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ORIGINAL

Relationship between the type of urinary incontinence and falls among frail elderly women in Japan

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Abstract : Urinary incontinence and falls are serious problem among elderly people, because of restriction of the Activities of Daily Living (ADL) and Quality of Life. Previous studies have examined the association between urinary incontinence and falls. However, results have been inconsistent. In Japan, with the rapid aging of the society, the number of elderly women who have urinary incontinence and are at risk of falling is increasing. We investigated the relationship between type of urinary incontinence and risk of falls among elderly users of day-care services in a long-term care system. Our study population comprised 118 ambulatory women. At baseline, we evaluated incontinent status, lower extremity muscle strength, balance ability, ADL, and Instrumental ADL. We asked subjects about number of falls every 4 months during a year. In univariate analysis, lower extremity muscle strength (p=0.001) and mixed incontinence (p=0.050) differed significantly according to the fall status. Stress and urge incontinence were not significantly associated with falls. In logistic regression analysis, subjects who had mixed incontinence were 3.05 (95% confidence interval 1.01-10.2) times more likely to fall than those without. These results suggest that mixed incontinence have independent associations with falls. Incontinent status should be considered to prevent falls among elderly persons who are partially dependent and need support. J. Med. Invest. 52 : 165-171, August, 2005

Keywords **:** *urinary incontinence, falls, aged, risk assessment*

INTRODUCTION

Urinary incontinence and falls are the most common health problems among elderly women. Urinary incontinence has been associated with loss of independence (1), admission to a long-term care unit (2, 3) and decreased Quality of Life (4, 5). In addition, urinary incontinence is a costly condition because of the use of absorbent products, urinary tract and skin infections, pharmacotherapy and other supplementary costs (6). A review of urinary incontinence found that approximately 35% of elderly women experienced the condition during a year (7). In Japanese setting, the prevalence of urinary incontinence among postmenopausal women was 26.3% (8).

Falls among the elderly can potentially cause a femoral neck fracture and lead to a restriction of the Activities of Daily Living (ADL) (9) and admission to a nursing home (2). Post-fall syndrome may make the elderly home-bound because of fear of falling. In Japan, the prevalence of falls has been reported to be around 20% among the community-dwelling elderly (10, 11), although western countries have a fall rate of over 30% (9, 12-14).

Numerous studies have examined the association between urinary incontinence and falls. However, results have been inconsistent. Some reports suggested that urinary incontinence was associated with falls (9, 12-14) and substantial fractures (13, 15, 16). How-

Received for publication March 1, 2005; accepted June 1, 2004.

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ever, most studies regarded urinary incontinence as only a frailty measurement, and did not consider the effects of types of incontinence, urge and stress incontinence. Symptoms of urge and stress incontinence are clinically different. Therefore, distinction between urge and stress incontinence may be useful for clarifying the connection between incontinence and falls (13). Brown and colleagues (13) suggested urge incontinence, but not stress incontinence, significantly increased the risk of falls and fractures. They hypothesized that the elderly might trip when they rushed to the bathroom to avoid incontinence.

In the Japanese population, however, the relationship between urinary incontinence according to type and falls is less clear. With the rapid aging of the society, the number of elderly women who have urinary incontinence and are at risk of falling is increasing. To evaluate the relationship between incontinence and falls are essential to prevent accidental falls. This study was aimed at clarifying whether each type of urinary incontinence was related to the risk of falls.

SUBJECTS AND METHODS

Study subjects

A total of 137 elderly women participated in a day-care service at the E geriatric health facility in Nagasaki Prefecture, Japan, in December 2001. Subjects who had obvious dementia (2 persons), had a history of stroke (5 persons) or could not walk independently (3 persons) were excluded. Therefore, eligible subjects comprised 127 ambulatory women. A day-care was one of a service of long-term care insurance system in Japan. Women who had complaints such as lower back pain, knee joint pain and/or muscle weakness of the lower extremities can receive rehabilitation for their physical disabilities and pain. All subjects provided verbal informed consent.

