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Risk assessment of fall-related occupational accidents in the workplace

Tsukimi Tsukada[1] and Hisataka Sakakibara[1]

[1]Department of Nursing, Nagoya University Graduate School of Medicine, Nagoya, Japan

Abstract: Objectives: This study aimed to examine effective assessment methods of falls in the workplace. **Methods:** There were 436 employees (305 males and 131 females) of electrical appliance manufacturers included in this study. In 2014, a baseline survey was conducted using the *fall scores questionnaire* and the *self-check risk assessment of falls and other accidents in the workplace (physical function measurement and questionnaire)*. In 2015, the occurrence of falls in the past year was investigated. Multivariate logistic regression analyses were performed to examine factors relevant to falls. **Results:** In total, 62 subjects (14.2%) fell during the year, including those who fell during off-hours. The occurrence of falls during that one year was only associated with having experienced falls during the past year in the baseline survey (odds ratio [OR] 5.0; 95% confidence interval [CI] 2.5-9.7). Falls during that year were also related to the inability to walk 1 km continuously (OR 0.1; 95% CI 0.1-0.6), tripping sometimes (OR 4.0; 95% CI 1.6-9.9), step height differences at home (OR 3.0; 95% CI 1.3-6.8), and working in the production section (OR 0.2; 95% CI 0.1-0.5). Measurements of physical functions, such as muscle strength, balance, and agility, were not different between subjects who fell and those who did not. **Conclusions:** Our results showed that the questionnaire assessing falls during the past year could be useful to assess the risk of falls in the workplace. Annual checks for falls may contribute to fall prevention programs in the workplace.
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Correspondence to: T. Tsukada, Faculty of Policy Studies, Nagoya University Graduate School of Medicine, 1-1-20 Daiko-minami, Higashi-ku, Nagoya, 461-8673, Japan (e-mail: tsukada.tsukimi@d.mbox.nagoya-u.ac.jp)

Introduction

The number of casualties from slips, trips, and falls increases with age. Fact Sheet No. 344, published in October 2012 by the World Health Organization (WHO), states that falls are the second leading cause of accidental or unintentional injury deaths worldwide. Adults older than 65 suffer the greatest number of fatal falls, and prevention strategies should emphasize education, training, creating safer environments, prioritizing fall-related research, and establishing effective policies to reduce risk[1)]. In Japan, accidental fall deaths are the most prominent cause of casualties, aside from traffic accidents[2)].

For occupational accidents, the Japanese annual report of occupational accidents (1989-2010) has reported that the most common cause of casualties was "being caught in the machine" until 1990, while "fall accident on floor" has increased and become number one cause of casualty since 2005[3)]. Based on data from the United States Bureau of Labor Statistics, Yeoh et al. (2013) reported that the entire compensation cost of casualties from slips, trips, and falls increased by 25% from 2006 to 2009, and they suggested that planning and implementation of falls prevention programs in workplaces might contribute to a reduction in necessary compensation[4)].

In order to reduce falls in the workplace, the *research study report on promotion for reduction of disaster risk according to the change of physical characteristics in older workers (self-check risk assessment of physical function measurement and questionnaire)* was published in 2010 in Japan. The report has proposed a means of self-check risk assessment for falls and other accidents in the workplace, which consists of physical function measurements and a questionnaire for self-check. Some trials have used this assessment in the workplace. However, it is not simple to use because the assessment requires time and manpower to measure physical functions, and the ef-

