Original Research Article

Relationships between mild/severe knee joint pain and fall risk assessment items in elderly females

ABSTRACT

Aims: This study aimed to examine differences in corresponding rates of fall risk survey items among 3 groups of elderly females categorized on the basis of knee pain.
Methodology: Total of 392 subjects completed the fall risk survey, which comprised 50 items representing 5 risk factors: “symptoms of falling,” “disease and physical symptoms,” “environment,” “behavior and character,” and “physical function.”
Results: The corresponding rates for items related to physical function factor tended to be significantly higher in the severe knee pain group than in the no and mild knee pain groups. However, the corresponding rates for items related to frequency of motion in the behavioral and character factors category were significantly higher in the no and mild knee pain groups than in the severe knee pain group. The corresponding rates of items related to environmental factors and behavioral and character factors tended to be higher in the severe knee pain group.
Conclusion: The severe knee pain group exhibited higher corresponding rates in several fall risk items compared with the other 2 groups. The fall risk items related to frequency of motion in the behavioral and character factors category showed a tendency to be low in the groups with no or mild pain.

Keywords: Mild knee pain; Severe knee pain; Fall risk assessment; Corresponding rates; Female elderly

1. INTRODUCTION

Arthritis of the locomotorium in individuals with advanced age increases their fall risk [1]. The knee joints have the greatest load-bearing capacity among all leg joints [2]. Moreover, knee joint pain due to arthritis makes walking or standing, which are basic physical activities of daily living (ADLs), difficult for elderly individuals. Therefore, the physical ability to perform ADLs decreases and the fall risk increases with age [3, 4]. However, there are large individual differences in the degree of pain among elderly individuals with knee joint pain [5, 6]. For example, Tennant et al. [7] reported that approximately 8% elderly individuals experience severe knee pain and require regular hospital visits or hospitalization, whereas McAlindon et al. [8], Reilly et al. [9], and Urwin et al. [10] reported that approximately 20% experience mild knee pain that does not require regular hospital visits. Although many studies have focused on elderly individuals with severe pain [11-13], relatively few have focused on those with mild knee joint pain. In addition, it is generally assumed that elderly individuals with either severe or mild knee pain exhibit different fall risks. Moreover, elderly individuals with knee pain are divided into those with unilateral or bilateral knee pain, and both groups may exhibit different fall risks.

Several factors contribute to the increase in the incidence of falling. However, these factors show large individual differences, and a combination of these factors may lead to a fall [1]. Suzuki [14] reported that causes of falling can be is grossly divided into either internal or external factors. The former includes factors such as physical illness, use of medicines, decreased physical function, whereas the latter includes environmental factors. Although knee pain is not always the cause of a fall in the elderly individuals, it can be inferred that those with knee pain are at higher risk because of the presence of fall risk factors. Demura [15] formulated a fall risk assessment by scoring responses to a number of items in a questionnaire. In addition, assessments of items selected by elderly individuals with knee pain may be important to decrease the fall risk.

It has been reported that elderly females have a relatively high prevalence of knee pain [16, 17]. This study aimed to examine the differences in corresponding rates of fall risk survey items among elderly females without knee pain, mild unilateral or bilateral knee pain, and severe unilateral or bilateral knee pain.

2. MATERIAL AND METHODS

2.1. PARTICIPANTS

Among elderly individuals with orthopedic abnormalities, approximately 50% do not report subjective knee pain [16, 18]. Peat et al. [16] reported that it is necessary to focus on knee joint pain because many elderly individuals experience such pain, but the type and cause of this pain may vary. In this study, the elderly females who responded Yes to the question “Do you have an articular disorder (ankle, knee, and/or hip joints)? (choice: Yes or No)” and Right, Left, or Both to the question “Do you have pain or disorders in either knee joint? (choice: Right, Left, Both, or No)” were defined as subjects with knee pain. Elderly females who responded negatively to both questions were defined as those without knee pain. In addition, mild and severe knee pain was scored using the Japanese edition of the knee function scale [19], which is based on the Western Ontario and McMaster Universities Osteoarthritis Index [20]. According to this assessment, subjects with a score of >210 points were considered to have severe knee pain, while those with a score of ≤210 points were considered to have mild knee pain [17].