Baseline assessments

At baseline, we measured the ADL and Instrumental ADL (IADL), isometric muscle forces of knee extension and balance ability. A physical therapist (K.T.) measured the knee extensor muscle force with a hand-held dynamometer (Musculator GT-10, OG Giken, Okayama, Japan). The subjects' positioning and dynamometer placement were as described by Bohannon (17). The test-retest reliability had been confirmed in our previous report (18). To adjust the lower-extremity muscle strength for body weight, muscle strength was divided by body weight and multiplied by 100. The standardized quadriceps force for body weight of less than 30% was defined as decreased lower muscle strength. As the balance capacity, we measured the time during which the subjects could maintain a full tandem stance without support to their upper limbs. We defined the subjects who could not keep their balance for less than 10 seconds as having balance instability.

ADL and IADL measurements

The Barthel index (19) and subscale of the Tokyo Metropolitan Institute of Gerontology (TMIG) Index of Competence (20) were used as ADL and IADL measures, and evaluated in a face-to-face interview. The Barthel index measures independence of 10 daily activities such as feeding, bathing, dressing, personal toilet, moving from chair to bed, getting on and off toilet, walking on level surface, ascending and descending stairs, and controlling bowels and bladder. The TMIG Index of Competence, a standardized multidimensional 13-item index of functional competence, included 5 items of IADL and 8 items of intellectual activity and social role. In this paper, we used IADL scales including the following 5 activities : using public transportation, shopping for daily necessities, preparing meals, paying bills, and managing deposits at a bank or a post office. For this index scales, we gave 1 point when the subjects could do each item of activity, and 0 points when they could not perform the activity without help. For both Barthel index and TMIG Index of Competence, the higher the score the less assistance was needed. The dependence of IADL was considered to be present when the subjects reported difficulties with at least two items.

Urinary incontinence

Detailed information on incontinence, including circumstance and frequency, was obtained, although the Barthel index included a simple urinary incontinence item. We determined the type of incontinence (urge, stress or mixed incontinence) based on self-reported symptoms. Urge urinary incontinence was defined as involuntary urinary leakage accompanied by or immediately preceded by urgency. Stress urinary incontinence was defined as involuntary leakage on effort or exertion, or on sneezing or coughing. Mixed urinary incontinence was leakage associated with urgency and also with exertion, effort, sneezing or coughing (21). For urinary incontinence, those who had a complaint every day and at least once a week were defined as urinary incontinent person as studied by Brown and colleagues (13).

Other measurements

Other measurements included usage of assistive devices and pain in the knee joint and lower back during the previous 3 months. The environment around the home (flat or slope) was also evaluated by day-care staffs. These measurements reflect characteristics of the participants, and might be related to the falls.

Fall status

After the baseline assessment, we interviewed each subject about falls every 4 months during 1 year. A fall was defined as unintentionally coming to rest on the ground or other lower levels, not as a result of a major intrinsic event such as a stroke or syncope (9).

Statistical analysis

In univariate analysis, we classified the subjects into a no fall group, a single fall group and recurrent fallers. The difference in physical and functional variables with regard to fall status was analyzed using the Kruskal-Wallis test and Mann-Whitney U test. We used multiple logistic regression analysis to assess the relationship between the type of urinary incontinence and falls. In this analysis, fall status (dependent variable) was divided into two categories (no fall vs. single and multiple fall), and three indicator variables corresponding to each type of urinary continence were included as independent variables in the model. In addition, the potential confounding effects of age, muscle strength (strong, decreased), IADL (independence, dependence) and balance on tandem standing (good, poor) were adjusted by including continuous or indicator variables as covariates. Odds ratios (OR) and their profile likelihood 95% confidence intervals (95% CI) were presented, using subjects with no urinary incontinence as a reference group. All statistical analyses were done with SPSS (Version 10.0) and SAS (Version 8.12) softwares.

RESULTS

Of 127 participants, two had died in the study period, six had stopped using the day-care service (one was injured because of a fall) and one had started to use a wheelchair because her gait condition worsened. Therefore, we completely followed 118 women living in the community.

The characteristics of the study subjects are presented in Table 1. The age and body weight ranged 70-93 years (median=81) and 32.6-73.2 kg (median=50.2), respectively. Absolute knee extensor muscle strength ranged 5.2-28.9 kg (median=16.55). The proportion of individuals with more than 30% of standardized muscle strength accounted for 67.8% (n=80). For the tandem balance ability, 69 (58.5%) could keep balanced over 10 seconds. With regard to ADL, 41 (34.7%) were fully independent according to the Barthel index scale. For IADL scales in TMIG index scales, 84 (71.2%) were fully independent or needed help with only one item.