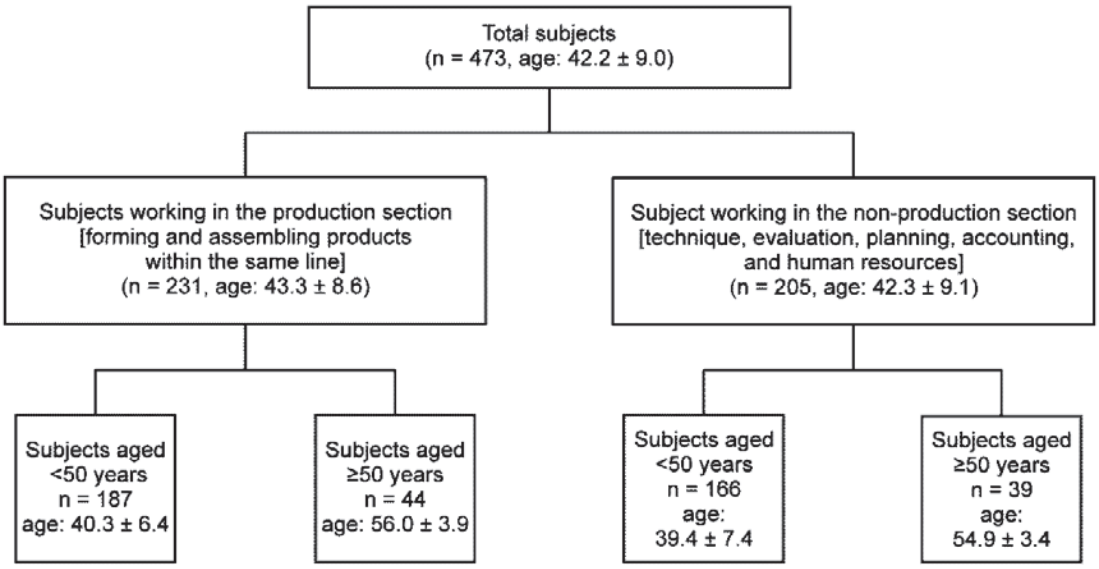

Fig. 1. Allocation of subjects. Ages are presented as means ± standard deviations.

ficacy has not been clearly confirmed[3].

Meanwhile, fall risk assessment lists have been developed in nursing facilities for the elderly[5] and in hospitals[6-8]. They have also been used to examine the community population[9-13]. Among them, Toba et al. (2005) prospectively studied falls in aged residents in seven regions of Japan, and they developed the *fall score questionnaire* to predict future falls with a sensitivity of 65.1% and a specificity of 72.4%[14]. Okochi et al. have also developed a self-rated questionnaire based screening test and reported 68% sensitivity and 70% specificity for the fall risk assessment in community-dwelling elder persons[15]. Since such a questionnaire can also be useful as a fall assessment tool in the workplace setting, we implemented an assessment using the *fall score questionnaire* as well as the *self-check risk assessment of falls and other accidents in the workplace (physical function measurement and questionnaire)*, and then performed a one-year follow-up of fall occurrence to examine their effectiveness in predicting the risk of falls.

Study Population and Methods

Subjects

There were 473 employees (333 males and 140 females) of two electrical appliance manufacturers that were affiliated to companies located at the same site in Aichi prefecture, Japan as of 2014 included in this study. A survey using the *fall score questionnaire* and the *self-check risk assessment of falls and other accidents in the workplace (physical function measurement and questionnaire)* was conducted in September 2014 as a baseline. In September 2015, the occurrence of falls in the past year was examined. We analyzed 436 subjects (305 males, age: 43.7±8.9 years and 131 females, age: 41.0±8.5 years) who consented to participate in both the 2014 and 2015 surveys (completion rate 92.2%). A flow chart depicting the allocation of subjects is presented in Fig. 1. This study was approved by the ethics committee of the Nagoya University Graduate School of Medicine.

The subjects worked in either the production section, with light work mainly involving forming and assembling products within the same line (n=231, age: 43.3±8.6) or the non-production section, e.g., the staff department including technique, evaluation, planning, accounting, and human resources (n=205, age: 42.3±9.1).or age groups, workers aged 50 years and older were defined as older workers, based on the definition in the *research study report on promotion for reduction of disaster risk according to the change of physical characteristics in older workers (self-check risk assessment of falls and other accidents in the workplace)*. The subjects included 353 workers younger than 50 years of age (235 males and 118 females) and 83 workers aged 50 years and older (70 males and 13 females).

Among the 436 subjects, 335 without physical symptoms completed the physical function measurements in the *self-check risk assessment of falls and other accidents in the workplace*.

Contents of the survey

Fall score questionnaire

Fall scores are calculated using a self-administered questionnaire consisting of 22 items (eight items for physical function; seven items for cognition, sensory organs, and bones/musculoskeletal system; one item for medication; five items for environmental factors; and an additional item regarding fall history in the past year).

Each question is answered with a yes or no. For fall scores, a "yes" answer is scored one point, and scores of 10 points or more are defined as high risk[14].

Additionally, if someone experienced falls in the workplace during the past year, the frequency, place, situation, and potential causes of the falls in the workplace during the past year were assessed.

