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Original Article

Relationships between Physical Activity, ADL Capability and Fall Risk in Community-Dwelling Japanese Elderly Population

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Abstract

Objective: The purpose of this study was to clarify the relationships among fall risk, physical activity habits, and ADL capability in a community-dwelling Japanese elderly population.

Methods: The subjects were 1,407 Japanese aged 65 or older (604 males, 803 females). Fall risk was evaluated using the Falling Assessment Chart of Suzuki et al. (2003). Physical activity habits such as the frequency of leaving the house, the use of transportation, the frequency of physical exercise, and interests were evaluated. ADL capability was evaluated using the Tokyo Metropolitan Institute of Gerontology Index of Competence.

Results: Approximately 25% of the subjects had a high fall risk (score of 5 or more). Fall risk increased with age and ADL capability decreased with age. The group with a low fall risk (score <5) had a significantly higher ADL capability than the group with a high fall risk (score ≥5). From results of two-way ANCOVA (gender×physical activity habits) with age as the covariate, the fall risk of people who regularly go on leaving the house, exercise, and have interests tended to be low. Further more, the relationships between the scores and physical activity habits were examined by two-way ANCOVA with age and ADL capability as the covariates. There were significant differences in the frequency of leaving the house, and elderly persons who leaved regularly the house, had a low fall risk.

Conclusions: This study showed that fall risk is closely related to ADL capability, and that the frequency of leaving the house is very important for reducing fall risk.

Key words: fall risk, ADL, physical activity, frequency of leaving the house, Falling Assessment Chart

Introduction

The aging of the Japanese society is proceeding at a much faster pace than that in other advanced countries. In recent years, falls in the elderly have been a focus of attention because they adversely affect the lifespan and quality of life (QOL) of the elderly. The number of deaths from falls in Japan increased by 1.5-fold from 1989 to 1997 and the majority of these falls were in the elderly. One of the reasons for this is the increase in the proportion of the elderly in the population (1, 2). In particular, bedrest due to injuries from falls causes a marked reduction in the physical function of the elderly (3, 4). For instance, many elderly become bedridden after treatment for femur fractures (4, 5). In addition, there is usually a decrease in activity due to the loss of confidence or the fear of falling again, referred to as the postfall syndrome (6). Falls among the elderly are a major cause of decreased physical function and reduced QOL, and thus preventative measures for falls are considered to be of great importance.

Several studies have been conducted to ascertain the incidence of falls among the community-dwelling Japanese elderly (4, 7–11). According to these results, the incidence of falls among the elderly aged 65 and older living at home in the preceding year was about 20% or less, although this figure varied by region. Okinawa had the lowest incidence of falls for both men and women (7). In this regard, the elderly in Okinawa have a very high life expectancy than the standard for their age groups and are more independent (7). This suggests that fall prevention is important for longevity and maintaining physical functions at a high level.

Several risk factors for falls in the elderly have been identified from previous studies, including muscle weakness, impaired balancing ability, impaired walking ability, impaired daily movements, and impaired postural control in the presence

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of external disturbances (12–20). However, few studies dealt with the relationships between fall risk and other relevant factors. For instance, valuable information could be obtained through a study of daily living habits and comparing this with the results of previous research concerning the relationships between the history of falls and various relevant factors.

Therefore, in this study, we aim to examine the relationships among fall risk, physical activity habits and ADL capability in a community-dwelling Japanese elderly population.

Method

1. Subjects and data collection

The subjects of the study were Japanese elderly aged 65 or older living in Kaga City, Ishikawa Prefecture, Japan. In Kaga City, the elderly population aged 65 or older was 14,143 as of October 1, 2001. Two thousand elderly (14.1%) were selected by simple random sampling from resident registration data. We excluded those qualified to receive support or nursing under the long-term care insurance system and requested the participation of 1,735 subjects (756 males and 979 females). Among them, 1,447 subjects agreed to participate in our survey. We explained the aim and design of the study to each subject before obtaining their non-written informed consent. Furthermore, the number of valid replies was 1,407 (male: 604, female: 803), excluding those incompletely answered questions regarding basic attributes of gender, age, and anamnesis. The valid reply rate was 81.1%. The average age was 73.6±6.1 (male: 73.2±6.0, female: 73.9±6.1). The survey was conducted by 26 nursing staff members through interviews. The subjects' characteristics are shown in Table 1.