Fifty-one (43.2%) subjects reported experiencing urinary incontinence at least once a week or more during the previous year. The proportion of those who had stress and urge incontinence was 49.0% (n=25) and 90.2% (n=46) among incontinent women of 51, respectively. Among them, 20 persons reported both stress and urge incontinence (mixed type).

During the follow up period of 1-year, 62 subjects (52.5%) had not experienced a fall, 25 (21.2%) had fallen only once, 18 (15.3%) had fallen twice, and 13 (11.0%) had fallen three times or more. Only 9 persons had fallen on the way to the bathroom.

Table 2 shows the difference among physical and functional ability measurements according to fall status. Age, body weight, the IADL and balance ability did not differ significantly with fall status. However, there was a significant difference in lower muscle strength (p=0.001) and mixed incontinence (p=0.050) according to the number of falls. Stress and urge incontinence was not associated with falls in the univariate analysis.

In logistic regression analysis, only mixed incontinence was associated with fall status (Figure 1). The elderly women who had mixed incontinence were 3.05 times (95% CI 1.01-10.2) more likely to fall than those who did not. Persons who had mixed incontinence were more likely to fall on the way to the bathroom, with an OR of 4.17 (95% CI 0.78 -23.5, p=0.09) after adjusting for other variables, though the result was not statistically significant. On the other hand, stress and urge incontinence had no relationship with fall status.

DISCUSSION

In the present study, 47.5% of the subjects had experienced at least one fall in the past year. It was reported that the risk of falling among elderly Japanese women living in a community was approximately 20% during a year (10, 11). Our proportion was much higher than those from other studies. One reason for this may be that our study subjects were older (median=81 years) and exhibited some dependency in daily activities.

Approximately 43% of our subjects had experienced

Table 1. Characteristics of 118 elderly women who participated in a fall survey in 2002.

Variables	118 women	
Age, median (min-max), years	81	(70-93)
Body weight, median (min-max), kg	50.2	(32.6-73.2)
Lower-extremity muscle strength		
Absolute strength [a], median (min-max), kg	16.55	(5.2-28.9)
Standardized strength [b], median (min-max), %	33.4	(11.1-59.2)
Strong, ≧30%, n ,%	80	67.8
Decreased, <30%, n ,%	38	32.2
Balance on tandem standing, n ,%		
Good, ≧10 seconds	69	58.5
Poor, <10 seconds	49	41.5
ADL score of Barthel Index, n ,%		
80-90	7	5.9
95	70	59.3
100	41	34.7
IADL score in TMIG Index of Competence [c], n ,%		
two or more items disabled	34	28.8
fully independent or only one item disabled	84	71.2
Presence of knee joint pain, n ,%	96	81.4
Presence of lower back pain, n ,%	101	85.6
Use of cane or walker, n ,%	79	66.9
A home around slope, n ,%	59	50.0
Urinary incontinence, n ,%	51	43.2
Stress (Pure Stress)	25(5)	49.0(9.8)[d]
Urge (Pure Urge)	46(26)	90.2(51.0)[d]
Both stress and urge incontinence (mixed type)	20	39.2[d]
Other (Pure Other)	2(0)	3.9(0)[d]
Fall status, n ,%		
0	62	52.5
1	25	21.2
≧2	31	26.3
Fall on the way to the bathroom, n %	9	7.6

[a] Obtained with a hand-held dynamometer. [b] Standardized for body weight.
[c] IADL included using public transportation, shopping for daily necessities, preparing meals, paying bills, and managing deposits at a bank or post office.
[d] Percentage among 51 person with incontinence.

