The Usefulness of Short Physical Performance Battery Score for Predicting the Ability of Toilet Activity in Hospitalized Older Patients

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ABSTRACT

Background: It has been still unclear whether the cut-off value of the short physical performance battery for predicting the ability of the toilet activity in the hospitalized older patients. The aim of this study was to reveal the relationship between the short physical performance battery and the ability of toilet activity, and also to determine the cut-off value of the short physical performance battery score for the ability of toilet activity in the hospitalized older patients. **Methods:** In this cross-sectional study, 71 hospitalized older patients were recruited. The short physical performance battery and the ability of toilet activity using the Barthel index (BI) were measured. The patients were split into two groups, according to the ability of toilet activity (Group 1: 10 point; Group 2: 5 point or less in BI score). A multiple logistic regression analysis was used to assess the relationship between the two groups. Moreover, the cut-off value for dividing into two groups, (Group 1 and Group 2) using the short physical performance battery score, which was calculated by a receiver operating characteristic curve. **Results:** The short physical performance battery score was an independent explanator for the ability of toilet activity using multiple logistic regression analysis. Besides, the cut-off value of the short physical performance battery for the ability of toilet activity was set in this study. **Conclusion:** The findings of this study suggest that the cut-off value of the short physical performance battery score could be a useful index to predict the ability of toilet activity in the hospitalized older patients.

Abbreviations:

ADL, Activities of daily living

AUC, Area under the curve

BI, Barthel index

BMI, Body mass index

CI, Confidence interval

OR, Odds ratio

ROC, Receiver operating characteristic

SD, Standard deviation

SPPB, Short physical performance battery

Background

The physical function, such as muscle strength, the ability of balance and gait speed deteriorates in old age [1, 2, 3]. There is a possibility that these result in the conditions requiring care in the daily life [4]. Thus, to early comprehend the condition of physical function is important to preserve the ability of activities of daily living (ADL) in the old adults. Besides, it has been reported that the ability of toilet activity, namely the toilet transfer and dressing lower extremity is associated with the returning home in hospitalized patients [5]. Therefore, maintaining or improving the ability of toilet activity through assessing the condition of physical function could lead to promote to return home in the hospitalized older patients.

The short physical performance battery (SPPB) is one of the methods used to evaluate the physical function included the balance, gait, strength, and endurance in older adults [6, 7]. The SPPB consists of standing balance (*i.e.*, side-by-side stand, semi-tandem stand, and tandem stand), comfortable 4-m gait speed, and five-repetition chair-stand tests [7]. In the clinical practice, SPPB can be a method to assess the standard physical function, and relationship between the ability of ADL and the SPPB in older adults has been observed in a previous study [6, 8, 9].

The older adults requiring care who had lower SPPB score had the lower ability of ADL and the cut-off value of SPPB score for predicting the ability of ADL was set in our previous study [10]. The cut-off value is of use in judging the presence or the absence of the disease [11]. However, it has been still unclear whether the cut-off value of the SPPB for predicting the ability of ADL and particularly the ability of toilet activity in hospitalized older patients. To reveal the cut-off value of SPPB could be a useful index to predict the ability of toilet activity in hospitalized older patients and help to increasing the proportion of the patients who return home.

The aim of this study was to reveal the relationship between the SPPB and the ability of the toilet activity, and also to determine the cut-off value of SPPB score for the ability of toilet activity in the hospitalized older patients. The lower SPPB score seems to be associated with the lower ability to the toilet activity, being the cut-off value of SPPB score for the ability of toilet activity in hospitalized older patients determined.

Materials & Methods

Participants

A total of 71 hospitalized older patients were recruited in the Toyoda Eisei Hospital (average age ± standard deviation [SD]: 83.1 ± 7.6; range, 67–98 years). The study design was a cross-sectional study. The exclusion criteria, included 1) the inability to obtain consent and 2) incomplete measurements. The proportion of primary diseases is as follows; orthopedic diseases (femur fracture: 33.8% [n = 24/71]; vertebral fracture: 25.4% [n = 18/71]; pelvic fracture: 5.6% [n = 4/71]; patella or leg fracture: 2.8% [n = 2/71]; cervical fracture: 2.8% [n = 2/71]; total 70.4%), cardiovascular diseases (stroke:18.3% [n = 13/71]; total 18.3%), and others (disuse syndrome: 5.6% [n = 4/71]; Guillain–Barré syndrome: 1.4% [n = 1/71]; meningioma: 1.4% [n = 1/71]; cervical spinal cord injury: 1.4% [n = 1/71]; Parkinson syndrome: 1.4% [n = 1/40]; total 11.2%). The average period elapsed from the develop of primary diseases was 27.5 ± 24.6 days. All the participants read and signed an informed consent form, being this study approved by the ethics committee of the Health Science University.