2. Details of investigation

In this study, we investigated the fall risk, physical activity habits and ADL capability in a community-dwelling elderly population.

1) Fall risk

To assess fall risk, we used the Falling Assessment Chart of Suzuki et al. (21) which comprised 15 items related to internal factors (physical disease, medications, changes in physical function with age), external factors (physical environment) and various factors related to history of falls (Appendix). Each item was assessed on a dichotomous scale. The fall risk is

Table 1 Characteristics of study sample

Content		Males			Females		
		60s	70s	80s	60s	70s	80s
Drinking	Drinkers	61.9	50.3	41.7	22.0	11.3	9.9
	Non Drinkers	38.1	49.7	58.3	78.0	88.7	90.1
Smoking	Smokers	46.4	32.5	16.7	10.6	8.7	7.2
	Previous Smokers	33.0	46.5	51.0	4.4	5.0	3.9
	Non Smokers (No previous history)	20.6	20.7	32.3	85.0	86.3	88.8
Disease (Multiple answers)	Hypertension	23.2	29.3	31.3	31.3	39.2	43.4
	Stroke	7.2	6.4	3.1	3.1	5.2	3.9
	Diabetes	14.4	12.7	6.3	7.9	7.3	7.9
	Cardiopathy	11.3	17.8	21.9	7.5	13.9	19.7
	Liver disease	3.6	3.2	2.1	2.6	2.8	2.0
	Lower-back problem	7.2	13.1	19.8	21.6	34.0	40.1
	No disease	38.1	22.3	15.6	27.3	14.4	19.7
	Other	24.2	36.3	37.5	33.5	39.2	28.9
Frequency of leaving the house	Hardly at all	2.1	5.1	15.6	1.8	4.0	13.8
	Once or twice a month	3.6	3.5	4.2	2.2	6.1	10.5
	Once or twice a week	17.0	18.8	18.8	19.4	21.5	21.7
	Three or 4 times a week	17.5	13.1	6.3	17.2	19.8	16.4
	Every day	59.8	59.6	55.2	59.5	47.9	37.5
Use of transportation	Walk, bicycle	12.4	22.9	46.9	42.7	52.1	52.6
	Bus, train	1.5	4.5	5.2	5.3	9.0	7.2
	Car	85.6	72.3	46.9	51.5	38.0	36.8
Frequency of exercise	Not at all	64.4	62.7	65.6	59.0	71.2	82.2
	Once or twice a week	10.8	7.0	7.3	13.7	9.9	5.3
	Three or 4 times a week	6.2	6.4	2.1	7.5	4.2	3.9
	More than 4 times a week	18.6	23.9	25.0	19.8	14.4	7.9
Interests	None	1.0	1.9	6.3	2.6	3.3	6.6
	Exercise	21.1	27.4	24.0	16.3	13.7	5.3
	Activity other than exercise	77.3	70.1	68.8	78.9	83.0	87.5

The values in this Table mean the relative frequency (%) to sample size of each age group.
Sample size of each gender and age group was as follows.
Male: 60s=194, 70s=314, 80s=96; Female: 60s=227, 70s=424, 80s=152.

considered to be high if a score of 5 or higher is obtained. This chart has been used by other researchers in the fall risk screening of the elderly (11, 21).

2) Physical activity habits

In this study, the physical activity habits of the elderly were assessed by the frequency of leaving the house, the use of transportation, the frequency of exercise and interests.

We evaluated the "frequency of leaving the house" to shop or take walks according to the following responses: 1) Hardly at all, 2) Once or twice a month, 3) Once or twice a week, 4) Three or four times a week and 5) Everyday. The subjects who went out frequently were assumed to have a high level of physical activity.

