# **Exploring Risk Factors of Patient Falls: A Retrospective Hospital Record Study in Japan**

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Patient falls are common adverse medical events in hospitals. The objectives of this study were to clarify the factors of patient falls at hospitalization or transfer to another ward, which could be assumed that patients experience new environment. Patients who were hospitalized or transferred to another ward at a hospital in Japan, between January 14 and February 14, 2014 were included. We used a risk assessment sheet and applied stepwise regression analysis to identify factors of patient falls. We also investigated changes in patient conditions on the risk assessment sheet by the chi-square test. A total of 1,362 patients (53.2% female; mean age,  $57.1 \pm 18.0$  years) were eligible for analysis, and 38 (2.8%) fell during the study period. The fallers were significantly older than the non-fallers (63.8 ± 18.0 vs.  $56.9 \pm 18.7$  years, P = 0.03), but no significant difference was seen in sex (55.3% vs. 53.1% female). "History of falls", "Tubes inserted", "Need assistance/supervision for toileting" and "Excretion more than two times per night" were significantly related to patient falls (adjusted odds ratios [95% confidence interval]: 2.41 [1.05-5.53], 3.64 [1.57-8.43], 4.52 [2.00-10.23] and 3.92 [1.38-11.09]). Among 30 fallers, "Overestimation or non-understanding of own physical abilities" was significantly more frequent after falls (30.0%) than before falls (6.7%, P = 0.02). The factors found in this study might be useful for identifying patients at higher risk of falls.

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## Introduction

Patient falls are often preventable. However, patient falls remain one of the major causes of death and severe morbidity in hospitals (Institute of Medicine (US) Committee on Quality of Health Care in America et al. 2000; Fields et al. 2015). Patient falls represent 69.3% of adverse medical events (Fagin and Vita 1965), with a rate of about 2.3 to 17.1 per 1,000 patient days (Hitcho et al. 2004; Galbraith et al. 2011). Patient falls also cause a considerable financial burden on the health care system (Institute of Medicine (US) Committee on Quality of Health Care in America et al. 2000; Fields et al. 2015). About 30% of patients who fall suffer injuries and 6% develop severe morbidity (Hitcho et al. 2004; Nadkarni et al. 2005; Bradley 2011). Therefore, prevention of patient falls in healthcare

facilities is crucial to ensure patient safety.

National patient safety programs implemented in a number of countries have led to a decrease in the occurrence of patient falls (Baines et al. 2015). Although a safety project was introduced in Japan in 2000 (http://ndpjapan. org/; last accessed: December 19, 2015), the prevention of patient falls was not a high priority; therefore, the optimal strategy for prevention of patient falls in Japan remains unclear. Some hospitals outside of Japan have implemented risk assessment strategies to prevent patient falls (Chu et al. 2015). Similar strategies for institutionalized elderly people have been implemented in Japan (Izumi et al. 2002); however, to our knowledge, current assessment strategies are not available for patients from a wide age range across all hospital departments. Moreover, it remains unclear whether factors of patient falls change between before and after

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# Table 1. Risk assessment sheet for patient falls.

## **Risk Assessment Sheet for Falls**

ID: \_\_\_\_\_ Name: \_\_\_\_\_ Age: \_\_\_\_ Sex: male/female

No.

		On the day of hospitalization				
		On the day of transfer to another ward				
		On the day of the fall				
			,	,	,	,
*You may write space f	additional information in the blank to the right of each column.		/	/	/	/
History of falls	Patient has fallen within one year befo	re admission				
Lifestyle	Patient sleeps on a futon (not a bed) a	t home				
Condition	Within three days from the day of hosp another ward	vitalization or transfer from				
	Within three days after surgery					
	Fever (≥ 38°C)					
	Anemia (Hb ≤8 mg/dL)					
	Dizziness (orthostatic hypertension)					
	Tubes inserted					
	Condition or activities of daily living go	t better or worse rapidly				
Physical activity	Need assistance/supervision to walk					
	Need assistance/supervision to transfe	er				
	Need assistance/supervision for toileti	ng				
Motor function	Muscle weakness of leg (being unstea	dy while standing)				
	Paralysis (unable to intentionally move disorder)	limbs due to neurological				
	Parkinsonism symptoms (particularly b instability)	oradykinesia or postural				
	Deformed/contracted bones/joints					
Sensory function	Hearing loss (poses an obstacle to cor	mmunication)				
	Vision impairment (poses an obstacle	to daily life)				
	Balance disturbance (dizziness resulting	ng from inner ear disorder)				
	Numbness and hyperesthesia of leg					
Cognitive function	Unable to call nurse call due to impaire	ed cognitive function				
	Consciousness disorder, delirium					
	Diminished attention (inattention, lack problems with cognitive function)	of concentration due to				
	Overestimation or non-understanding	of own physical abilities				
	Cognitive dysfunction (dementia or sus	spected dementia)				

## Risk Factors for Patient Falls

Table 1. Continued.

		On the day of hospitalization				
		On the day of transfer to another ward				
		On the day of the fall				
*You may write space t	additional information in the blank to the right of each column.		/	/	/	/
Behavioral psychology	Diminished attention with anxiety (no p function)	roblems with cognitive				
	Hesitating/resisting to be treated (patie	nt does not call for a nurse)				
Treatment	Under radiation therapy					
	Narcotic use (injections, internal, patch	ı, or other)				
	Using psychotropics (sedative, tranqui antidepressant, anxiolytic, anticonvulsa	izer, psychotropic, ant)				
	Using analgesics (regular or single use medicine)	of injections/internal				
	Under or after chemotherapy					
	Laxative use (regular or single, enema	)				
	Diuretic use (regular or single)					
	Tube insertion (including non-continuo	us cases)				
Sleep	Difficulty initiating sleep (require more have trouble sleeping)	than one hour to fall asleep,				
	Nocturnal awakening (constantly wakir after falling asleep)	ng up throughout the night				
	Day-night reversal (cannot sleep smoo the day)	thly at night, dozes off during				
Excretion	Incontinence (urine/feces)					
	Frequent urination (≥10 times/day)					
	Excretion more than two times per nigl	nt (urine/feces)				
	Use of a urinal (including temporary us	e)				
	Use of a portable toilet (including temp	orary use)				
Environment	Difference in floor levels between bathroom and room					
	Disorderly items around the bed					

Action needed to prevent falls (Please check the most appropriate plan of action from items 1 through 3.)