Short Physical Performance Battery (SPPB)

SPPB that measured the physical function included the balance, gait, strength, and endurance in older adults was used in this study to evaluate the physical function [6, 7]. The SPPB score was calculated according to the con- sequences of standing balance (side-by-side

stand, semi-tandem stand and tandem stand), 4-m gait speed and five-repetition chair-stand tests [7]. The minimum and the maximum SPPB score were 0 and 12 points (each item were ranged from 0 to 4 points), and lower point means poorer physical function. The gait speed was assessed twice, and the higher speed was analyzed as a central value.

Barthel Index (BI)

The ability of ADL was assessed using the BI, which consists of 10 items [12]. The 10 items are as follows; getting on and off the toilet (0, 5, or 10 points), eating (0, 5, or 10 points), moving from a wheelchair to a bed and back (0, 5, 10, or 15 points), walking (0, 5, 10, or 15 points), ascending and descending stairs (0, 5, or 10 points), dressing (0, 5, or 10 points), bowel control (0, 5, or 10 points), bladder control (0, 5, or 10 points), grooming activity (0 or 5 points) and bathing (0 or 5 points). The BI score was ranged from 0 to 100 points and the lower point represents need more assistance in ADL. The contents included getting on and off the toilet in BI were handling, clothes, wipe and flush. The 10 point at getting on and off the toilet indicates that the subjects can perform these contents by themselves. The 5 point or less indicates that the subjects need assistance in carrying out these contents.

Statistical Analysis

The values were showed as the mean ± SD. The statistical assessment was conducted by the JMP 11 software (SAS Institute Inc., Cary, NC, USA). The minimal sample sizes using the R Package "*pROC*" (version 1.16.2) were as follows; 8.3 (cases) and 33.0 (controls) [area under the curve (AUC) = 0.80, significant. level = 0.05, power 0.80, kappa 4] and 10.9 (cases) and 43.6 (controls) (AUC = 0.80, significant. level = 0.05, power 0.90, kappa 4). The patients were split into the two groups according to the ability of toilet activity (Group 1: 10 point; Group 2: 5 point or less in BI score). The difference of the characteristics between the two groups was evaluated using a chi-squared test and an unpaired *t*-test. A multiple logistic regression analysis (stepwise method, dependent variable- s: Group 1 and Group 2; explanatory variables: SPPB score and significant variables by chi-squared test and an unpaired *t*-test between groups) was used to assess the relationship between the two groups. Furthermore, the cut-off value for dividing into two groups (Group 1 and Group 2) using the SPPB score was calculated by a receiver operating characteristic curve (ROC curve). The significance threshold was set at $p < 0.05$.

Results

Table 1 represents the characteristics of the two groups included in this study. The patients in Group1 had significantly heavier weight than that of the Group 2 (Group 1 52.0 ± 11.6 kg vs. 45.2 ± 10.4 kg, p-value < 0.05, Table 1). Besides, an higher SPPB and BI score in Group 1 was observed compared with the Group 2 (SPPB: Group 1 7.2 ± 3.2 point vs. Group 2 3.2 ± 2.8 point; BI: Group 1 83.3 ± 11.6 point vs. Group 2 45.1 ± 15.8 point, all p-value < 0.05, Table 1). There were no significant differences in other items between the groups (all p-value > 0.05, Table 1). The SPPB score was an independent explanator for the toilet activity (Group 1: 10 point ; Group 2: 5 point or less in BI score) in a multiple logistic regression analysis (explanatory variables: weight and SPPB, weight: OR [Odds Ratio] 1.05, 95% CI 0.98–1.12, p = 0.173 ; SPPB: OR 1.48, 95% CI 1.20–1.89, p <.0001; The explanatory variable was: SPPB, SPPB: OR 1.51, 95% CI 1.23–1.94, p-value <.0001, Table 2). Moreover, the cut-off value, the sensitivity, the specificity and AUC of the SPPB score for toilet activity (Group 1: 10 point; Group 2: 5 point or less in BI score) by ROC curve were 6 point, 0.88, 0.67 and 0.83, respectively (Figure 1).

Discussion

The patients included in the Group 1 who were independent with toilet activity had higher physical function, according to the SPPB score in comparison with the patients included in the Group 2 who were dependent with toilet activity. The toilet activity, which was evaluated using BI was explained by the SPPB score in a multiple logistic regression analysis, and the cut-off value of the SPPB score was 6 point using ROC

curve in the hospitalized older patients. These results suggest that the cut-off value of the SPPB score could be a useful index to predict the ability of the toilet activity in the hospitalized older patients.

Table 1. The characteristics of the patients included in this study.