The responses used to evaluate the "use of transportation" were 1) Walk or bicycle, 2) Bus or train, and 3) Car. The subjects who walked or rode a bicycle were considered to have a higher level of physical activity than those who used public transport or automobiles. Thus, we assumed that physical activity levels were higher in the order of walk or bicycle, bus or train, and car.

For the "frequency of exercise", we asked the following question: "Not including work, do you intentionally engage in any form of exercise (walking, golf, physical exercise)?" The subjects responded with one of the following choices: 1) Not at all, 2) Once or twice a week, 3) Three to four times a week and 4) More than four times a week. The subjects who often exercised were assumed to have a high level of physical activity.

We investigated whether subjects had interests and whether these interests involved exercise. We asked the subjects, "What do you usually do for interest or enjoyment?" the subjects responded from three categories of 1) Nothing, 2) Exercise and 3) Activities other than exercise. When subjects did have an interest, we considered that it led to a physical activity (e.g. meeting friends, shopping, working in the garden) regardless of the type of interest. Furthermore, the subjects whose interests were exercise were assumed to have a higher level of physical activity than those whose interests did not involve exercise or did not have an interest.

In this study, we examined the relationships between fall risk and physical activity habits based on the above assumptions.

3) Activities of daily living (ADL) capability

Activities of daily living (ADL) capability was evaluated using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG) (22). This ADL index was developed to measure the functional capacity of the elderly who independently live and is composed of three competencies of instrumental self-maintenance, intellectual activity, and social role. This ADL index was used in previous studies to examine the functional capacity of community-dwelling Japanese elderly for independent living (22, 23).

Statistical analysis

1. Analysis of fall risk and ADL capability characteristics

The frequency distribution of fall scores was calculated. In accordance with to a previous study, we defined a score of 5 or over as an indicator of a high risk of falls, and calculated the percentage of subjects with scores of 5 or over.

To determine gender and age differences in fall and ADL scores, we conducted a two-way (gender×age) analysis of variance (ANOVA) for the fall and ADL scores, respectively. Then, the difference in ADL score between the high- and low-fall risk groups was examined by a two-way (gender×falling risk group) analysis of covariance (ANCOVA) with a covariate of age.

2. Relationships among physical activity habits, fall risk and ADL capability

To study the relationships among physical activity habits (frequency of leaving the house, frequency of exercise, use of transportation, interests) and fall risk, we examined the differences in fall scores among the categories of each physical activity habit by two-way ANCOVA (gender×physical activity category) with a covariate of age. Similarly, the differences in ADL scores were examined by two-way ANCOVA (gender× physical activity category) with a covariate of age. Because we expected that there is a close relationship between fall risk and ADL capability, significant differences in fall scores among categories of each physical activity habit were examined by two-way ANCOVA (gender×physical activity category) with covariates of age and ADL score. When the main effect was significant, we conducted a multiple comparison analysis according to Tukey's HSD test. Furthermore, to examine the relationships between fall risk and physical activity habits considering the effects of age and ADL score, we calculated the partial correlation coefficients between fall score and physical activity habits on the basis of an assumed interval scale for the assessment of physical activity categories. The significance level in the present study was set at $p<0.05$.

Results

1. Characteristics of fall and ADL scores

As a result of calculating the distribution of fall scores (total score), the subjects with 5 points or more accounted for 25% of the sample.

Table 2 shows the gender and age differences in fall and ADL scores. Multiple comparisons revealed that women had higher fall scores than men, and that fall score increased with age. ADL score significantly decreased with age.

This study designated the subjects with fall scores of 5 points or more as the "high risk group", and those with fall scores less than 5 as the "low risk-group", and compared ADL score between these two groups (Table 3). Two-way (gender and falling risk) ANCOVA with a covariate of age revealed that the ADL score was significantly higher in the low risk-group.