1:	Take fall prevention measures such as adding a surveillance monitor, adding a sensor to detect when the patient leaves the bed,		
	or increasing the number of side rails		
2:	Improve observation by visiting the room and watching the patient when they are transferred or moved		
<b>3</b> :	No action needed		
	Signature of the individual who checked the assessment sheet		
	each day		

A risk assessment sheet applied in the present research is shown.

falls. Therefore, the objectives of this study were to clarify the factors of patient falls at hospitalization or transfer to another ward, and to compare patient conditions between before and after falls among fallers.

#### Methods

This study was conducted at Tohoku University Hospital, Japan. In addition to functioning as an educational institution, Tohoku University Hospital provides third-level medical care for both inpatients and outpatients. As of March 31, 2014, Tohoku University Hospital had 1,262 beds. Each department at Tohoku University Hospital routinely assesses the risk of patient falls at the following three time points using a risk assessment sheet: at hospitalization; after patient transfer to another ward; and on the day of any patient fall occurrence. Recently, the Working Group for the Prevention of Falls at Tohoku University Hospital developed a new risk assessment sheet. The new risk assessment sheet is composed of 45 assessment items and the following 12 main elements: "History of falls", "Lifestyle", "Condition", "Physical activity", "Motor function", "Sensory function", "Cognitive function", "Behavioral psychology", "Treatment", "Sleep", "Excretion", and "Environment" (Table 1). The risk assessment sheet also includes a section regarding the required action plan for preventing patient falls. The action plan has the following three options: "Take fall prevention measures such as adding a surveillance monitor, adding a sensor to detect when the patient leaves the bed, or increasing the number of side rails", "Improve observation by visiting the room and watching the patient when they are transferred or moved", and "No action needed". For the purposes of this study, the first two plans were regarded as "preventive action needed" and the third plan was regarded as "no preventive action needed"; these assessment data were then used to analyze factors associated with patient falls. The study protocol was approved by the institutional review board at Tohoku University Graduate School of Medicine.

This study included all patients who were hospitalized or transferred to another ward at Tohoku University Hospital between January 14 and February 14, 2014. For patients who were hospitalized or transferred more than once, we used the data from the first risk assessment sheet only. Observational period of patient falls was from January 14 to February 28, 2014. Patients whose fall risk was not assessed at hospitalization or transfer to another ward, and those whose assessment sheets had incomplete data regarding sex or age were excluded.

Although patient falls are recorded on the assessment sheets, we confirmed each case by checking the Tohoku University Hospital incident reports, which are generated as part of an institutional patient safety management system. The incident reporting system was created based on the 2002 Guidelines of the National University Hospital Medical Safety Management Council. In the guidelines, "incidents" are considered to encompass the following: 1) situations in which a patient was injured (with some exceptions); 2) situations in which a patient might have been injured; and 3) complaints from patients or families in relation to medical practice. More specific details regarding any reported incident include the following: a) failure of a medical device (e.g., medical equipment or materials); b) falls or slips; c) suicide or attempted suicide; d) discharge against medical advice; e) unexpected complications; f) delay in discovery and response (treatment); g) mistakes in relation to self-managed medication; and h) needlestick injuries or similar incidents. Ideally, as soon as an incident occurs, a report is completed by the involved party or the discoverer and turned in to a risk manager. The risk manager then confirms the content and returns it for clarification if anything is unclear. Once the risk manager accepts the report, it is turned in to a general risk manager. When the general risk manager judges the report as acceptable, the report is saved digitally. At Tohoku University Hospital, incidents are evaluated by several different committees, including the Medical Safety Promotion Committee, the Incident Response Committee, the Incident Deliberations Committee and the Medical Accident Investigation Committee. The Medical Safety Promotion Office organizes all of these committees and analyzes each case independently.

To analyze the patients' characteristics and the results at first assessment, we used the chi-square test, Fisher's exact test, or the t test appropriately. At first, analysis was performed for all patients, and then stratified according to whether preventive action was needed. To identify factors of patient falls, we conducted stepwise regression analysis using age, sex, and any items that were significantly different between fallers and non-fallers in bivariate analysis as confounders. Among fallers, we also used the chi-square test to compare items of the risk assessment sheet between before and after falls. SAS (version 9.4, SAS Institute, Inc., Cary, NC, USA) was used for statistical analysis.

#### Results

During the study period, fall risk was assessed in 1,391 patients. A total of 27 patients were excluded because their fall risk was not assessed at hospitalization or transfer to another ward, and two patients were excluded due to incomplete data regarding sex or age. Therefore, 1,362 patients (53.2% female; mean age,  $57.1 \pm 18.0$  years) were eligible for analysis. Among these patients, 108 (7.9%) had a history of falls, and 38 (2.8%) fell during the study period. None of the fallers died or suffered fracture. Out of 38 fallers, 18 of them had tumor. The following diagnostic diseases had two fallers for each: cirrhosis, abdominal aortic aneurysm, pneumonia, and diabetes mellitus. Ten fallers had one of the following: pancreatitis, sepsis, pharyngolaryngitis, knee osteoarthritis, chronic kidney disease, supranuclear palsy, cerebral palsy, stroke, ischemic heart disease, or disuse syndrome. Two fallers' diagnoses were not reported. The fallers were significantly older than the nonfallers (63.8  $\pm$  18.0 vs. 56.9  $\pm$  18.7 years, respectively; P = 0.03) (Table 2), but no significant difference was seen in regard to sex (55.3% vs. 53.1% female, respectively; P =0.8) (Table 2). The most significant difference between fallers and non-fallers on the risk assessment sheets at first assessment was "Need assistance/supervision for toileting" (42.1% vs. 7.3%, respectively; P < 0.01). No patients in either group were assessed as "Disorderly items around the bed".