After administering the abovementioned survey to 964 individuals [age range, 60–94 years; mean age, 72.9 years; standard deviation (SD), 9.1 years], 392 elderly females (age range, 60–94 years; mean age, 72.8 years; SD, 6.8 years) were selected as subjects. These subjects were categorized as follows: 225 without knee pain (G1 group, 71 with mild unilateral knee pain (G2 group), 35 with mild bilateral knee pain (G3 group), 34 with severe unilateral knee pain (G4 group), and 27 with severe bilateral knee pain (G5 group). The subjects usually attended health classes or social educational activities hosted by municipal governments and engaged in social activities at least once per week or every alternate week. In short, they could independently perform ADLs. The purpose and procedures of this study were explained in detail to all the subjects before informed consent was obtained. The present experimental protocol was approved by the Ethics Committee on Human Experimentation of Faculty of Human Science, Kanazawa University (Ref. No. 2012-11).

2. 2. FALL RISK ASSESSMENT

Demura’s fall risk assessment [21] was used in this study. It included 50 items representing the following 5 risk factors: “symptoms of falling” (3 items), “disease and physical symptoms” (13 items), “environment” (4 items), “behavior and character” (8 items), and “physical function” (22 items). All responses were scored using a dichotomous scale

(Yes or No). In this study, the corresponding rate of the item was calculated on the basis of the number of individuals who responded affirmatively to a particular item.

2. 3. STATISTICAL ANALYSIS

The corresponding rates were analyzed using the chi-squared frequency test ($\chi 2$ test). Scheffe's test was used for linear comparisons if a significant difference was noted among mean values. Relationships between the presence or absence of knee pain and the corresponding rates were examined on the basis of the association coefficient of Cramer (V). The significance level was set at $p < 0.05$ and was adjusted using Scheffe's method.

3. RESULTS

Table 1 shows the basic statistical analysis results of corresponding rates of each item in all the groups. Moreover, the mean values of these test results are cited in the table. A significant difference was noted among groups in 29 of the 50 items. Multiple comparison test results showed that the corresponding rate of the item "32. using walking aids" was significantly higher in the G5 group than in the G4 group; however, differences between the G2 and G3 groups as well as between the G4 and G5 groups were insignificant for other items. Therefore, both the G2 and G3 groups and the G4 and G5 groups were pooled and linear comparisons were made among the resulting 3 groups (no knee pain, G1; mild knee pain, G2 + G3; and severe knee pain, G4 + G5). The G4 + G5 group showed significantly higher rates for items 43, 44, 46, and 47, followed by the G2 + G3 group and the G1 group. The corresponding rates of items 7, 18, and 25 were higher in the G4 + G5 group than in the G1 group. However, the corresponding rates of items 1, 13, and 42 were higher in the G2 + G3 and G4 + G5 groups than in the G1 group, whereas those of items 2, 26, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 45, 49, and 50 were higher in the G4 + G5 group than in the G1 and G2 + G3 groups. In addition, the corresponding rates of items 21 and 22 were lower in the G4 + G5 group than in the G1 and G2 + G3 groups. The association between the presence or absence of knee pain and the corresponding rates was moderate (V: 0.30–0.71) for items 13, 30, 31, 32, 36, 39, 43, 45, 46, and 47; however, it was low (V: 0.03–0.28) for the other items.

111 **Table 1. The basic statistical analysis of corresponding rates and test results**