incontinence during a year. Thom (7) reported that the prevalence of any incontinence among 21 published studies ranged from 17% to 55% (median=35%) in older women. This review suggested that the median of pure stress, pure urge and mixed incontinence was 26.5 % (range 21-43%), 33.5% (range 9-46%) and 37.5% (range 29-56%), respectively, among 6 studies. In Japan, Ushiroyama et al. (8) reported the proportion of any incontinence was 26.3% among 3026 postmenopausal women (mean age=53.1), and symptoms of pure stress, pure urge and mixed incontinence was 64.9%, 18.6% and 7.3%, respectively. The present study showed that the prevalence of pure stress, pure urge and mixed incontinence was 9.8% (n=5), 51.0% (n=26) and 39.2% (n=20), respectively. Although we defined incontinent persons as those who suffered from weekly and daily incontinent episodes, our result for any incontinence showed a little higher prevalence than in other studies. It is possible that our participants were older and had increased frailty. According to the type of incontinence, our results were different from that of Ushiroyama's study, especially for stress incontinence. Stress incontinence predominates in younger women, whereas urge and mixed incontinence predominate in older women (7). The difference in the age distribution may explain the discrepancy.

Results of multivariate analysis demonstrated that mixed incontinence was independently associated with falling, whereas stress and urge incontinence were not associated with fall status. Several studies have assessed the relationship between urinary incontinence and falls (9, 12-14, 22). Most, however, did not classify urinary incontinence according to type (stress, urge and mixed (9, 12, 22). Perhaps these studies treated

Table 2. Comparison of each variable according to fall status, among 118 elderly women using a day-care service, 2002.

Variables	Number of Falls 0	1	≧2	
	n=62	n=25	n=31	*p*-value
Age, median, y	81.5	81.0	78.0	0.27[b]
Body weight, median, kg	50.6	48.4	53.6	0.09[b]
Lower-extremity muscle strength				
Strong, ≧30%, n (%)	50(80.6)	15(60.0)	15(48.4)	
Decreased, <30%, n (%)	12(19.4)	10(40.0)	16(51.6)	0.001[c]
Balance on tandem standing				
Good, ≧10s , n (%)	34(54.8)	16(64.0)	19(61.3)	
Poor, <10s , n (%)	28(45.2)	9(36.0)	12(38.7)	0.46[c]
IADL[a]				
Independence, ≦1 item disabled, n (%)	42(67.7)	17(68.0)	25(80.6)	
Dependence, ≧2 items disabled, n (%)	20(32.3)	8(32.0)	6(19.4)	0.25[c]
Urinary incontinence, n (%)				
Stress, n=25	9(36.0)	7(28.0)	9(36.0)	
No incontinent women, n=67	36(53.7)	14(20.9)	17(25.4)	0.15[c]
Urge, n=46	23(50.0)	9(19.6)	14(30.4)	
No incontinent women, n=67	36	14	17	0.61[c]
Mixed type, n=20	6(30.0)	5(25.0)	9(45.0)	
No incontinent women, n=67	36	14	17	0.050[c]

[a] IADL items include the following : using public transportation, shopping for daily necessities, preparing meals, paying bills,managing deposits at a bank or post office.
[b] Kruskal Wallis test was used to evaluate the difference of factors by fall status.
[c] Mann-Whitney U test was used to evaluate the difference of fall status.

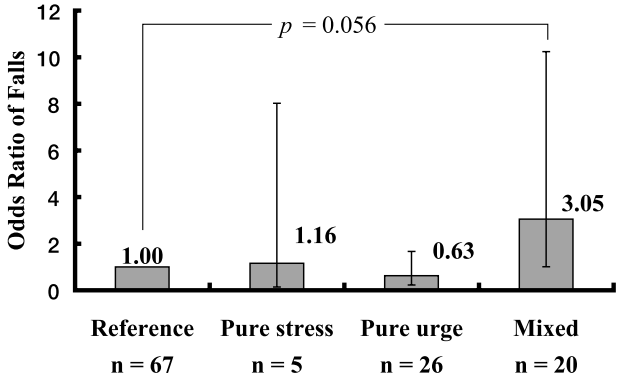

Figure 1 Association of incontinence type with the risk of fall status among 118 elderly women using a day-care service, 2002.