Preventive action was needed for 178 (13.1%) patients, and 18 (10.2%) of them fell during the study period. In contrast, 20 (1.7%) of 1,184 patients whose preventive action was not necessary fell (Table 3). Among all patients needing or not needing preventive action, a significant difference was observed between fallers and non-fallers for

Age, years Sex (female)   56.9 ± 18.7   63.8 ± 18.0   0.03     Sex (female)   703 (53.1)   21 (55.3)   0.8     History of falls   99 (7.5)   9 (23.7)   < 0.01     Life style   Sleeps on a "futon" (not a bed) at home   207 (15.6)   8 (21.1)   0.4     Within three days from the day of hospitalization or transfer from another ward   1270 (95.9)   29 (76.3)   < 0.01     Anemia   23 (1.7)   0   1.0   0.5   .0.3     Prever   Anemia   23 (1.7)   0   1.0   0.10     Dizziness   27 (2.0)   3 (7.9)   0.04   .0.01     Anternia   23 (1.7)   0   1.0   .0.01     Dizziness   27 (2.0)   3 (7.9)   0.04   .0.01     Need assistance/supervision to transfer   137 (10.4)   18 (47.4)   < 0.01     Need assistance/supervision for tolleting   96 (7.3)   16 (42.1)   < 0.01     Motor function   Hearing loss   48 (3.6)   3 (7.9)   0.02     Vision impairment function   Ibes call nurse call			Non-fallers (N = 1,324)	Fallers (N = 38)	Р
History of fails   99 (7.5)   9 (23.7)   < 0.01     Life style   Sieeps on a "futon" (not a bed) at home   207 (15.6)   8 (21.1)   0.4     Condition   hospitalization or transfer from another ward   1270 (95.9)   29 (76.3)   < 0.01	Age, years Sex (female)		56.9 ± 18.7 703 (53.1)	63.8 ± 18.0 21 (55.3)	0.03 0.8
Life style   Sleeps on a "futon" (not a bed) at home   207 (15.6)   8 (21.1)   0.4     Condition   home   Within three days from the day of hospitalization or transfer from another ward   1270 (95.9)   29 (76.3)   < 0.01	History of falls		99 (7.5)	9 (23.7)	< 0.01
Condition   Hospitalization or transfer from another ward   1270 (95.9)   29 (76.3)   < 0.01     Fever   32 (2.4)   7 (18.4)   < 0.01	Life style	Sleeps on a "futon" (not a bed) at home	207 (15.6)	8 (21.1)	0.4
Within three days after surgery   32 (2.4)   7 (18.4)   < 0.01     Fever   23 (1.7)   1 (2.6)   0.5     Anemia   23 (1.7)   0   1.0     Dizziness   27 (2.0)   3 (7.9)   0.048     Tubes inserted   95 (7.2)   14 (36.8)   < 0.01	Condition	Within three days from the day of hospitalization or transfer from another ward	1270 (95.9)	29 (76.3)	< 0.01
Fever   23 (1.7)   1 (2.6)   0.5     Anemia   23 (1.7)   0   1.0     Dizziness   27 (2.0)   3 (7.9)   0.048     Tubes inserted   95 (7.2)   14 (38.8)   < 0.01		Within three days after surgery	32 (2.4)	7 (18.4)	< 0.01
Initial   23 (1.7)   0   1.0     Dizziness   27 (2.0)   3 (7.9)   0.048     Tubes inserted   95 (7.2)   14 (36.8)   < 0.01		Fever Anomia	23 (1.7)	1 (2.6)	0.5
Discrimination   Discrimination   Discrimination   Discrimination     Physical activity   Tubes inserted Condition or ADL got better or worse rapidly   51 (3.9)   7 (18.4)   < 0.01		Dizzinoss	23(1.7)	3 (7 0)	0.049
Physical activity   TeleSol inScience/Supervision to warse rapidly   51 (3.9)   7 (18.4)   < 0.01     Physical activity   Need assistance/supervision to transfer   137 (10.4)   18 (47.4)   < 0.01		Tubes inserted	27 (2.0) 95 (7.2)	14 (36 8)	< 0.040
Physical activity   worse rapidly Need assistance/supervision to walk   51 (3.9)   7 (18.4)   < 0.01     Moed assistance/supervision to transfer   137 (10.4)   18 (47.4)   < 0.01		Condition or ADL got better or	55 (7.2)	T4 (00.0)	< 0.01
Instruction   Instruction bis data field subtrances super vision to transfer   137 (10.4)   18 (47.4)   < 0.01     Motor function   Need assistance/supervision for tolleting   125 (9.4)   18 (47.4)   < 0.01	Physical	worse rapidly	51 (3.9)	7 (18.4)	< 0.01
Need assistance/supervision to transfer   125 (9.4)   18 (47.4)   < 0.01     Meed assistance/supervision for toileiting   96 (7.3)   16 (42.1)   < 0.01	activity	walk	137 (10.4)	18 (47.4)	< 0.01
Meed assistance/supervision for toileiting   96 (7.3)   16 (42.1)   < 0.01     Motor function   Muscle weakness of leg   100 (7.6)   9 (23.7)   < 0.01		transfer	125 (9.4)	18 (47.4)	< 0.01
Much function   Muscle weakness of leg   100 (7.6)   9 (23.7)   < 0.01     Paralysis   32 (2.4)   3 (7.9)   0.07     Parkinsonism symptoms   16 (1.2)   1 (2.6)   0.4     Deformed/contracted bones/joints   33 (2.5)   0   1.0     Sensory function   Hearing loss   48 (3.6)   3 (7.9)   0.2     Vision impairment   70 (5.3)   5 (13.2)   0.053     Balance disturbance   12 (0.9)   1 (2.6)   0.4     Numbness and hyperesthesia of leg   84 (6.3)   6 (15.8)   0.03     Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Diminished attention or non-understanding of own physical abilities   38 (2.9)   4 (10.5)   0.03     Cognitive dysfunction   45 (3.4)   6 (15.8)   < 0.01	Motor	Need assistance/supervision for toileting	96 (7.3)	16 (42.1)	< 0.01