	Items	G1:No knee pain (n = 225)		G2: Mild unilateral knee pain (n = 71)		G3: Mild bilateral knee pain (n = 35)		G4: Severe unilateral knee pain (n = 34)		G5: Severe Bilateral knee pain (n = 27)		χ^2	V	p	Scheff's Post-hoc	
		n	%	n	%	n	%	n	%	n	%				G1, G2, G3, G4, G5	G1, (G2+G3), (G4+G5)
Symptoms of falling factor																
1	Feel like falling in the preceding year	67	29.8%	28	39.4%	22	62.9%	20	58.8%	21	77.8%	33.4*	0.21	0.000	G1 < G3, G4, G5 G2 < G5	G1 < (G2+G3), (G4+G5)
2	Stumble (frequently)	32	14.2%	19	26.8%	6	17.1%	18	52.9%	15	55.6%	44.5*	0.24	0.000	G1, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
3	Look like falling (third-party evaluation)	5	2.2%	1	1.4%	2	5.7%	4	11.8%	4	14.8%	16.6	0.15	0.002	−	−
Disease and physical symptoms factor																
4	Feel dizzy upon standing up	36	16.0%	15	21.1%	8	22.9%	8	23.5%	8	29.6%	4.27	0.07	0.37	−	−
5	Lightheadedness upon standing up	24	10.7%	16	22.5%	3	8.6%	9	26.5%	6	22.2%	12.4	0.13	0.02	−	−
6	Medication (daily)	154	68.4%	49	69.0%	25	71.4%	28	82.4%	23	85.2%	5.63	0.08	0.23	−	−
7	Circulatory disease	80	35.6%	31	43.7%	19	54.3%	20	58.8%	19	70.4%	18.6*	0.15	0.001	G1 < G5	G1 < (G4+G5)
8	Forgetfulness	103	45.8%	32	45.1%	19	54.3%	23	67.6%	22	81.5%	17.4	0.15	0.002	−	−
9	Hearing disorder	57	25.3%	21	29.6%	13	37.1%	11	32.4%	10	37.0%	3.64	0.07	0.46	−	−
10	Seeing disorder	63	28.0%	26	36.6%	9	25.7%	16	47.1%	11	40.7%	7.89	0.10	0.10	−	−
11	Feel groggy	1	0.4%	0	0%	0	0%	1	2.9%	1	3.7%	6.31	0.09	0.18	−	−
12	Stroke	3	1.3%	1	1.4%	0	0%	2	5.9%	0	0%	5.30	0.08	0.26	−	−
13	Articular disorder (ankle, knee, and/or hip joints)	0	0%	71	100%	35	100%	34	100%	27	100%	391*	0.71	0.000	G1 < G2, G3, G4, G5	G1 < (G2+G3), (G4+G5)
14	Osteoporosis	45	20.0%	18	25.4%	8	22.9%	14	41.2%	8	29.6%	8.09	0.10	0.09	−	−
15	Complications from a disease	2	0.9%	1	1.4%	0	0%	0	0%	1	3.7%	2.78	0.06	0.60	−	−
16	Diabetes	14	6.2%	5	7.0%	1	2.9%	3	8.8%	2	7.4%	1.18	0.04	0.88	−	−
Environment factor																
17	Slippery places (in the house)	22	9.8%	6	8.5%	5	14.3%	5	14.7%	9	33.3%	14.0	0.13	0.01	−	−
18	Obstacle (in the house)	46	20.4%	13	18.3%	11	31.4%	14	41.2%	14	51.9%	20.7*	0.16	0.000	G1, G2 < G5	G1 < (G4+G5)
19	Use of sandals or slippers	169	75.1%	54	76.1%	25	71.4%	28	82.4%	16	59.3%	4.63	0.08	0.33	−	−
20	Shoes unfit	7	3.1%	1	1.4%	1	2.9%	0	0%	0	0%	2.40	0.06	0.66	−	−
Behavior and character factor																
21	Do not sit at home	189	84.0%	64	90.1%	30	85.7%	22	64.7%	16	59.3%	19.9*	0.16	0.001	G5 < G1, G2 G4 < G2	(G4+G5) < G1, (G2+G3)
22	Go out frequently	221	98.2%	66	93.0%	32	91.4%	25	73.5%	22	81.5%	33.8*	0.21	0.000	G4, G5 < G1 G4 < G2	(G4+G5) < G1, (G2+G3)
23	Go to the toilet at night	71	31.6%	24	33.8%	8	22.9%	17	50.0%	16	59.3%	14.2	0.13	0.01	−	−
24	Do not act cautiously	71	31.6%	17	23.9%	11	31.4%	4	11.8%	3	11.1%	10.5	0.12	0.03	−	−