Variables	All (n = 71)	Group 1 (n = 15)	Group 2 (n = 56)	p-value
Gender, n (men/women)	33/38	8/7	25/31	0.55
Age (year)	83.1 ± 7.6	79.8 ± 7.9	84.0 ± 7.4	0.058
Height (cm)	149.8 ± 10.6	153.4 ± 9.2	148.8 ± 10.8	0.14
Weight (kg)	46.6 ± 11.0	52.0 ± 11.6	45.2 ± 10.4	0.031
BMI (kg/m^2)	20.7 ± 3.5	22.0 ± 3.5	20.3 ± 3.5	0.11
Diagnosis (%)				
Orthopedic disease	70.4	66.7	71.4	
Cardiovascular disease	18.3	20.0	17.9	0.93
Others	11.2	13.3	10.7	
The period from the onset (days)	27.5 ± 24.6	29.7 ± 17.8	26.9 ± 26.3	0.70
SPPB (score)	4.1 ± 3.3	7.2 ± 3.2	3.2 ± 2.8	<.0001
BI (score)	53.2 ± 21.7	83.3 ± 11.6	45.1 ± 15.8	<.0001

Values are expressed as mean ± standard deviation (SD)

BMI: body mass index, SPPB: short physical performance battery, BI: Barthel index

Table 2. Relationship between the ability of toilet activity and the SPPB score by a multiple logistic regression analysis (n = 71).

Explanators		OR	95% CI	p-value
Weight and SPPB	Weight	1.05	0.98–1.12	0.18
	SPPB	1.48	1.20–1.89	<.0001
SPPB	SPPB	1.51	1.23–1.94	<.0001

OR: Odds ratio, 95% CI: 95% Confidence interval, SPPB: short physical performance battery
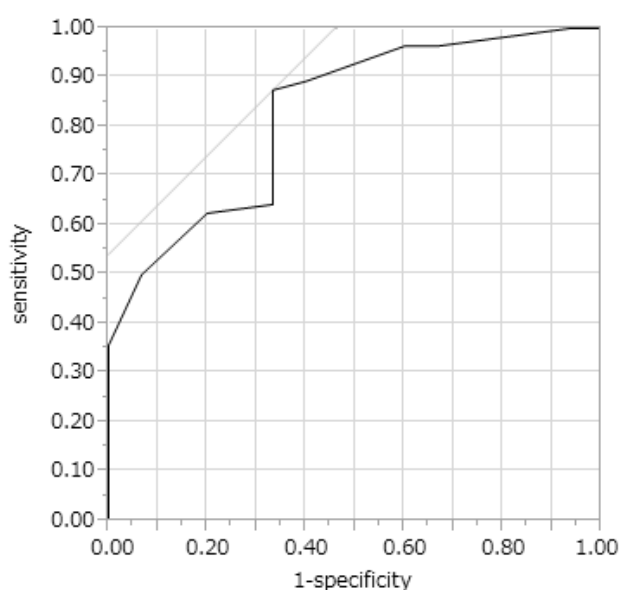

Figure 1. The association of the ability of toilet activity with the SPPB score using ROC curve
SPPB: short physical performance battery

The SPPB can be a method to assess the standard physical function, and the SPPB has also been used in the Asian Working Group for Sarcopenia (AWGS) 2019 algorithm for sarcopenia [6, 13]. Moreover, the cut-off value is useful in judging the presence or the absence of disease [11]. Regarding to the cut-off value of the SPPB score, the subjects whose SPPB score was from 4 to 6 point were at an higher relative risk of mobility-related disability compared with that in the subjects whose the SPPB score was from 10 to 12 point [14]. The cut-off value of the SPPB for the ability of the toilet activity was 6 point in this study. Thus, the cut-off value in this study could be an adequate parameter for predicting the ability of the toilet activity.

In this study, the AUC value under the ROC curve was 0.83. The AUC value obtained, which is ranged from 0.7 to 0.9 is classified as a moderate accuracy (or excellent) [11, 15, 16]. Moreover, in this study the values of sensitivity and specificity were 0.88 and 0.67 using the ROC curve, and the value of sensitivity was higher than that of specificity. The sensitivity reflects the ability of the test to find the subjects who have the disorder in the practice [16]. The cut-off value of SPPB in this study could be particularly useful for detecting the patients who need assistance to perform the toilet activity.

There are some limitations in this study. The sample size is small, and in further studies more patients need to be recruited. Moreover, this study could not reveal a relation of cause and effect because of a cross-sectional design and thus a longitudinal study should be con- ducted for clarifying the association between the ability of toilet activity with the SPPB. Finally, the period from the development of the primary diseases in the patients is limited, and it could not adapt to the whole period of inpatients care.

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