Self-check risk assessment of falls and other accidents in the workplace

The *self-check risk assessment of falls and other accidents in the workplace* includes physical function measurement items and a self-administered questionnaire[16].

The following five physical function measurements were performed: (1) a two-step test for muscle strength and walking ability, (2) functional reach for dynamic balance, (3) standing time on one leg with closed eyes for balance (static), (4) standing time on one leg with open eyes for balance (dynamic), and (5) stepping test in the seated position for agility. The measured values for each measurement were evaluated according to the standard values in the self-check risk assessment manual, using a scale of 1 to 5, where the scores of 1 and 2 were high-risk and scores of 3 to 5 were low-risk.

For standing time on one leg with open eyes, a score of 5 corresponds to 120 seconds, and a score of 1 corresponds to 15 seconds or less. Accordingly, a score of 5 was low-risk, and scores of 1 or 2 were high-risk. For standing time on one leg with closed eyes, a score of 1 corresponds to 7 seconds or less, and a score of 5 corresponds to 90 seconds or more. For functional reach, wherein we measured dynamic balance ability by measuring how much body can tilt without destroying the balance, 19 cm or less was scored as 1, and 40 cm or more was scored as 5. For the stepping test, which measures the agility of the lower extremities, less than 24 times was scored as 1 and more than 48 times was scored as 5. In order to understand walking ability and lower extremity muscle strength, the two-step test was conducted by assessing 2 strides performed without destroying balance. This was expressed as the ratio of distance in two steps to the height of the subject. A two-step test value of 1.24 or less was scored as 1, and a value more than 1.66 was scored as 5.

The questionnaire involved the following items that were thought to influence the risk of falls and other accidents: self-perception of physical function, awareness of safe behavior, and other risks of falls and other accidents. In this study, subjects were asked, "Have you been injured or have you had a near injury during work during the past year?" Each question was answered: (1) not confident; (2) not very confident; (3) ordinary level; (4) a little confidence; or (5) confident. In this study, the responses of (1) and (2) were defined as "no," and those of (3) to (5) were regarded as "yes."

Analysis method

The outcome of this study was the occurrence or absence of a fall in the year after baseline assessment. The results of the *fall score questionnaire* and the *self-check risk assessment of falls and other accidents in the workplace* at baseline were analyzed in relation to falls in the intervening year. A chi-squared test was first conducted to compare the two groups classified by the occurrence or absence of falls. Multivariate logistic regression analysis was then performed to identify factors associated with falls. The items with a significant tendency to predict falls ($p<0.1$) from the above-mentioned analyses were used as independent variables in the multivariate logistic regression analysis. The analysis was also adjusted by age and sex. A similar analysis was also performed using past falls in the workplace as the dependent variable.

In our study, we defined falls as a case when a person falls down on approximately the same plane or a case when a person falls to the ground because of a trip or slip.

Questions about the fall scene of persons who experienced falls in the workplace, i.e., the frequency, location, surrounding situation, and potential causes of falls during work in the workplace during the past year, were analyzed using a descriptive method.

Analyses were conducted using the statistical analysis software IBM SPSS Statistics version 23 for Windows (SPSS Inc., Chicago, IL, USA). Continuous variables are expressed as mean±SD. Statistical significance was set at $p<0.05$.

Results

Occurrence of one-year falls

A total of 62 subjects (40 males and 22 female) experienced falls, including those that occurred during off-hours, during the year following baseline assessment. The average ages of females and males in the fall group were 39.2±10.7 and 44.9±9.8, respectively. The overall fall rate was 14.2%, with rates of 13.3% in subjects younger than 50 years of age and 18.0% in subjects aged 50 years and older. The proportion of people older than 50 years was higher in the fall group than it was in no-fall group. The difference, however, was not statistically significant ($p=0.29$) (Table 1).

Fall score questionnaire

Factors related to falls during the year between surveys were analyzed using items in the fall score questionnaire at baseline. Then, to identify factors related to falls, multivariate logistic regression analyses adjusting for sex and age were performed using the items with results with significant tendencies ($p<0.1$), as shown in Table 1 (working in the production section; having experienced falls during the previous year; sometimes tripping; being anxious about the possibility of falls; obstacles in a corridor, liv-

Table 1. Comparison of factors in the *fall score questionnaire* between workers who did or did not experience falls in the year between surveys.