25	Confident about falling	102	45.3%	41	57.7%	21	60.0%	25	73.5%	23	85.2%	24.2*	0.18	0.000	G1 < G5	G1 < (G4+G5)
26	Fear of falling	52	23.1%	24	33.8%	13	37.1%	21	61.8%	19	70.4%	41.1*	0.23	0.000	G1 < G4, G5 G2 < G5	G1, (G2+G3) < (G4+G5)
27	Climb up steep slope	33	14.7%	10	14.1%	5	14.3%	3	8.8%	4	14.8%	0.78	0.03	0.94	–	–
28	Rush everywhere	87	38.7%	14	19.7%	15	42.9%	10	29.4%	8	29.6%	10.0	0.11	0.04	–	–
Physical function factor																
29	Cannot wringing out a wet towel	11	4.9%	7	9.9%	4	11.4%	1	2.9%	3	11.1%	5.22	0.08	0.27	–	–
30	Cannot putting on a sock while standing	36	16.0%	18	25.4%	9	25.7%	18	52.9%	22	81.5%	68.8*	0.30	0.000	G1, G2, G3 < G5 G1 < G4	G1, (G2+G3) < (G4+G5)
31	Cannot standing with one foot (about 5 s)	11	4.9%	9	12.7%	3	8.6%	14	41.2%	14	51.9%	73.6*	0.31	0.000	G1, G2, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
32	Using walking aids	1	0.4%	1	1.4%	1	2.9%	3	8.8%	9	33.3%	74.4*	0.31	0.000	G1, G2, G3, G4 < G5	G1, (G2+G3) < (G4+G5)
33	Short-stepped gait	60	26.7%	17	23.9%	16	45.7%	25	73.5%	22	81.5%	59.6*	0.28	0.000	G1, G2 < G4, G5	G1, (G2+G3) < (G4+G5)
34	Slow-walking speed	78	34.7%	33	46.5%	19	54.3%	28	82.4%	22	81.5%	45.4*	0.24	0.000	G1, G2 < G4, G5	G1, (G2+G3) < (G4+G5)
35	Cannot walking 1 km	6	2.7%	7	9.9%	3	8.6%	8	23.5%	12	44.4%	60.2*	0.28	0.000	G1, G2, G3 < G5 G1 < G4	G1, (G2+G3) < (G4+G5)
36	Cannot folding up and down a heavy futon	39	17.3%	23	32.4%	11	31.4%	23	67.6%	22	81.5%	74.3*	0.31	0.000	G1, G2, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
37	Cannot not sit-up (1–2 times)	54	24.0%	19	26.8%	16	45.7%	22	64.7%	20	74.1%	47.8*	0.25	0.000	G1, G2 < G4, G5	G1, (G2+G3) < (G4+G5)
38	Cannot jumping a gap (about 50 cm)	114	50.7%	39	54.9%	20	57.1%	28	82.4%	24	88.9%	24.0*	0.17	0.000	G1 < G4, G5	G1, (G2+G3) < (G4+G5)
39	Cannot jumping a ditch (about 30 cm)	2	0.9%	3	4.2%	4	11.4%	14	41.2%	10	37.0%	94.6*	0.35	0.000	G1, G2, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
40	Cannot one foot balance with open eyes (≥30 s)	104	46.2%	36	50.7%	21	60.0%	30	88.2%	25	92.6%	38.5*	0.22	0.000	G1, G2 < G4, G5	G1, (G2+G3) < (G4+G5)
41	Cannot standing on the bus or train (without holding onto a hand strap or rail)	134	59.6%	57	80.3%	24	68.6%	34	100%	27	100%	42.6*	0.23	0.000	G1 < G2, G4, G5	G1, (G2+G3) < (G4+G5)
42	Cannot walking (about 60 min)	118	52.4%	53	74.6%	25	71.4%	29	85.3%	25	92.6%	33.6*	0.21	0.000	G1 < G2, G4, G5	G1 < (G2+G3), (G4+G5)
43	Cannot running (3–5 min)	56	24.9%	27	38.0%	18	51.4%	26	76.5%	26	96.3%	78.4*	0.32	0.000	G1, G2 < G4, G5 G3 < G5	G1 < (G2+G3) < (G4+G5)
44	Cannot climbing up stairs (without handrail or wall)	103	45.8%	47	66.2%	23	65.7%	34	100%	27	100%	62.1*	0.28	0.000	G1 < G4, G5 G2 < G4	G1 < (G2+G3) < (G4+G5)
45	Cannot climbing up stairs slowly (without a handrail or wall)	0	0%	0	0%	0	0%	29	85.3%	23	85.2%	325*	0.64	0.000	G1, G2, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
46	Cannot standing from sitting posture (Seiza) without hands	68	30.2%	46	64.8%	20	57.1%	32	94.1%	27	100%	95.5*	0.35	0.000	G1 < G2, G4, G5 G2, G3 < G5	G1 < (G2+G3) < (G4+G5)
47	Cannot standing from sitting posture (Seiza) with hands on the floor	2	0.9%	4	5.6%	8	22.9%	10	29.4%	10	37.0%	72.8*	0.30	0.000	G1 < G3, G4, G5 G2 < G4, G5	G1 < (G2+G3) < (G4+G5)
48	Cannot buttoning or unbuttoning a shirt (with single hand)	156	69.3%	54	76.1%	27	77.1%	29	85.3%	24	88.9%	8.7*	0.11	0.07	–	–
49	Cannot buttoning or unbuttoning a shirt (quickly with hands)	17	7.6%	9	12.7%	3	8.6%	12	35.3%	15	55.6%	59.2*	0.27	0.000	G1, G2, G3 < G4, G5	G1, (G2+G3) < (G4+G5)
50	Cannot carrying (about 5 kg)	3	1.3%	4	5.6%	2	5.7%	6	17.6%	5	18.5%	27.8*	0.19	0.000	G1 < G4, G5	G1, (G2+G3) < (G4+G5)