2. Relationships among physical activity, fall score and ADL score

Table 4 shows a comparison of fall scores and different physical activity habits by two-way (gender and physical activity) ANCOVA with a covariate of age. No significant interaction was found for any physical activity habit. A significant gender difference in fall score was found in the frequency

Table 2 Gender and age differences in fall and ADL scores

Score		60s			70s			80s			2-way ANOVA			Multiple comparisons	
		N	Mean	SD	N	Mean	SD	N	Mean	SD	Gender	Age	Interaction	Gender	Age
Fall Risk	Males	194	2.5	1.7	314	3.1	2.0	96	4.3	2.3	9.5 *	53.7 *	0.7 ns	M<F	60<70<80
	Females	227	2.9	1.9	424	3.7	2.0	152	4.5	2.3					
ADL	Males	194	11.3	1.7	314	10.9	2.3	96	8.9	3.3	0.0 ns	117.7 *	2.0 ns		60>70>80
	Females	227	11.7	1.7	424	11.0	2.2	152	8.6	3.2					

This table shows the age and gender differences in fall and ADL scores examined by 2-way ANOVA.
* p<0.05, ns: not significant.

Table 3 Differences in ADL scores in high and low risk fall groups

	Low Fall Risk Group			High Fall Risk group			2-way ANCOVA			Multiple comparisons	
	N	Mean	SD	N	Mean	SD	Gender	Fall Risk	Interaction	Gender	Fall Risk
Males	472	11.2	1.8	132	8.9	3.4	3.0 ns	157.0 *	0.3 ns		Low>High
Females	577	11.3	1.9	226	9.2	3.1					

This table shows the differences in ADL scores between fall risk groups based on 2-way (gender and fall risk groups) ANCOVA with a covariate of age.
* p<0.05, ns: not significant.

Table 4 Relationships between fall risk and physical activity habits (covariate: age)

Physical activity habits	Category	Males			Females			2-way ANCOVA			Multiple comparisons	
		N	Mean	SD	N	Mean	SD	Gender	Factor	Interaction	Gender	Factor
Frequency of leaving the house	1 Hardly at all	35	5.4	2.7	42	6.0	2.5	6.7 *	26.6 *	0.0 ns	M<F	1>2>4>5
	2 Once or twice a month	22	3.6	2.4	47	4.4	2.3					1>3>5
	3 Once or twice a week	110	3.3	2.1	168	3.7	2.0					
	4 Three or 4 times a week	81	3.1	2.0	148	3.6	2.0					
	5 Every day	356	2.8	1.7	395	3.1	1.8					
Use of transportation	1 Walk, bicycle	141	3.3	2.1	398	3.3	1.9	2.5 ns	4.1 *	3.0 ns		
	2 Bus, train	22	3.5	1.8	61	3.3	1.9					
	3 Car	438	3.0	2.0	334	3.8	2.2					
Frequency of exercise	1 Not at all	385	3.3	2.1	561	3.7	2.2	9.0 *	3.2 *	0.6 ns	M<F	1>2, 4
	2 Once or twice a week	50	3.0	2.2	81	3.1	1.4					
	3 Three or 4 times a week	34	2.5	1.5	41	3.4	1.9					
	4 More than 4 times a week	135	2.8	1.8	118	3.2	2.1					
Interests	1 None	14	5.6	2.3	30	4.4	2.5	0.1 ns	9.4 *	3.0 ns		1>3>2
	2 Exercise	150	2.9	1.8	103	3.3	2.1					
	3 Activity other than exercise	436	3.1	2.0	664	3.6	2.1					

This table shows the differences in fall scores among categories of each physical activity habit by 2-way (gender and physical activity) ANCOVA with a covariate of age. * p<0.05, ns: not significant.

of leaving the house and in the frequency of exercise, and women had a higher fall score than men. A significant main effect was found for all physical activity habits. Regarding the frequency of leaving the house, the subjects who went out had lower fall scores. Regarding the frequency of exercise, the subjects who exercised (i.e. once, twice, three and four or more times per week) had lower fall scores than the subjects who did not exercise. Concerning “interests”, fall scores were higher in the order of “having an interest in exercise”, “having an interest other than exercise”, and “having no interest”. Concerning “the use of transportation”, no significant differences were found by the multiple comparison test.