Paralysis   32 (2.4)   3 (7.9)   0.07     Parkinsonism symptoms   16 (1.2)   1 (2.6)   0.4     Deformed/contracted bones/joints   33 (2.5)   0   1.0     Sensory function   Hearing loss   48 (3.6)   3 (7.9)   0.2     Vision impairment   70 (5.3)   5 (13.2)   0.053     Balance disturbance   12 (0.9)   1 (2.6)   0.3     Numbness and hyperesthesia of leg   84 (6.3)   6 (15.8)   0.03     Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Cosnicousness disorder, delirium   15 (1.1)   1 (2.6)   0.4     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.2     Heasitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psyc	function	Muscle weakness of leg	100 (7.6)	9 (23.7)	< 0.01
Parkinsonism symptoms   16 (1.2)   1 (2.6)   0.4     Deformed/contracted bones/joints   33 (2.5)   0   1.0     Sensory function   Hearing loss   48 (3.6)   3 (7.9)   0.2     Vision impairment   70 (5.3)   5 (13.2)   0.053     Balance disturbance   12 (0.9)   1 (2.6)   0.3     Numbness and hyperesthesia of leg   84 (6.3)   6 (15.8)   0.03     Cognitive   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own non-understanding of own non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		Paralysis	32 (2.4)	3 (7.9)	0.07
Sensory function   Hearing loss   48 (3.6)   3 (7.9)   0.2     Vision impairment   70 (5.3)   5 (13.2)   0.053     Balance disturbance   12 (0.9)   1 (2.6)   0.3     Numbness and hyperesthesia of leg   84 (6.3)   6 (15.8)   0.03     Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.2     Eehavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		Parkinsonism symptoms	16 (1.2)	1 (2.6)	0.4
InitiationVision impairment Balance disturbance Numbness and hyperesthesia of leg70 (5.3) 12 (0.9)5 (13.2) 1 (2.6)0.053 0.3Cognitive functionUnable to call nurse call due to impaired cognitive function Consciousness disorder, delirium Overestimation or non-understanding of own physical abilities Cognitive dysfunction26 (2.0) 3 (7.9)3 (7.9) 0.04Behavioral psychologyDiminished attention or non-understanding of own physical abilities Cognitive dysfunction36 (2.7) 2 (5.3)2 (5.3) 0.30.3Behavioral psychologyDiminished attention with anxiety Hesitating/resisting to be treated Under radiation therapy Under after chemotherapy10 (0.8) 1 (2.6)1 (2.6) 0.30.02TreatmentUnder radiation therapy Under or after chemotherapy Dimerstion25 (3.9) 1 (2.6)1 (2.6) 0.030.03SleepDifficulty initiating sleep Trequent urination Trequent urination38 (2.9) 4 (10.5)0.030.04ExcretionFrequent urination Frequent urination Use of a urinal Use of a urinal U	Sensory	Hearing loss	33 (2.5) 48 (3.6)	0 3 (7.9)	0.2
Cognitive function   Hold interface Numbness and hyperesthesia of leg   12 (0.9)   1 (2.6)   0.3     Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Consciousness disorder, delirium   15 (1.1)   1 (2.6)   0.4     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.3     Cognitive dysfunction   45 (3.4)   6 (15.8)   <0.01	TUNCTION	Vision impairment	70 (5 3)	5 (13 2)	0.053
Numbress and hyperesthesia of leg   84 (6.3)   6 (15.8)   0.03     Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     Consciousness disorder, delirium   15 (1.1)   1 (2.6)   0.4     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.3     Cognitive dysfunction   45 (3.4)   6 (15.8)   < 0.01		Balance disturbance	12 (0.9)	1 (2.6)	0.3
Cognitive function   Unable to call nurse call due to impaired cognitive function   26 (2.0)   3 (7.9)   0.04     function   Consciousness disorder, delirium   15 (1.1)   1 (2.6)   0.4     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.3     Behavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2   0.1     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		Numbness and hyperesthesia of leg	84 (6.3)	6 (15.8)	0.03
Consciousness disorder, delirium   15 (1.1)   1 (2.6)   0.4     Diminished attention   38 (2.9)   4 (10.5)   0.03     Overestimation or   non-understanding of own   36 (2.7)   2 (5.3)   0.3     physical abilities   Cognitive dysfunction   45 (3.4)   6 (15.8)   < 0.01	Cognitive function	Unable to call nurse call due to impaired cognitive function	26 (2.0)	3 (7.9)	0.04
Diministed attention   36 (2.9)   4 (10.3)   0.03     Overestimation or non-understanding of own physical abilities   36 (2.7)   2 (5.3)   0.3     Behavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Under or after chemotherapy   58 (4.4)   0   0.4     Laxative use   65 (4.9)   1 (2.6)   1.0     Diuretic use   52 (3.9)   1 (2.6)   1.0     Tube insertion   252 (19.0)   13 (34.2)   0.03     Sleep   Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)		Consciousness disorder, delirium	15 (1.1)	1 (2.6)	0.4
Behavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.3     Behavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Under or after chemotherapy   58 (4.4)   0   0.4     Laxative use   65 (4.9)   1 (2.6)   1.0     Diuretic use   52 (3.9)   1 (2.6)   1.0     Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01		Overestimation or	36 (2.9)	4 (10.5)	0.03
Cognitive dysfunction   45 (3.4)   6 (15.8)   < 0.01     Behavioral psychology   Diminished attention with anxiety   23 (1.7)   2 (5.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		physical abilities	30 (2.7)	2 (0.3)	0.3
