%)	10 (11.8%)	0.021
Blood biochemical data				
Hemoglobin [g/dl], mean±SD	10.9±1.9	11.1±1.9	10.8±1.9	0.270
Serum albumin [g/dl], median (IQR), N=97*	3.3 (3.0-3.6)	3.2 (2.7-3.5)	3.3 (3.1-3.7)	0.154
eGFR [ml/min/1.73m^2], median (IQR), N=166*	53.0 (38.6-69.6)	57.4 (38.7-73.9)	48.5 (37.3-63.4)	0.017
CRP [mg/dl], median (IQR), N=145*	0.7 (0.2-1.9)	0.9 (0.3-2.4)	0.5 (0.1-1.5)	0.029
BMI [kg/m^2], median (IQR)	20.2 (18.1-22.4)	20.0 (17.6-21.7)	20.4 (18.4-23.4)	0.181
Underweight <18.5, N (%)	49 (29.3%)	26 (31.7%)	23 (27.1%)	0.130
Normal 18.5-24.9, N (%)	97 (58.1%)	50 (61.7%)	47 (55.3%)	
Obesity ≥25.0, N (%)	21 (12.6%)	6 (7.3%)	15 (17.6%)	
HDS-R, median (IQR)	24.0 (19.0-27.0)	24.0 (21.0-26.0)	24.0 (18.0-27.0)	0.832
Barthel Index, median (IQR)	80.0 (65.0-85.0)	80.0 (65.0-90.0)	75.0 (65.0-85.0)	0.105
SPPB score, median (IQR)	6.0 (3.0-11.0)	8.0 (4.0-11.0)	5.0 (3.0-9.0)	0.002
Walking speed [m/sec], median (IQR)	0.60 (0.41-0.82)	0.66 (0.46-0.91)	0.53 (0.40-0.73)	0.011
Handgrip strength [kgf], median (IQR)	16.0 (12.7-21.7)	21.0 (16.8-25.5)	13.7 (10.7-15.8)	<0.001
Knee-extensor muscle strength [Nm/kg], median (IQR)	0.8 (0.6-1.1)	1.0 (0.7-1.2)	0.7 (0.6-1.0)	<0.001
Kyphosis index, median (IQR)	8.9 (6.9-12.5)	9.0 (7.0-11.6)	8.9 (6.8-12.7)	0.976
ROM [degree]				
Hip flexion, median (IQR)	115.0 (107.5-120.0)	115.0 (110.0-120.0)	115.0 (107.5-120.0)	0.306
Hip extension, median (IQR)	10.0 (5.0-10.0)	10.0 (5.0-10.0)	5 (2.5-10)	0.054
Knee flexion, median (IQR)	152.5 (141.3-155.0)	155.0 (145.0-155.0)	150.0 (140.0-155.0)	0.143
Knee extension, median (IQR)	0 (-5-0)	0 (-5.0-0)	-2.5 (-5.0-0)	0.102
Ankle dorsiflexion, median (IQR)	15.0 (10.0-15.0)	15.0 (10.0-15.0)	15.0 (10.0-15.0)	0.527
Ankle plantarflexion, median (IQR)	55.0 (50.0-57.5)	50.0 (47.5-55.0)	55.0 (50.0-60.0)	0.164

IQR=interquartile range; SD=standard deviation; COPD=chronic obstructive pulmonary disease; CKD=chronic kidney disease; eGFR=estimated glomerular filtration rate; CRP=C-reactive protein; BMI=Body Mass Index; HDS-R=Revised Hasegawa's Dementia Scale; SPPB=Short Physical Performance Battery; ROM=range of motion.
*Insufficient data.

Table 2. Comparisons of the characteristics of patients with or without low physical performance