Similarly, Table 5 shows a comparison of ADL among different physical activity levels with a covariate of age. Similar results were obtained when comparing fall score among the categories of physical activity habits. Thus, the ADL scores were higher in the subjects who leaved frequently the house, exercised and had personal interests.

These results suggest that there is a close relationship between fall risk and ADL capability. Therefore, we re-examined the relationships between fall risk and physical activities considering the effects of age and ADL capability (Table 6). A significant effect was found only in the “frequency of leaving the house”, and the subjects with the habit of leaving the house had lower fall scores than those who did not.

Furthermore, to clarify the relationship between the frequency of leaving the house and fall risk, partial correlations, which considered the effects of age and ADL score, were

Table 5 Relationships between ADL and physical activity habits (covariate: age)

Physical activity Habits		Category	Males			Females			2-way ANCOVA			Multiple comparisons	
			N	Mean	SD	N	Mean	SD	Gender	Factor	Interaction	Gender	Factor
Frequency of leaving the house	1	Hardly at all	35	6.5	3.7	42	6.3	3.2	0.4 ns	73.0 *	0.3 ns		1>2>3>5
	2	Once or twice a month	22	9.5	2.8	47	8.8	3.5					1>2>4
	3	Once or twice a week	110	10.6	2.1	168	10.9	2.2					
	4	Three or 4 times a week	81	11.2	2.2	148	11.0	2.0					
	5	Every day	356	11.2	1.9	395	11.3	1.9					
Use of transportation	1	Walk, bicycle	141	10.4	2.6	398	10.8	2.1	0.1 ns	1.9 ns	0.2 ns		
	2	Bus, train	22	10.6	2.1	61	10.9	2.2					
	3	Car	438	10.9	2.3	334	10.7	2.8					
Frequency of exercise	1	Not at all	385	10.5	2.6	561	10.4	2.7	0.7 ns	10.3 *	0.4 ns		1<2, 3, 4
	2	Once or twice a week	50	11.2	1.9	81	11.7	1.7					
	3	Three or 4 times a week	34	11.3	2.1	41	11.1	2.1					
	4	More than 4 times a week	135	11.2	2.1	118	11.6	1.8					
Interests	1	None	14	6.1	3.3	30	8.0	3.8	5.4 *	48.1 *	1.9 ns		1<3<2
	2	Exercise	150	11.3	1.8	103	11.6	1.7					
	3	Activity other than exercise	436	10.7	2.4	664	10.7	2.5					

This table shows the differences in ADL scores among categories of physical activity by 2-way (gender and physical activity) ANCOVA with a covariate of age. * $p<0.05$, ns: not significant.

Table 6 Relationships between fall risk and physical activity habits (covariates: age, ADL)

Physical activity habits		Category	Males			Females			2-way ANCOVA			Multiple comparisons	
			N	Mean	SD	N	Mean	SD	Gender	Factor	Interaction	Gender	Factor
Frequency of leaving the house	1	Hardly at all	35	5.4	2.7	42	6.0	2.5	8.6 *	6.7 *	0.1 ns	M<F	1>2>4>5
	2	Once or twice a month	22	3.6	2.4	47	4.4	2.3					1>3>5
	3	Once or twice a week	110	3.3	2.1	168	3.7	2.0					
	4	Three or 4 times a week	81	3.1	2.0	148	3.6	2.0					
	5	More than 4 times a week	356	2.8	1.7	395	3.1	1.8					
Use of transportation	1	Walk, go by bicycle	141	3.3	2.1	398	3.3	1.9	3.4 ns	2.7 ns	2.9 ns		
	2	Bus, train	22	3.5	1.8	61	3.3	1.9					
	3	Car	438	3.0	2.0	334	3.8	2.2					
Frequency of exercise	1	Not at all	385	3.3	2.1	561	3.7	2.2	12.8 *	0.5 ns	0.5 ns	M<F	
	2	Once or twice a week	50	3.0	2.2	81	3.1	1.4					
	3	Three or 4 times a week	34	2.5	1.5	41	3.4	1.9					
	4	More than 4 times a week	135	2.8	1.8	118	3.2	2.1					
Interests	1	None	14	5.6	2.3	30	4.4	2.5	0.4 ns	0.5 ns	1.7 ns		
	2	Exercise	150	2.9	1.8	103	3.3	2.1					
	3	Activity other than exercise	436	3.1	2.0	664	3.6	2.1					