psychology   Diministed attention with anxiety   23 (1.7)   2 (3.3)   0.2     Hesitating/resisting to be treated   17 (1.3)   3 (7.9)   0.02     Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Under or after chemotherapy   58 (4.4)   0   0.4     Laxative use   65 (4.9)   1 (2.6)   1.0     Diuretic use   52 (3.9)   1 (2.6)   1.0     Tube insertion   252 (19.0)   13 (34.2)   0.03     Sleep   Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01	Behavioral	Cognitive dysfunction	45 (3.4)	6 (15.8)	< 0.01
Treatment Hesitating/resisting to be treated 17 (1.3) 3 (7.9) 0.02   Treatment Under radiation therapy 10 (0.8) 1 (2.6) 0.3   Narcotic use 29 (2.2) 2 (5.3) 0.2   Using psychotropics 85 (6.4) 5 (13.2) 0.1   Using analgesics 69 (5.2) 7 (18.4) < 0.01	psychology		23 (1.7)	2 (5.5)	0.2
Treatment   Under radiation therapy   10 (0.8)   1 (2.6)   0.3     Narcotic use   29 (2.2)   2 (5.3)   0.2     Using psychotropics   85 (6.4)   5 (13.2)   0.1     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		Hesitating/resisting to be treated	17 (1.3)	3 (7.9)	0.02
Narcolic use 29 (2.2) 2 (3.3) 0.2   Using psychotropics 85 (6.4) 5 (13.2) 0.1   Using analgesics 69 (5.2) 7 (18.4) < 0.01	Treatment	Under radiation therapy	10 (0.8)	1 (2.6)	0.3
Using analgesics   63 (0.4)   3 (13.2)   0.1     Using analgesics   69 (5.2)   7 (18.4)   < 0.01		Narcouc use	29 (2.2) 85 (6.4)	∠ (3.3) 5 (13.2)	0.2
SileepDifficulty initiating sleep $58 (4.4)$ $0$ $0.4$ Laxative use $65 (4.9)$ $1 (2.6)$ $1.0$ Diuretic use $52 (3.9)$ $1 (2.6)$ $1.0$ Tube insertion $252 (19.0)$ $13 (34.2)$ $0.03$ SleepDifficulty initiating sleep $54 (4.1)$ $3 (7.9)$ $0.2$ Nocturnal awakening $38 (2.9)$ $4 (10.5)$ $0.03$ Day-night reversal $6 (0.5)$ $0$ $1.0$ ExcretionIncontinence $40 (3.0)$ $6 (15.8)$ $< 0.01$ Frequent urination $37 (2.8)$ $1 (2.6)$ $1.0$ Excretion more than two times per night $46 (3.5)$ $5 (13.2)$ $0.01$ Use of a urinal $24 (1.8)$ $1 (2.6)$ $0.4$ Difference in floor levels between bathroom and room $18 (1.4)$ $1 (2.6)$ $0.4$		Using analgesics	69 (5.2)	7 (18.4)	< 0.1
Laxative use $65 (4.9)$ $1 (2.6)$ $1.0$ Diuretic use $52 (3.9)$ $1 (2.6)$ $1.0$ Diuretic use $52 (3.9)$ $1 (2.6)$ $1.0$ Tube insertion $252 (19.0)$ $13 (34.2)$ $0.03$ SleepDifficulty initiating sleep $54 (4.1)$ $3 (7.9)$ $0.2$ Nocturnal awakening $38 (2.9)$ $4 (10.5)$ $0.03$ Day-night reversal $6 (0.5)$ $0$ $1.0$ ExcretionIncontinence $40 (3.0)$ $6 (15.8)$ $< 0.01$ Frequent urination $37 (2.8)$ $1 (2.6)$ $1.0$ Excretion more than two times per night $46 (3.5)$ $5 (13.2)$ $0.01$ Use of a urinal $24 (1.8)$ $1 (2.6)$ $0.4$ Difference in floor levels between bathroom and room $18 (1.4)$ $1 (2.6)$ $0.4$		Under or after chemotherapy	58 (4 4)	0	0.01
Diuretic use   52 (3.9)   1 (2.6)   1.0     Tube insertion   252 (19.0)   13 (34.2)   0.03     Sleep   Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01		Laxative use	65 (4.9)	1 (2.6)	1.0
Tube insertion   252 (19.0)   13 (34.2)   0.03     Sleep   Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01		Diuretic use	52 (3.9)	1 (2.6)	1.0
Sleep   Difficulty initiating sleep   54 (4.1)   3 (7.9)   0.2     Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01		Tube insertion	252 (19.0)	13 (34.2)	0.03
Nocturnal awakening   38 (2.9)   4 (10.5)   0.03     Day-night reversal   6 (0.5)   0   1.0     Incontinence   40 (3.0)   6 (15.8)   < 0.01	Sleep	Difficulty initiating sleep	54 (4.1)	3 (7.9)	0.2
Day-night reversal   6 (0.5)   0   1.0     Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01		Nocturnal awakening	38 (2.9)	4 (10.5)	0.03
Excretion   Incontinence   40 (3.0)   6 (15.8)   < 0.01     Frequent urination   37 (2.8)   1 (2.6)   1.0     Excretion more than two times per night   46 (3.5)   5 (13.2)   0.01     Use of a urinal   24 (1.8)   1 (2.6)   0.5     Use of a portable toilet   19 (1.4)   1 (2.6)   0.4     Difference in floor levels between bathroom and room   18 (1.4)   1 (2.6)   0.4		Day-night reversal	6 (0.5)	0	1.0
Frequent urination 37 (2.8) 1 (2.6) 1.0   Excretion more than two times per night 46 (3.5) 5 (13.2) 0.01   Use of a urinal 24 (1.8) 1 (2.6) 0.5   Use of a portable toilet 19 (1.4) 1 (2.6) 0.4   Difference in floor levels between bathroom and room 18 (1.4) 1 (2.6) 0.4	Excretion	Incontinence	40 (3.0)	6 (15.8)	< 0.01
Excretion more than two times per night46 (3.5)5 (13.2)0.01Use of a urinal24 (1.8)1 (2.6)0.5Use of a portable toilet19 (1.4)1 (2.6)0.4Difference in floor levels between bathroom and room18 (1.4)1 (2.6)0.4		Frequent urination	37 (2.8)	1 (2.6)	1.0
Use of a urinal24 (1.8)1 (2.6)0.5Use of a portable toilet19 (1.4)1 (2.6)0.4Difference in floor levels between bathroom and room18 (1.4)1 (2.6)0.4		Excretion more than two times per night	46 (3.5)	5 (13.2)	0.01
Environment Difference in floor levels between 18 (1.4) 1 (2.6) 0.4		Use of a urinal Use of a portable toilet	24 (1.8) 19 (1.4)	1 (2.6) 1 (2.6)	0.5 0.4
bathroom and room 18 (1.4) 1 (2.6) 0.4	Environment	Difference in floor levels between	10 (1.1)	1 (2.6)	0.4
Disorderly items around the bed 0 0 0 -	Environment	bathroom and room Disorderly items around the bed	10 (1.4) N	i (2.0)	- 0.4

