Usefulness of the Subjective Risk Rating of Specific Tasks for Falls in Frail Elderly People

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Abstract. [Purpose] The purpose of this study was to examine the reliability and clinical usefulness of a subjective risk rating of specific tasks (SRRST) for assessing risks of falls in frail elderly people. The participants were 30 elderly individuals who utilized day-care services. [Subjects and Methods] Participants were investigated the SRRST, grip strength, one repetition maximum of leg-press machine (1RM), one-leg standing time (OLS), functional reach, timed up and go test (TUG), and 10 m-walking speed, Barthel index, Tokyo Metropolitan Institute of Gerontology index, and history of falls in the previous year. The SRRST is comprised of 7 dichotomous questions screening of fall risk during activities of daily living such as walking, transferring, and wandering, and was scored twice a week by four raters. [Results] Intra-rater reliabilities of the SRRST were high (ICC (1,1) = 0.727 to 0.914, ICC (1,2) = 0.842 to 0.955), and inter-rater reliabilities of the SRRST were moderate to high (ICC (2,1) = 0.513, ICC (2,4) = 0.808). In comparison to the non-faller group, the faller group showed significantly lower 1RM and higher the SRRST. The SRRST showed moderate correlations with the OLS and TUG. [Conclusion] The SRRST showed moderate to high reliability and concurrent validity for assessing the fall risks in frail elderly people.

Key words: Fall, Subjective risk rating of specific tasks, Frail elderly people

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INTRODUCTION

Numerous studies have developed many assessment tools to detect the fall risks in community dwelling elderly people^{1,2)}. Using these assessment tools for frail elderly people, a lot of subjects are judged to have fall risks³⁾. For intensive intervention to prevent falls, it is necessary to detect those with high risk of falls among frail elderly people⁴⁾. Because there are many frail elderly subjects who cannot perform functional tests, in a previous study, subjective fall risk assessment based on observations by care staff was developed and its usefulness as a fall risk predictor was examined^{5,6)}. However, the subjective fall risk assessment was not developed to assess multiple fall risks of specific tasks or behaviors in activities of daily living (ADL). Falls are induced by multidimensional factors particular during walking, ascending/descending stairs, toileting, and transferring in the bedroom, toilet, or bathroom³⁾. A subjective fall risk assessment should consist of multiple items related to mobility, such as walking,

transferring, toileting, and ascending/descending stairs, items of basic ADL which are commonly performed by elderly people. Additionally, among the frail elderly, dementia is the major fall risk factor^{3,7)}, and the subjective fall risk assessment needs to have applicability to specific risky behaviors such as wandering, agitating, and the other risky behaviours exhibited by frail elderly people with cognitive impairment.

The purpose of the present study was to develop a subjective risk rating of specific tasks (SRRST) for the risk of fall during execution of ADL related to mobility, and to examine its reliability and association with falls, and fall-related physical performances or the functional status in frail elderly people utilizing adult day-care services.

SUBJECTS AND METHODS

The participants in this study were 30 elderly adults aged 65 and older, who utilized day-care services. Prior to testing, all subjects claimed no severe cognitive

Table 1. Subjective risk rating of specific tasks

Assessment	Yes	No or not applicable
Do you feel there is a risk of falls when the client (Mr or Mrs X) is walking?	1	0
Do you feel there is a risk of falls when the client is transferring in bedroom, toilet, or bathroom?	1	0
Do you feel there is a risk of falls when the client is toileting?	1	0
Do you feel there is a risk of falls when the client is ascending or descending stairs?	1	0
Do you feel there is a risk of falls when the client is wandering?	1	0
Do you feel there is risk of falls because the client exhibits risky behaviour?	1	0
Do you feel there is a risk of falls because the client is agitated?	1	0

impairment. Exclusion criteria were neurological, cardiovascular or major musculoskeletal impairments that precluded participants from walking for 20 m without the assistance of another person. All subjects provided their written informed consent.

Subjective fall risk was investigated by the SRRST. The SRRST consists of 7 items asking about the subjective fall risk of specific tasks during ADL related to mobility. It was designed to assess the performance of elderly people with or without cognitive impairment in ADL such as walking, transferring, toileting, ascending/descending stairs, wandering, exhibiting risky behaviour, agitating (Table 1). The response to each item in the SRRST is designated as “yes” (1 point) or “no or not applicable” (0 points), and the total score which is used as the representative value ranges from 0 to 7. Four raters (one physical therapist, one nurse, and two caregivers) rated all the subjects with the SRRST twice a week, individually. The SRRST and information about the experience of falls in the previous year were obtained at the same time. In this study, a fall was defined as unintentional loss of balance resulting in the person landing on a lower surface or the ground.