Since there was a close relationship between fall risk and ADL, this table shows differences in fall scores among each category of physical activity by 2-way (gender and physical activity) ANCOVA with covariates of age and ADL score. * $p<0.05$, ns: not significant.

calculated between each fall assessment item and the frequency of leaving the house (Table 7). Significant partial correlations (r_p) were found in "pedestrian crossing" ($r_p=0.15$, $p<0.01$), "walking 1 km" ($r_p=0.19$, $p<0.01$), "standing on one foot to put on a sock" ($r_p=0.12$, $p<0.01$), "anxiety about falling" ($r_p=-0.12$, $p<0.01$), "hospitalization in the preceding year" ($r_p=-0.07$, $p<0.05$), "diabetes" ($r_p=0.05$, $p<0.05$), and "slip at home" ($r_p=-0.07$, $p<0.05$).

Discussion

The objective of this study was to clarify the characteristics of fall risk among community-dwelling Japanese elderly from the viewpoint of the relationships between fall risk and physical activity habits.

Previous studies cited impaired vision, adverse effects of medication such as tranquilizers and antihypertensive agents, reduced physical activity due to muscle weakness, physical environments within and outside the home, and a history of falling (experience of falling within a period of one year) as significant risk factors for falls (24–27).

In this study, fall risk was based on internal factors (physical disease, medication, change in physical function with age), external factors and history of falls. Fall risk increased with age and decreasing ADL capability.

Furthermore, the subjects with a high fall risk (fall score

Table 7 Partial correlations between fall assessment item and frequency of leaving the house

Contents	r_p
1 Fall in the preceding year	−0.03
2 Pedestrian crossing	0.15 **
3 Walking 1 km	0.19 **
4 Standing on one foot to put on a sock	0.12 **
5 Wringing out a wet towel	0.02
6 Hospitalization in the preceding year	−0.07 **
7 Feel dizzy on standing up	−0.03
8 Stroke	−0.03
9 Diabetes	0.05 *
10 Medication	0.05
11 Sandals or Slippers	0.02
12 Seeing	0.03
13 Hearing	0.00
14 Slip at home	−0.07 *
15 Anxiety about falling	−0.12 **

r_p: Partial correlations between each assessment item and the frequency of leaving the house when considering the effects of age and ADLs. ** $p<0.01$, * $p<0.05$.

of 5 or more) accounted for 25% of the study population. In previous studies of the incidence of falls in the preceding year for the community-dwelling Japanese elderly, the incidence was reported to be about 20% or less (4, 7–11). The fall assessment chart used in this study included a prior experience of falling because the elderly who previously experienced falls are reported to be at a very high risk of falling again (27). Therefore, it is expected that the high-fall-risk group in this study includes the elderly with a fall history. The results of this study revealed that about one in five of the community-dwelling Japanese elderly had a history of falls and that one in four had a high fall risk.

In this study, we also investigated the relationships between fall risk and physical activity habits (e.g. frequency of leaving the house, frequency of exercise, use of transportation, and interests). In the analysis considering the effect of age, the fall risk was lower for people who had a high frequency of leaving the house or exercise, or had some kind of interest, than for those who did not. Moreover, a similar trend was noted in the results on the relationships between ADL and physical activity habits. However, from our results it was not clear whether a large amount of physical activity reduced the risk of falls or whether people with excellent physical function could perform a large amount of physical activity, which results in a reduction in fall risk. We therefore examined the relationships between fall score and physical activity habits taking into consideration age and ADL score. As the results indicate, a significant difference in fall risk was only found with the frequency of leaving the house, with the fall risk tending to be lower as the frequency of leaving the house increased. This indicates that people who go out frequently have a lower risk of falling regardless of their age and physical function.