Table 2. Patients' characteristics and conditions at first assessment.

ADL, activities of daily living.

Data are expressed as the mean  $\pm$  standard deviation and n (%).

Risk of falls for patients who were hospitalized or transferred to the other ward first time during the study period was assessed and analyzed between fallers and non-fallers.

		No preventive action needed		Preventive Action needed		
		Non-fallers (N = 1164)	Fallers (N = 20)	Non-fallers (N = 160)	Fallers (N = 18)	
Age, years		55.7 ± 17.6	58.0 ± 21.4	65.5 ± 18.2	70.2 ± 12.9	
Sex		621 (53.4)	11 (55.0)	82 (51.3)	10 (55.6)	
(female) History of		· · · ·		· · · ·	· · · ·	
falls		68 (5.8)	3 (15.0)	31 (19.4)	6 (33.3)	
Life style	Sleeps on a futon (not a bed) at home	182 (15.6)	5 (25.0)	25 (15.6)	3 (16.7)	
Condition	Within three days from the day of hospitalization or transfer from another ward	1124 (96.6)	14 (70.0)**	146 (91.3)	15 (83.3)	
	Within three days after surgery	18 (1.6)	3 (15.0)**	14 (8.8)	4 (22.2)	
	Fever	14 (1.2)	1 (5.0)	9 (5.6)	0	
	Anemia	13 (1.1)	0	10 (6.3)	0	
	Dizziness	19 (1.6)	1 (5.0)	8 (5.0)	2 (11.1)	
	Tubes inserted	55 (4.7)	4 (20.0)*	40 (25.0)	10 (55.6)**	
	Condition or ADL got better or	21 (1.8)	2 (10.0)	30 (18.8)	5 (27.8)	
Dhysical	worse rapidly	( -)			- ( - )	
activity	walk	42 (3.6)	4 (20.0)**	95 (59.5)	14 (77.8)	
	transfer	44 (3.8)	3 (15.0)*	81 (50.6)	15 (83.3)**	
Madan	toileting	24 (2.1)	4 (20.0)**	72 (45.0)	12 (66.7)**	
function	Muscle weakness of leg	36 (3.1)	1 (5.0)	64 (40.0)	8 (44.4)	
lanotion	Paralvsis	12 (1.0)	2 (10.0)*	20 (12.5)	1 (5.6)	
	Parkinsonism symptoms	8 (0.7)	0	8 (5.0)	1 (5.6)	
	Deformed/contracted bones/joints	22 (1.9)	0	11 (6.9)	0	
Sensory function	Hearing loss	26 (1.3)	0	22 (13.8)	3 (16.7)	
	Vision impairment	47 (4.0)	2 (10.0)	23 (14.4)	3 (16.7)	
	Balance disturbance	6 (0.5)	0	6 (3.8)	1 (5.6)	
	Numbness and hyperesthesia of	56 (4.7)	2 (10.0)	28 (17.5)	4 (22.2)	
Cognitive function	Unable to call nurse call due to impaired cognitive function	4 (0.3)	0	22 (13.8)	3 (16.7)	
	Consciousness disorder, delirium	4 (0.3)	0	11 (6.9)	1 (5.6)	
	Diminished attention Overestimation or	12 (1.0)	0	26 (16.3)	4 (22.2)	
	non-understanding of own physical abilities	14 (1.2)	1 (5.0)	22 (13.8)	1 (5.6)	
Data data d	Cognitive dysfunction	13 (1.1)	2 (10.0)*	32 (20.0)	4 (22.2)	
Benaviorai psvchology	Diminished attention with anxiety	12 (1.0)	1 (5.0)	11 (6.9)	1 (5.6)	
, , , , , , , , , , , , , , , , , , , ,	Hesitating/resisting to be treated	3 (0.3)	1 (5.0)	14 (8.8)	2 (11.1)	
Treatment	Under radiation therapy	8 (0.7)	0	2 (1.3)	1 (5.6)	
	Narcotic use	21 (1.8)	0	8 (5.0)	2 (11.1)	
	Using psychotropics	59 (5.1)	3 (15.0)	26 (16.3)	2 (11.1)	
	Using analgesics	44 (3.8)	2 (10.0)	25 (15.6)	5 (27.8)	
	Under or after chemotherapy	55 (4.7)	0	3 (1.9)	0	
	Laxative use	46 (4.0)	0	19 (11.9)	1 (5.6)	
	Diuretic use	42 (3.6)	0	10 (6.3)	1 (5.6)	
0	I ube insertion	189 (16.2)	6 (30.0)	63 (39.4)	7 (38.9)	
Sleep	Difficulty initiating sleep	38 (3.3)	1 (5.0)	16 (10.0)	2 (11.1)	
	Nociumai awakening Dav-night reversal	21 (2.3)	∠ (10.0)	11 (0.9) 3 (1 0)	∠(11.1)	
Excretion	Incontinence	9 (0.3)	1 (5 0)	31 (19 4)	5 (27 8)	
	Frequent urination	27 (2.3)	0	10 (6.3)	1 (5 6)	
	Excretion more than two times per	27 (2.0)			. (0.0)	
	night	30 (2.6)	1 (5.0)	16 (10.0)	4 (22.2)	
	Use of a urinal	7 (0.6)	1 (5.0)	17 (10.6)	0	
	Use of a portable toilet	8 (0.7)	0	11 (6.8)	1 (5.6)	
Environment	Difference in floor levels between	17 (1.5)	0	1 (0.6)	1 (5.6)	
	bathroom and room		÷	. (0.0)	. (0.0)	
	Disorderly items around the bed	0	U	0	U	