note: * $p < 0.05/50 = 0.001$

4. DISCUSSION

Demura's fall risk assessment [21] was used in this study to assess the risk of falling using the following 5 risk factors: "symptoms of falling," "disease and physical symptoms," "environment," "behavior and character," and "physical function." In both the mild and severe pain groups, it was assumed that performance of ADLs was more difficult for the subjects with bilateral knee pain than for those with unilateral knee pain. Therefore, it was inferred that the group with bilateral knee pain would have higher corresponding rates of the items pertaining to the symptoms of falling and physical function related to knee pain compared with those with unilateral knee pain. However, a significant difference was observed only in one item, "using walking aids," which was considered a physical function factor. It was assumed that elderly individuals with bilateral knee pain had difficulty in independent walking because the use rate of the walking aids was high (33.3%). This study included only elderly females who could perform ADLs independently. Therefore, even subjects with bilateral knee pain may have been able to perform ADLs such as walking, ascending and descending stairs, and standing up, despite enduring pain. On the basis of the abovementioned results, the groups with both mild (G2 and G3) and severe (G4 and G5) knee pain were pooled and analyzed in this study.

The rate of affirmative responses to the query "feel like falling in the preceding year" was significantly higher in the mild and severe knee pains groups than that in the group without knee pain, and the rate of "stumble (frequently)" was significantly higher in the severe knee pain group than that in the no and mild knee pain groups. In this study, scores for each risk factor and the subject's total fall risk score were used as evaluation parameters with one point corresponding to each question item of Demura's fall risk assessment [21]. Demura et al. [22] reported that the cut-off value for a high fall risk based on a falling factor score was 1 point; therefore, subjects with positive scores in 1 of 3 items are at a greater fall risk. The rates of affirmative responses to "feel like falling in the preceding year" in the G2 + G3 group, particularly those in the G3 group, were >60%, which was similar among the G4 + G5 group. On the other hand, the achievement of toe off while walking and reaching the flexural limit of the knee joints [23] may be difficult because approximately 50% of the elderly individuals with severe knee pain often stumble. Knee pain was more likely to be associated with the parameters of "feel like falling" and "stumbled."