urinary incontinence as only a physical functional outcome. On the other hand, Brown *et al*. (13) studied incontinent types and the risk of falls among 6049 community-dwelling women (mean age=78.5). In multivariate models, weekly or more frequent urge incontinence was independently associated with risk of falling (OR=1.26, 95% CI 1.14-1.40) and with non-spine non-traumatic fracture (Relative Hazard [RH]=1.34, 95% CI 1.06-1.69). In contrast, stress incontinence was not significantly associated with falls (OR=1.06, 95% CI 0.95-1.19) or fracture (RH=0.98, 95% CI 0.75-1.28). Our result is inconsistent with this report. We hypothesize that women with mixed incontinence had a more severe condition that lead to falls than women with pure type of incontinence. In fact, mixed incontinent women were more prone to frailty than those with urge and stress incontinent women (Table 3). Additionally, we observed mixed incontinence was most common among the subjects who leaked urine at least twice a month or more (Table 3). Yarnell *et al*. (23) suggested that subjects with mixed incontinence leaked a large amount of urine and had a more frequent occurrence compared to those with other types of incontinence. Frailty could explain the relationship of mixed incontinence to the occurrence of falls.

There are several limitations to our study. First, we did not use a fall calendar, because we were anxious for compliance. Instead, we interviewed the subjects every 4 months. For elderly Japanese women, recalling fall status during 1 year was reported to be sufficiently reliable (24). Furthermore, the fall rate between our previous study (18) and the present study was very similar (49.0% vs 47.5%). Second, we evaluated the presence and type of urinary incontinence in a face-to-face interview, not by clinical examinations. In the clinical setting, the type of urinary incontinence was diagnosed using structured questionnaires, physical examinations, a pad-test and urodynamics. Ishiko and colleagues (25) developed a questionnaire for Japanese

Table 3. Frequency by types of urinary incontinence of 118 elderly women who participated in a fall survey in 2002.

Variables	Mixed type n=20	Pure Urge n=26	Pure Stress n=5	Other	No incontinence n=67
Median Age, years	79.5	80.0	83.0	-	81.0
Muscle weakness <30%, n (%)	8(40.0)	7(26.9)	0(0)	-	23(34.3)
IADL dependence, n (%)	7(35.0)	5(19.2)	2(40.0)	-	20(29.9)
Poor balance, n (%)	11(55.0)	10(38.5)	1(20.0)	-	27(40.3)
Frequency of incontinence, n (%)					
Every day [a]	8(40.0)	10(38.5)	3(60.0)	0	-
1-/week [a]	12(60.0)	16(61.5)	2(40.0)	0	-
2-/month [b]	5	1	2	0	-
1 /month [b]	0	4	3	0	-
Less than 1/month [b]	0	1	3	2	-

[a] Every day and at least once a week were defined as urinary incontinence.
[b] Excluded from urinary incontinent women in our study.

women, and using this 15-item questionnaire, they obtained a high accuracy of classification. However, we were not aware of this structured questionnaire at the time of the baseline examination. The use of this questionnaire should be considered in future studies. As some studies suggested that the prevalence of urinary incontinence varied, the type of survey is important. Incontinence tends to be underreported. The interview must be carefully designed not to cause embarrassment (26). In our unpublished previous survey, only 12% of subjects reported incontinence, because of a careless interview technique. One year after the study, we have trained female interviewers to ask carefully about incontinent status. As a result, approximately 43% of the participants answered that they had symptoms of urinary incontinence. We believe that our estimated prevalence has greater accuracy. Third, as a result of the small sample size, 95% CIs for the odds ratios were relatively wide. Provided that the sample size was larger, we might obtain more precise estimates of the ORs for the relationships between urinary incontinence and falls.

Our participants did not represent the general population. They were using a day-care service as part of a long-term care system because of their frailty. Therefore, our findings are not directly applicable to a general healthy population. In Japan, however, the number of persons who belong to a long-term care system is increasing with the aging of the society. Thus, we believe that our results are still meaningful to the development of a fall prevention strategy.

In conclusion, the present study showed that urinary incontinence, especially mixed incontinence, was strongly associated with falls among day-care users. A resent study described pelvic floor muscle exercises improve stress incontinence (27) and anticholinergic drug (oxybutynin chloride, propiverine hydrochloride) could be effective for urge incontinence (28-30). Accurate diagnosis of the type of urinary incontinence, pelvic floor muscle exercises, the use of an incontinent pad and pants, and drug therapy might be useful to prevent falls among elderly women. One should consider incontinent status as well as physical ability and function for the prevention of falls among the elderly.

ACKNOWLEDGMENT

The authors are grateful to Dr. Hiroaki Mikasa for his useful discussions.

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