Table 3. Patients' characteristics and condition at first assessment without/with the need for preventive action.

ADL, activities of daily living.

Data are expressed as the mean  $\pm$  standard deviation and n (%).

<sup>\*</sup>P < 0.05, \*\*P < 0.01 between without and with preventive action for falls using Fisher's exact test or the chi-square test.

Risk of falls for patients who were hospitalized or transferred to the other ward first time during the study period was assessed and analyzed between patients who needed any preventive action from falls among fallers and non-fallers respectively.

Table 4. Selected variables as risk factors for patient falls at first assessment.

Variable	OR (95% CI)	Р
History of falls	2.41 (1.05 - 5.53)	0.04
Tubes inserted	3.64 (1.57 - 8.43)	< 0.01
Need assistance/supervision for toileting	4.52 (2.00 - 10.23)	< 0.01
Excretion more than two times per night	3.92 (1.38 - 11.09)	0.01

OR, odds ratio; CI, confidence interval.

Possible factors at the first assessment for falls identified by stepwise regression analysis are described here.

"Tube inserted", "Need assistance/supervision to transfer", and "Need assistance/supervision for toileting". Among the patients not needing preventive action, "Within three days from the day of hospitalization or transfer from another ward", "Within three days after surgery", "Need assistance/ supervision to walk", "Paralysis" and "Cognitive dysfunction" were more frequent in fallers than in non-fallers.

Stepwise regression analysis identified "History of falls" "Tubes inserted", "Need assistance/supervision for toileting" and "Excretion more than two times per night" as risk factors for falls at hospitalization or transfer to another ward (Table 4).

Of the 38 fallers, 30 (78.9%) were assessed both before and after falls. These 30 patients experienced "Overestimation or non-understanding of own physical abilities" more frequently after falls (30.0%) than at hospitalization or transfer to another ward (6.7%, P = 0.02) (Table 5).

#### Discussion

In this study, we found that "History of falls", "Tubes inserted", "Need assistance/supervision for toileting" and "Excretion more than two times per night" at hospitalization or transfer to another ward were risk factors of patient falls. We also analyzed changes in patient conditions between before and after falls, and found that patients with "Overestimation or non-understanding own physical abilities" significantly more frequently after falls compared with before falls.

During our study period, 2.8% (38/1,362 participants) fell among the participants. Another article mentioned that 3 to 20% of inpatients (number was not shown) experienced falls at least once during their stay (Inouye et al. 2009). Usually, incidents or accidents are underreported. Therefore, there might have been more falls during the study period.

Abreu et al. (2015) previously reported that urinary incontinence had a relative risk of 5.67. However, based on our analysis, excretion-related factors were remarkable. In particular, we found that needing excretion assistance and having a high frequency of excretion were possible factors related to patient falls. History of falls was identified as a possible risk factor in a previous study (Chu et al. 2015), and that result was consistent with our findings. On the other hand, Abreu et al. (2015) also reported that the use of laxatives had a relative risk of 4.4; this was not identified as a risk factor in our study. This disparity may have been the result of differences in the risk assessment items and the methods of the analysis. The risk assessment sheet used in our study was created by the Working Group for the Prevention of Falls at Tohoku University Hospital; therefore a design-related bias might have influenced the analysis. Haines et al. (2007) reviewed articles related to fall risk assessment and found that study design may affect predictive accuracy. Our study identified possible factors for patient falls at hospitalization or transfer to another ward, as well as compared patient conditions between before and after falls. The assessment sheet needs to be validated with identified possible factors before it can be used in other facilities. We are planning to conduct a second assessment in Tohoku University Hospital; therefore, the need for validation of the risk assessment sheet should be taken into account.

Drug use has also been considered as a factor affecting patient falls. Findley and Bulloch (2015) reported that patient falls were more frequent among users of nonsteroidal anti-inflammatory drugs than among non-users, and Obayashi et al. (2013) reported that the use of some types of hypnotic drugs affected falls among hospitalized patients. The risk assessment sheet which we used in this study also included items on the use of drugs such as narcotics, psychotropics, analgesics, chemotherapy, laxatives and diuretics. Although a higher proportion of fallers than non-fallers was using analgesics, this difference was not significant on stepwise regression analysis. This might be because our risk assessment sheet categorized each drug as part of a group; therefore, it might be necessary to assess the risk of individual drugs for patient falls in a future study.

Falls occurred more frequently in patients who needed preventive action than in those who did not. Patients who were at a higher risk of falls tended to need action plans. This phenomenon was also observed in a previous study (Anderson et al. 2016). This suggests that more patients would have fallen if high risk patients were not taken preventive action.