Grip strength (GS)⁸⁾, lower-extremity muscle strength measured as the one repetition maximum (1RM) on a leg press machine⁹⁾, postural balance function (one leg standing time (OLS)¹⁰⁾, functional reach (FR)¹¹⁾, gait function (timed “up and go” test (TUG)¹²⁾, and walking speed (WS)¹³⁾ were performed using indices of physical performance with demonstrated reliability and validity. GS was measured using a digital handgrip dynamometer. The subjects were asked to stand, and the dynamometer was adjusted till the proximal interphalangeal joints were flexed to 90° with the elbow straightened. The subjects were instructed to increase the handgrip force to the maximum and sustain the contraction for 3 seconds, and the peak force recorded was considered the maximum handgrip strength. For measurement of 1RM on the leg press, subjects started in a sitting position of approximately 90° of knee flexion and extended their legs to a position approximating 0°. A standardized protocol was executed that consisted of warm-up repetitions and a sequence of progressively increased resistance approaching the subjects’ 1RM each separated by fixed rest periods. The resistance

was then adjusted, and 1RM attempts were performed, each separated by a set rest period, until 1RM was determined. In the OLS test, subjects were instructed to start in a standing position with a comfortable base of support, with eyes open and arms by the side of the trunk and then stand unassisted on either leg. The OLS was timed in seconds from the time one foot was lifted from the floor to when it touched the ground or the standing leg. In the FR test, each subject was positioned next to a wall with one arm raised 90° with the fingers extended, and a yardstick was mounted on the wall at shoulder height. The distance in centimeters that a subject was able to reach forward from an initial upright posture to the maximal anterior leaning posture without moving or lifting the feet was measured by visual observation of the position of the third finger tip on a mounted yardstick as the FR score. In the TUG test, subjects were asked to stand up from a chair, walk a 3-m distance at a normal pace, turn, walk back to the chair, and sit down. The time measured in seconds began at the word “go” and ended when the subject’s hip touched the seat of the chair. In the WS test, subjects were instructed to walk 16 m with 3 m to accelerate and decelerate before and after the 10 m test distance at their normal comfortable speed; the required time to walk the distance was measured with a stopwatch. WS was calculated and the distance for 1 minute was extrapolated. For investigation of functional status, the Barthel index (BI)¹⁴⁾ and Tokyo Metropolitan Institute of Gerontology index of competence (TMIG-IC)¹⁵⁾ were administered. The BI is used for the evaluation of basic ADL (score range: 0-100), and includes feeding, bathing, toileting, dressing, bowel and bladder control, grooming, transferring, mobility, and ascending and descending stairs, with a higher score indicating better ADL ability. The TMIG-IC assesses functional capacity of ADL and is divided into three sections: 5 questions about instrumental self-maintenance, 4 questions about intellectual activity, and 4 questions about social role in ADL. The answer to each question is “yes” or “no”, and is scored 1 for “yes” and 0 for “no”. The total score is the sum total of the 13 questions (score range: 0-13).

Intraclass correlation coefficients (ICC) were calculated to ascertain the intra-rater and inter-rater reliability for the SRRST. A group comparison was then performed to

evaluate the differences in characteristics, physical performances, and functional status between non-fallers and fallers using the chi-square test and the Mann-Whitney U-test. Spearman correlation coefficient was calculated for the SRRST and physical performances and functional status. All of these analyses were performed using SPSS12.0, and the level of significance for all statistics was chosen as $p < 0.05$.

RESULTS

The results of the SRRST were shown in Table 2. The SRRST took an average of 1 minute per subject for each rater to perform. Intra-rater reliabilities of ICC (1, 1) and (1, 2) for the SRRST of each rater were 0.727 to 0.914 and

0.842 to 0.955, respectively (Table 3). The inter-rater reliabilities for the SRRST, ICC (2, 1) and (2, 4) were 0.513 and 0.808 for the four raters, and ICC (2, 1) and (2, 2) were 0.503 and 0.669 for the two caregivers (Table 4). In comparison to the non-faller group, the faller group showed significantly lower 1RM and higher SRRST than the group of non-fallers (Table 5). The chi-square test showed that those with the SRRST score of 2 (or 3) or more had greater rate of presence of faller than those with the SRRST score of 1 (or 2) and below, although a significant difference was not found between those with the SRRST score of 0 and those with the SRRST score of 1 or more (Table 6). Spearman correlation coefficients showed that the SRRST correlated with OLS ($r_s = -0.433$, $P = 0.017$), and TUG ($r_s = 0.441$, $P = 0.015$) (Table 7).