To determine the reasons for this, we investigated the relationship between each fall assessment item score and the frequency of leaving the house. Significant relationships were found in “pedestrian crossing”, “walking 1 km”, “standing on one foot to put on a sock” and “anxiety about falling”. These factors were mainly related to walking ability, balancing ability, and anxiety about falling. Walking ability and balancing ability are factors related to physical functions and are representative risk factors for falls (connected to physical functions). Maki (20), Suzuki (11) and Housdorff et al. (28) noted that maintaining and enhancing physical functions, particularly walking ability, are essential for preventing falls. Furthermore, Suzuki (11) reported that walking speed is a useful predictive factor for falls and that comprehensive exercises including building muscle strength and improving balance are the most effective means of preventing falls. From this, we consider walking ability and balancing ability to be closely related to the frequency of leaving the house and also to influence the relationship between fall risk and frequency of leaving the house. However, the results of this study did not clearly show whether this occurs because the elderly with good walking ability and balancing ability have habit of leaving the house more often or whether these trips have a beneficial effect on walking ability and balancing ability, which results in reduced fall risk. Significant differences may have been observed only in the frequency of leaving the house because anxiety about falls was included in the assessment chart.

As mentioned previously, a history of falls is an important predictor of future falls (11, 25–27) and a previous study showed that the risk of fall relapse is 3.8 times higher for the elderly who experienced a fall in the preceding year. It has also been found that a previous fall induces anxiety. In this regard, Suzuki (11) reported that 85% of the elderly with a history of falls felt anxious about falling again and 34% said that they did not go out because they were afraid of falling again. Other researchers noted that there were significant differences in results of various tests, including standing on one leg with the eyes open, the Up & Go test, grip strength test and knee extension strength test, between those who did and did not leave the house because they feared falling again. We therefore consider anxiety to affect the frequency of leaving the house and thus influence fall risk.

However, further comprehensive studies of the connections between lifestyle habits, physical capability and fall risk will be necessary to determine whether the frequency of leaving the house is an effective indicator for ascertaining fall risk in the elderly and whether leaving the house is an effective means of preventing falls.

Conclusions

In this study we aimed to identify the relationships between physical activity, ADL capability, and fall risk in a regional Japanese elderly population. The study showed that one in four persons in this population has a high fall risk and that fall risk increases with age. The study also showed that fall risk is closely related to ADL capability and that the frequency of leaving the house is very important for reducing fall risk.

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Appendix

Falling assessment chart

1.	In the past year, have you slipped or stumbled and then fallen down?	1. Yes;	0. No
2.	At a pedestrian crossing, can you cross the road while the light is green?	0. Yes;	1. No
3.	Can you walk continuously for about 1 km?	0. Yes;	1. No
4.	Can you stand on one foot and put a sock on the other foot?	0. Yes;	1. No
5.	Are you strong enough to wring out a wet towel or cloth effectively?	0. Yes;	1. No
6.	Have you been hospitalized in the past year?	1. Yes;	0. No
7.	Do you ever feel dizzy on standing up?	1. Yes;	0. No
8.	Have you ever had a stroke?	1. Yes;	0. No
9.	Have you ever been diagnosed as having diabetes?	1. Yes;	0. No
10.	Are you taking any sleeping drugs, blood pressure medications or tranquilizers?	1. Yes;	0. No
11.	Do you wear sandals or slippers a lot every day?	1. Yes;	0. No
12.	Can you see well (newspaper, people's faces, etc.)?	0. Yes;	1. No
13.	Can you hear well (people talking, etc.)?	0. Yes;	1. No
14.	Do you often slip or stumble when at home?	1. Yes;	0. No
15.	Do you generally worry a lot about falling or do you refrain from going out because you are afraid of falling?	1. Yes;	0. No

Note: The scores in the above fifteen questions were totaled and subjects with scores of 5 or higher scores were evaluated as having a high risk of falling. This chart was translated from Japanese into English by the authors and corrected by native English speakers.