"Overestimation or non-understanding of own physical abilities" was identified as a variable factor in patient falls. The result suggested that it was difficult for medical staff to recognize patients' understanding of their own physical abilities correctly for a few days from hospitalization or transfer from a former ward. We were unable to analyze enough how patients' understanding of their diseases

		Before fall	After fall	Р
Condition	Within three days from the day of hospitalization or transfer from	_	_	-
Condition	another ward		-	
	Within three days after surgery	6 (20.0)	4 (13.3)	0.5
	Fever	1 (3.3)	2 (6.7)	1.0
	Anemia	0	1 (3.3)	1.0
	Dizziness	2 (6.7)	4 (13.3)	0.7
	Tubes inserted	12 (40.0)	7 (23.3)	0.2
	Condition or ADL got better or worse rapidly	7 (23.3)	6 (20.0)	0.8
Physical activity	Need assistance/supervision to walk	14 (46.7)	11 (36.7)	0.4
	Need assistance/supervision to transfer	14 (46.7)	12 (40.0)	0.6
	Need assistance/supervision for toileting	13 (43.3)	11 (36.7)	0.6
Motor function	Muscle weakness of leg	5 (16.7)	10 (33.3)	0.1
	Paralysis	2 (6.7)	2 (6.7)	1.0
	Parkinsonism symptoms	0	0	-
	Deformed/contracted bones/joints	0	0	-
Sensory function	Hearing loss	3 (10.0)	2 (6.7)	1.0
	Vision impairment	4 (13.3)	3 (10.0)	1.0
	Balance disturbance	1 (3.3)	1 (3.3)	1.0
	Numbness and hyperesthesia of leg	5 (16.7)	6 (20.0)	0.7
Cognitive function	Unable to call nurse call due to impaired cognitive function	3 (10.0)	4 (13.3)	1.0
	Consciousness disorder, delirium	1 (3.3)	5 (16.7)	0.2
	Diminished attention	3 (10.0)	5 (16.7)	0.7
	Overestimation or non-understanding of own physical abilities	2 (6.7)	9 (30.0)	0.02
	Cognitive dysfunction	5 (16.7)	6 (20.0)	0.7
Behavioral psychology	Diminished attention with anxiety	1 (3.3)	2 (6.7)	1.0
	Hesitating/resisting to be treated	3 (10.0)	7 (23.3)	0.2
Treatment	Under radiation therapy	1 (3.3)	1 (3.3)	1.0
	Narcotic use	2 (6.7)	3 (10.0)	1.0
	Using psychotropics	4 (13.3)	10 (33.3)	0.07
	Using analgesics	6 (20.0)	7 (23.3)	0.8
	Under or after chemotherapy	0	2 (6.7)	0.5
	Laxative use	1 (3.3)	2 (6.7)	1.0
	Diuretic use	1 (3.3)	1 (3.3)	1.0
	Tube insertion	12 (40.0)	14 (46.7)	0.6
Sleep	Difficulty initiating sleep	3 (10.0)	4 (13.3)	1.0
	Nocturnal awakening	3 (10.0)	5 (16.7)	0.7
	Day-night reversal	0	1 (3.3)	1.0
Excretion	Incontinence	4 (13.3)	6 (20.0)	0.5
	Frequent urination	0	0	-
	Excretion more than two times per night	3 (10.0)	4 (13.3)	1.0
	Use of a urinal	1 (3.3)	2 (6.7)	1.0
	Use of a portable toilet	1 (3.3)	1 (3.3)	1.0
Environment	Difference in floor levels between bathroom and room	1 (3.3)	2 (6.7)	1.0
	Disorderly items around the bed	0	0	-

Table 5. Patient conditions before and after falls among 30 fallers who were assessed twice.

ADL, activities of daily living.

Data are expressed as n (%).

Out of 38 patients, 30 patients were assessed both before and after fall.

Items from the risk assessment sheet were compared between before and after falls only among 30 fallers who assessed both before and after falls.

changed. However, our result suggests that subsequent assessments of patients' understanding of their condition are necessary. Our results also suggest that in some cases, the first assessment by the hospital staff might have not been sufficient to prevent falls, which may explain the differences between before and after patient falls for the item "Overestimation or non-understanding of own physical abilities". Further study is necessary for clarify the factors underlying these differences.

This study had some limitations. First, we did not col-

lect information on circumstances such as patient disease, hospital ward/department, characteristics of the medical staff involved in the fall risk assessments, and the infrastructure and other features of the hospital system. Considering such circumstances might be necessary to achieve better risk assessment in relation to patient falls. In particular, we could not conduct research for all seasons because of the difficulty on practical issue to apply this trial for whole hospital departments. We need to assess the seasonal trend once we apply the new assessment sheet in the future. Second, because our study had a relatively small sample size, the results might not be easily generalizable. However, our study site was one of the largest hospitals in Japan. Therefore, the results might be representative of other hospitals that have similar functions. Third, we could not assess changes in patient conditions among the nonfallers. Therefore, it remains unclear whether non-fallers also experience "Overestimation or non-understanding of own physical abilities". Clarifying changes in conditions among non-fallers in future studies could be useful in confirming our results. Finally, we could not assess actual correlation between the risk assessment and factors for falls, because the information for the situation at fall was not available. Further analysis whether falls are consistent with risk assessment for each case should be conducted as well as the type of patient characteristics.

In conclusion, we assessed risk factors of patient falls at hospitalization or transfer to another ward, as well as risk factors that could change during hospitalization. "History of falls", "Tubes inserted", "Require assistance for excretion" and "Excretion more than two times per night" were identified as risk factors for falls. "Overestimation or nonunderstanding of own physical abilities" was experienced more frequently after falls than at hospitalization or transfer to another ward. These results are expected to be useful in identifying patients at a higher risk of falls.

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## **Conflict of Interest**

The authors declare no conflict of interest.

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