In this study, elderly individuals who answered affirmatively to "articular disorder (ankle, knee, and/or hip joints)" were defined as patients with knee pain. However, all patients with knee pain responded affirmatively to the abovementioned question regardless of mild or severe knee pain. The present study's results show that among the elderly individuals with knee pain, approximately 30% (range, 20.0%–41.2%) had a concomitant history of osteoporosis, whereas only <9% had a concomitant history of stroke, diabetes, or complications of diabetes. On the other hand, several elderly individuals (approximately 70%; range, 68.4%–85.2%) are administered medications that may induce side effects, such as sleepiness, unsteadiness, and a decrease in concentration or attentiveness, thus, increasing the fall risk [15, 24]. Regardless of knee pain status, it is necessary that the subjects recognize the abovementioned side effects. In addition, those with severe knee pain suffered from "circulatory disease" more frequently than those without knee pain. Regular physical activities for the prevention and treatment of hypertension or arteriosclerosis are also generally considered effective [25, 26]. However, subjects with severe knee pain, particularly those with severe bilateral knee pain, may have difficulty in performing physical activities. It is expected that the subjects with the abovementioned symptoms may be able to perform physical activities without imposing a large burden on the body regardless of the degree and condition of pain.

An affirmative response to the query “obstacle (in the house)” was significantly higher in the subjects with severe knee pain than in those without. Because the elderly individuals with severe knee pain had difficulty in achieving toe off while walking by reaching the flexural limit of the knee joints [23], it is inferred that the ability to cross over an obstacle was compromised by severe knee pain in these subjects. Therefore, it is necessary for subjects with severe knee pain to walk carefully and undergo training to widen the range of motion of the knee joint without aggravating existing knee pain. In contrast, the response rate to the “use of sandals or slippers” did not significantly differ among the groups, as all groups tended to use such footwear (range, 59.3%–82.4%). Elderly individuals tend to wear sandals and slippers for short neighborhood walks or walking around the house because they are easy to put on and take off. However, this type of footwear increases fall risk because the heel of the footwear is not attached to the foot while walking and it is easier to slip wearing these compared with the conventional shoes [15]. These subjects must consciously flex their knee joints while wearing shoes, although those with knee pain may want to avoid this movement. Nonetheless, it is recommended that these subjects refrain from wearing sandals or slippers to prevent possible falls.

The subjects of the present study were elderly females who could independently perform ADLs, and over 70% responded affirmatively to the query “much going out.” Although the ability to avert falls may be high, going outdoors often increases the risk of accidental falls. However, if the frequency of going outdoors is low, the fall risk may increase due to further decrease in the physical activity. Therefore, it is important for subjects with both mild knee pain and without knee pain to continue with physical exercises; however, with awareness regarding the fall risk association with such activities.

The factor of physical function is related to performance of ADLs. Because a decrease in the ability to perform ADLs is considered as a major factor contributing to falls [3, 4], recreational activities that do not result in knee pain and resistance training that enhances muscle strength around the knee joints are required [27]. Sugiura et al. [5] and Sugiura and Demura [6] reported that it was difficult for elderly individuals with severe knee pain to perform many ADLs. According to the results from this study, scores of 20 items on physical function factor except “wringing out a wet towel” and “buttoning or unbuttoning a shirt (with single hand)” were lower in elderly individuals with knee pain compared with those without knee pain. In contrast, the elderly individuals with mild knee pain showed inferior abilities to achieve “walking (about 60 min),” “running (3–5 min),” “climbing up stairs (without a handrail or wall),” “standing from sitting posture (Seiza) without hands,” and “standing from sitting posture (Seiza) with hands on the floor” compared with those without knee pain. The symptoms of knee pain may worsen by performing activities requiring use of the knee joints in elderly individuals who are enduring knee pain. In addition, the ability to perform ADLs may decline further when activity is compromised because of knee pain. Therefore, it is important for the subjects to understand their physical limitations in each movement and self-assess the fall risk while attempting to improve their ability to perform ADLs.

5. CONCLUSION

Unilateral or bilateral knee pain was only slightly correlated to the corresponding rates of fall risk in subjects who were able to independently perform ADLs. However, the degree of knee pain (mild or severe) largely influenced these abilities. The corresponding rates of several activity related items included in physical function factors were high in the subjects with severe knee pain. Similar results were noted in the subjects with mild knee pain on activities such as walking, running, ascending and descending stairs, and standing up. In contrast, the subjects without knee pain and those with mild knee pain tended to achieve high corresponding rates in the fall risk items pertaining to behavior and character factors.

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