Table 2. Results of subjective risk rating of specific tasks in each rater

subjective fall risk assessment	Physical therapist		Nurse		Caregiver1		Caregiver2	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Do you think patient has a risk of fall ...								
during walking (number)	16	18	8	11	25	27	8	10
during transferring (number)	7	8	8	7	23	27	11	16
during toileting (number)	7	8	5	7	1	0	1	0
during stair ascending/descending (number)	18	22	15	15	29	27	22	28
during wandering (number)	11	9	10	14	3	0	0	0
because of risky behaviors (number)	17	13	27	25	29	29	24	28
because of agitation (number)	16	12	27	25	24	22	0	1
average (point)	3.1	3.0	3.3	3.5	4.5	4.4	2.2	2.8
standard deviation (point)	2.6	2.7	2.2	2.4	1.2	1.1	1.4	1.2
median (point)	2.0	2.0	2.5	3.0	5.0	5.0	2.0	3.0
minimum (point)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
maximum (point)	7.0	7.0	7.0	7.0	6.0	5.0	5.0	5.0

Table 3. Intraclass correlation coefficient for intrarater reliability of subjective risk rating of specific tasks

	ICC (1,1)	95% confidence interval	
		lower confidence limit	upper confidence limit
Physical therapist	0.914*	0.828	0.958
Nurse	0.880*	0.765	0.941
Caregiver1	0.772*	0.578	0.884
Caregiver2	0.727*	0.504	0.859
	ICC (1,2)	95% confidence interval	
		lower confidence limit	upper confidence limit
Physical therapist	0.955*	0.906	0.978
Nurse	0.936*	0.867	0.969
Caregiver1	0.872*	0.732	0.939
Caregiver2	0.842*	0.670	0.924

*: $p < 0.001$

Table 4. Intraclass correlation coefficient for interrater reliability of subjective risk rating of specific tasks

	Four raters	95% confidence interval	
		lower confidence limit	upper confidence limit
ICC (2,1)	0.513**	0.331	0.692
ICC (2,4)	0.808**	0.665	0.900
	Two raters	95% confidence interval	
		lower confidence limit	upper confidence limit
ICC (2,1)	0.503*	0.180	0.728
ICC (2,2)	0.669*	0.305	0.842

Four raters: one physical therapist, one nurse, two caregivers

Two raters: two caregivers

*: $p < 0.01$, **: $p < 0.001$ **Table 5.** Comparison of functional status and activity between non-faller and faller

	non-faller (n=13)	faller (n=17)
gender (number)		
male	6	9
female	7	8
support or care level (number)		
support level 1	3	4
support level 2	1	6
care level 1	6	5
care level 2	3	2
disease (number)		
cerebrovascular disease	4	4
Parkinson disease	0	0
femoral neck fracture	1	1
osteoarthritis	1	6
height (cm)	154.9 ± 11.4	151.8 ± 8.9
weight (kg)	58.2 ± 14.8	52.0 ± 9.3
body mass index (kg/m ²)	24.0 ± 4.4	22.5 ± 3.1
GS (kg)	22.8 ± 8.5	19.0 ± 7.8
1RM (kg)	59.4 ± 16.3	44.6 ± 19.6*
OLS (s)	12.3 ± 14.2	6.5 ± 5.1
FR (cm)	35.2 ± 5.2	32.4 ± 9.3
TUG (s)	12.9 ± 4.7	16.7 ± 12.2
WS (m/min)	48.5 ± 17.8	42.9 ± 17.3
BI (point)	97.7 ± 3.3	97.6 ± 5.0
TMIG-IC (point)	6.7 ± 3.9	8.1 ± 3.9
SRRST (point)	2.1 ± 2.5	3.8 ± 2.5*

GS: grip strength, 1RM: one repetition maximum of leg press machine, OLS: one legged standing time, FR: functional reach, TUG: timed up and go test, WS: walking speed, BI: Barthel index, TMIG-IC: Tokyo Metropolitan Institute of Gerontology - index of competence, SRRST: subjective risk rating of specific tasks

*: $p < 0.05$

Table 6. Results of chi-square test: relationship between the presence of subjective fall risk and the presence of fall during the previous year

	non-faller	faller	Total
SRRST = 0	4	2	6
SRRST $\geq$ 1	9	15	24
Total	13	17	30
SRRST $\leq$ 1	7	3	10
SRRST $\geq$ 2	6	14	20
Total	13	17	30
SRRST $\leq$ 2	10	6	16
SRRST $\geq$ 3	3	11	14
Total	13	17	30

The numbers were showed in the table.

The chi-square test showed that those with the SRRST score of 2 (or 3) or more had greater rate of presence of faller than those with the SRRST score of 1 (or 2) and below. There was no significant difference about rate of faller between those with the SRRST score of 0 and those with the SRRST score of 1 or more.