	Men			Women		
	Low physical performance (N=22)	Without low physical performance (N=60)	P	Low physical performance (N=39)	Without low physical performance (N=46)	P
Age, median (IQR)	85.5 (84.0-88.0)	80.0 (73.0-84..5)	0.001	87.0 (82.0-90.5)	81.5(75.0-86.0)	0.003
Length of hospitalization, median (IQR)	12.5 (8.0-19.0)	15.0 (10.0-19.5)	0.170	15.0 (9.0-24.0)	11.5(7.0-15.0)	0.028
Charlson index, median (IQR)	3.0 (2.0-3.0)	2.0 (1.0-3.0)	0.045	2.0 (1.5-3.0)	2.0 (1.0-3.0)	0.465
Prevalence of medical conditions						
Heart disease, N (%)	6 (27.3%)	29 (48.3%)	0.088	15 (38.5%)	27 (58.7%)	0.063
COPD, N (%)	5 (22.7%)	5 (8.3%)	0.078	2 (5.1%)	1 (2.2%)	0.462
Diabetes, N (%)	4 (18.2%)	20 (33.3%)	0.182	9 (23.1%)	11 (23.9%)	0.928
CKD, N (%)	6 (27.3%)	15 (25.0%)	0.835	5 (12.8%)	5 (10.9%)	0.781
Blood biochemical data						
Hemoglobin [g/dl], mean±SD	10.8±1.7	11.2±2.0	0.324	10.5±1.7	11.0±2.0	0.324
Serum albumin [g/dl], median (IQR), N=97*	3.0 (2.6-3.3)	3.3 (2.8-3.7)	0.172	3.3 (3.0-3.4)	3.6 (3.1-3.7)	0.071
eGFR [ml/min/1.73m^2], median (IQR), N=166*	64.5 (49.0-86.8)	55.8 (38.3-72.7)	0.107	49.1 (32.1-61.7)	47.9 (40.5-66.6)	0.857
CRP [mg/dl], median (IQR), N=145*	1.1 (0.7-1.9)	0.7 (0.2-3.0)	0.714	0.8 (0.2-1.5)	0.3 (0.1-1.8)	0.576
BMI [kg/m^2], median (IQR)	18.7 (17.5-20.3)	20.4 (18.3-22.2)	0.058	19.4 (17.9-21.7)	21.6 (18.7-24.8)	0.053
Underweight <18.5, N (%)	10 (45.5%)	16 (26.7%)	0.211	14 (35.9%)	9 (19.6%)	0.114
Normal 18.5-24.9, N (%)	10 (45.5%)	40 (66.7%)		21.0 (14.0-25.5)	26 (56.5%)	
Obesity ≥25.0, N (%)	2 (9.1%)	4 (6.7%)		4 (10.3%)	11 (23.9%)	
HDS-R, median (IQR)	20.0 (14.0-24.0)	24.0 (22.0-27.0)	0.003	21.0 (14.0-25.5)	25.0 (22.0-28.0)	0.001
Barthel Index, median (IQR)	62.5 (50.0-70.0)	85.0 (80.0-95.0)	<0.001	65.0 (55.0-75.0)	80.0 (75.0-95.0)	<0.001
SPPB score, median (IQR)	2.5 (2.0-3.0)	10.0 (7.0-12.0)	<0.001	3.0 (2.0-4.0)	9.0 (6.0-11.0)	<0.001
Walking speed [m/sec], median (IQR)	0.36 (0.29-0.42)	0.82 (0.63-1.01)	<0.001	0.41 (0.30-0.47)	0.73 (0.60-0.89)	<0.001
Handgrip strength [kgf], median (IQR)	17.0 (14.1-20.3)	22.1 (17.3-26.9)	0.001	11.9 (9.7-14.1)	15.1 (11.5-19.1)	<0.001
Knee-extensor muscle strength [Nm/kg], median (IQR)	0.7 (0.5-0.8)	1.1 (0.9-1.4)	<0.001	0.6 (0.5-0.8)	0.9 (0.7-1.1)	<0.001
Kyphosis index, median (IQR)	10.4 (8.2-13.0)	8.8 (6.9-10.5)	0.057	10.4 (7.4-16.6)	7.7 (6.3-11.4)	0.012
ROM [degree]						
Hip flexion, median (IQR)	110.0 (100.0-120.0)	116.3 (113.8-120.0)	0.004	112.5 (105.0-120.0)	115.0 (110.0-120.0)	0.119
Hip extension, median (IQR)	5.0 (0-10.0)	10 (5.0-10.0)	0.001	5.0 (0-5.0)	10.0 (5.0-10.0)	<0.001
Knee flexion, median (IQR)	152.5 (140.0-155.0)	155.0 (147.5-155.0)	0.376	152.5 (141.3-155.0)	150.0 (140.0-155.0)	0.436
Knee extension, median (IQR)	-3.8 (-7.5-0)	0 (-5.0-0)	0.116	-5 (-7.5-0)	0 (-5.0-0)	0.026
Ankle dorsiflexion, median (IQR)	13.8 (10.0-15.0)	15.0 (13.8-16.3)	0.063	15.0 (10.0-15.0)	15.0 (12.5-15.0)	0.027
Ankle plantarflexion, median (IQR)	50.0 (45.0-55.0)	55.0 (50.0-55.0)	0.055	50.0 (45.0-55.0)	55.0 (50.0-60.0)	0.001

IQR=interquartile range; SD=standard deviation; COPD=chronic obstructive pulmonary disease; CKD=chronic kidney disease; eGFR=estimated glomerular filtration rate; CRP=C-reactive protein; BMI=Body Mass Index; HDS-R=Revised Hasegawa's Dementia Scale; SPPB=Short Physical Performance Battery; ROM=range of motion.
*Insufficient data.

Table 3. The factors associated with low physical performance

Independent variables	Men				Women			
	Univariate analysis		Multivariate analysis		Univariate analysis		Multivariate analysis	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Age (per year)	1.15 (1.05-1.26)	0.003			1.10 (1.03-1.18)	0.003		
Length of hospitalization (per day)	0.96 (0.90-1.02)	0.201			1.03 (0.99-1.08)	0.115		
Charlson index (per point)	1.46 (1.02-2.10)	0.040			1.14 (0.80-1.60)	0.471		
Medical conditions								
Heart disease	0.40 (0.14-1.16)	0.093			0.44 (0.18-1.05)	0.065		
COPD	3.24 (0.84-12.53)	0.089			0.98 (0.28-3.50)	0.976		
Diabetes	0.44 (0.13-1.49)	0.189			0.96 (0.35-2.61)	0.928		
CKD	1.13 (0.37-3.40)	0.835			1.21 (0.32-4.52)	0.781		
Blood biochemical data								
Hemoglobin (per 1.0 g/dl)	0.90 (0.69-1.16)	0.413			0.86 (0.68-1.09)	0.198		
BMI (per 1.0 kg/m^2)	0.88 (0.74-1.03)	0.120			0.89 (0.79-1.01)	0.064		
HDS-R (per point)	0.87 (0.79-0.95)	0.003			0.89 (0.83-0.96)	0.002		
Handgrip strength (per 1.0 kgf)	0.87 (0.80-0.96)	0.004			0.76 (0.65-0.88)	<0.001	0.83 (0.69-0.99)	0.039
Knee-extensor muscle strength (per 0.1 Nm/kg)	0.59 (0.45-0.77)	<0.001	0.59 (0.45-0.77)	<0.001	0.65 (0.52-0.82)	<0.001	0.73 (0.54-0.99)	0.042
Kyphosis index (per 1.0)	1.16 (1.01-1.33)	0.034			1.13 (1.03-1.24)	0.009		
ROM								
Hip flexion (per 5 degrees)	0.63 (0.47-0.85)	0.002			0.81 (0.63-1.04)	0.093		
Hip extension (per 5 degrees)	0.43 (0.25-0.72)	0.002			0.25 (0.13-0.48)	<0.001	0.26 (0.13-0.53)	<0.001
Knee flexion (per 5 degrees)	0.89 (0.70-1.15)	0.373			1.06 (0.88-1.28)	0.546		
Knee extension, (per 5 degrees)	0.72 (0.47-1.12)	0,143			0.54 (0.33-0.89)	0.016		
Ankle dorsiflexion, (per 5 degrees)	0.60 (0.36-1.01)	0.057			0.60 (0.37-0.97)	0.037		
Ankle plantarflexion, (per 5 degrees)	0.68 (0.45-1.02)	0.063			0.50 (0.33-0.76)	0.001		

OR=odds ratio; CI=confidence interval; COPD=chronic obstructive pulmonary disease; CKD=chronic kidney disease; BMI=Body Mass Index; HDS-R=Revised Hasegawa's Dementia Scale; ROM=range of motion.

training[28] and stretching,[29] the present study suggests that exercise therapy for older inpatients is an appropriate intervention in an acute medical setting.

Several limitations of this study warrant mention. First, this study used a cross-sectional design. Therefore, we could not mention the causal relationship between low physical performance and related factors. In addition, this study had no clinical outcome data. Thus, further studies that verify the influence of physical performance and related factors to clinical outcome after discharge by longitudinal design is required. Second, this study was conducted at a single facility. Therefore, it is necessary to consider the characteristics of the clinical setting in reflecting the results of this study. Third, this study comprised of a relatively low ratio of enrolled patients. Thus, this study might have a selection bias. Fourth, this study did not include potential confounders such as nutritional and depressive indicators for analysis. Moreover, intervention studies are required to identify how physical performance can be improved in older inpatients.

CONCLUSION

The factors associated with low physical performance in older inpatients include knee-extensor muscle strength among men; and knee-extensor muscle strength, handgrip strength, and hip-extension ROM among women. Therefore, the prevention of low physical performance, interventions to strengthen knee-extensor muscles for both men and women, and the improvement of hip-extension ROM and general muscle strength in women are necessary.

CONFLICTS OF INTEREST STATEMENT

The authors declare no conflict of interest.

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