Table 7. Spearman correlation coefficient among subjective risk rating of specific tasks and functional status and activity

	SRRST
GS	0.102
1RM	-0.096
OLS	-0.433*
FR	-0.295
TUG	0.441*
WS	-0.305
BI	-0.278
TMIG-IC	-0.133

GS: grip strength, 1RM: one repetition maximum of leg press machine, OLS: one legged standing time, FR: functional reach, TUG: timed up and go test, WS: walking speed, BI: Barthel index, TMIG-IC: Tokyo Metropolitan Institute of Gerontology - Index of competence, SRRST: subjective risk rating of specific tasks

*: $p < 0.05$

DISCUSSION

Fall prevention starts with screening for risk factors of falls such as physical factors and environmental factors, and investigates the relationship among the factors. For frail elderly people utilizing day-care services, the major risk factors of falls are related to mobility such as muscle weakness, postural balance disorders, gait dysfunction, and impaired ADL. In particular, physical impairment is more important factor for preventing falls^{7,16}. Therefore, physical assessment is an important measure for prevent falls in persons who have fallen or at risk of falling⁴. However, the frail elderly with cognitive impairment or severe physical impairment have difficulties performing the assessments of

mobility impairment although fall risks were increased¹⁷. Additionally, there are many frail elderly who cannot perform functional tests used to assess the fall risk. In a previous study, a subjective fall risk assessment based on observations by care staff was developed and its usefulness as a fall risk predictor was examined^{5,6}. In this study, we examined the utility of a subjective assessment tool based on observations by care staff for identifying useful measures for screening the fall risk of specific tasks in ADL among frail elderly people.

Regarding inter-rater reliability, the ICCs for the SRRST of the four raters indicated moderate reproducibility (0.513 or more), and the reproducibility for the SRRST was slightly different for each of the four raters in this study. We calculated the ICCs for the SRRST of the two caregivers to verify the reproducibility within the same profession; the ICCs indicated moderate reproducibility (0.503 or more), too. The reason why inter-rater reliability had low values was that the scene and the perspective of evaluation of each rater was different because the results of the SRRST reflect the subjectivity of each rater. Therefore, when using the SRRST, it is necessary to compensate for the insufficient reliability by having comprehensive discussions about risks of falling with each rater, across professions, including the results of other assessments for falls if necessary. In contrast, the ICCs of intra-rater reliability of each rater for the SRRST indicated high reproducibility (0.727 or more). The time needed to evaluate by the SRRST was about one minute on average, showing the SRRST was a clinically practical assessment.

In the comparative analysis of fallers and non-fallers, participants who had experienced falls showed significantly lower 1RM and higher SRRST, but other physical performance scores and functional statuses which are risk factors for falls did not show any significant differences. These results suggest that 1RM and the SRRST were factors closely related to falling in frail elderly, and those

who had experienced falling had not single but more several subjective fall risks in the SRRST. And so, for comparison the association between different score of the SRRST and falling, the chi-square test revealed that those with the SRRST score of 2 (or 3) or more had greater rate of falling than those with the SRRST score of 1 (or 2) and below, although significant difference was not found between those with the SRRST score of 0 and those with the SRRST score of 1 or more. It is necessary to do more multidirectional assessment for predicting fall in terms of subjective fall risks, because fall that occurs during movements and behaviors at various situations in ADL cannot predict by single assessment for fall risks. The SRRST consist of subjective evaluation items of fall risks for typical and specific tasks in ADL, and might be able to detect multiple fall risks. Although the SRRST will need to validate the sensitivity and specificity for the predictive validity of fall risks, it was considered that those who were detected several subjective fall risks in the SRRST were had potentially high risk of falling.

In Spearman correlation analysis, the SRRST was associated with the OLS and TUG, moderately. Postural balance and gait disturbance as shown by lower OLS and higher TUG were important risk factors for predicting falling as well as lower muscle weakness^{3,7,18}. Since the SRRST showed significant correlations with these indicators, the SRRST was considered an indicator of a major decline in physical performances affecting the fall, and had moderate concurrent validity. Moreover, it showed moderate correlation coefficient values, the SRRST had task specificity of movements and behaviors in ADL related to falling which was difficult to reflect by single element of physical performance.

One of the limitations of our study is that we analyzed retrospectively recalled falls. It is possible that underreporting of falls by participants may have led an underestimation of the rates of falls. Therefore, further investigation of the validity of these tests in predicting falls in frail elderly people using a prospective study design is recommended. Secondly, the investigations of the SRRST and the experience of falls were assessed at the same time in this cross-sectional study. Thus, the information of the experience of falls might affect subjective judgements of the raters, and these results cannot show the causal association between the SRRST and falling, sufficiently. Thirdly, this study was limited by the small subject sample. To overcome this limitation, further studies with a larger number of subjects should be performed to examine the relative risk of the SRRST for predicting falls in order to enhance the clinical usability by longitudinal study.

In conclusion, this study reported that the SRRST as a

subjective fall risk assessment was feasible evaluation for the specific fall risks with moderate to high reliability and concurrent validity in frail elderly people. This study provides the evidence that subjective assessment by care staff might be able to predict risk in frail elderly people.

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