Variable in the *fall score questionnaire*	Subjects without fall experience	Subjects with fall experience	*p* value
	n=374	n=62	
Male	70.9	64.5	0.37
50 years and older	18.2	24.2	0.29
At least 10 points in the questionnaire	3.5	4.8	0.49
I work in the production section	55.1	40.3	0.04
I have experienced falls during the past year	8.6	38.2	0.0001
I have experienced falls during work in the workplace during the past year	1.6	6.5	0.04
I sometimes trip	62.0	82.3	0.002
I have experienced trips during work in the workplace during the past year	39.8	71.0	0.0001
I cannot walk up and down stairs without holding a railing	5.6	8.1	0.40
My walking pace has become slow	28.3	30.6	0.76
I cannot cross the pedestrian crossing before the signal turns red	1.3	1.6	1.00
I cannot walk about 1 km continuously	1.3	3.2	0.26
I cannot stand on one leg for around 5 seconds	3.5	1.6	0.70
I use a stick	2.1	3.2	0.64
I cannot squeeze a towel firmly	2.7	3.2	0.68
I have dizziness or stagger	16.8	24.2	0.21
My back has become bent	28.3	30.6	0.76
I have pain in the knee	19.0	16.1	0.73
I have difficulties in vision	42.8	50.0	0.33
I have difficulties in hearing	15.0	16.1	0.85
I'm worried about forgetfulness	31.6	41.9	0.11
I'm anxious about the possibility of falls	5.3	11.3	0.09
I take at least five kinds of drugs every day	1.9	1.6	1.00
I feel gloomy when I walk home	2.9	0.0	0.38
There are obstacles in the corridor, living room, or entrance hall	29.7	45.2	0.02
There are height differences at home	64.7	75.8	0.11
I have to use the stairs	73.5	87.1	0.03
I walk a steep slope near my house everyday	24.6	25.8	0.87

Data are presented as percentages of the population whose answers corresponded to a yes to the question.

ing room, or entrance hall; and having to use the stairs) as independent variables. The multivariate logistic regression analysis in Table 2 showed that only having experienced falls during the past year at baseline was associated with the occurrence of falls in the intervening year (odds ratio [OR] 5.0; 95% confidence interval [CI] 2.5-9.7). From the baseline survey, 56 total people (33 males and 23 females) fell in the previous year. Among these, 24 people (42.9%) also fell during the year between surveys (11 males [33.3%] and 13 females [56.5%]). The same analysis was performed using the workplace-specific item of having experienced falls during work in the workplace during the past year as the independent variable, instead of falls that occurred at any time, including during off-hours. This result also indicated a significant association with previous falls in the workplace (OR 9.2; 95%, CI 1.4-62.6) (data not shown).

The present analysis showed that a fall history at baseline could be a good risk indicator for the future fall occurrence. Hence, the characteristics of persons with past fall experience were further examined using items in the fall score questionnaire at baseline as a cross-sectional study. Significant results ($p<0.1$) by chi-squared test were found for the following items: male, worked in the pro-

Table 2. Odds ratio (OR) for the occurrence of falls in the year between surveys by multivariate logistic regression analysis

Variable in the *fall score questionnaire*	OR	95% CI		*p* value
Male	0.8	0.4	1.6	0.57
50 years and older	0.7	0.3	1.3	0.25
I work in the production section	0.8	0.4	1.4	0.36
I have experienced falls during the past year	5.0	2.5	9.7	0.0001
I sometimes trip	1.9	0.9	3.9	0.09
I'm anxious about the possibility of falls	1.2	0.4	3.3	0.73
I have to use the stairs	2.1	0.9	4.8	0.07
There are obstacles in a corridor, in a living room, or at the entrance hall	1.5	0.9	2.8	0.15

Multivariate logistic regression analysis was performed for the occurrence of falls in the year between surveys as the dependent variable (without fall experience=0; with fall experience=1). Independent variables were items with p values<0.1 in Table 1.
CI, confidence interval

Table 3. Odds ratio (OR) for the occurrence of falls in this year for the workers also experienced fall during the past year by multivariate logistic regression analysis, for workplace-specific items.

Variable in the *fall score questionnaire*	OR	95% CI		*p* value
Male	0.5	0.3	1.0	0.05
50 years and older	1.3	0.6	3.1	0.48
At least 10 points in fall scores	2.5	0.6	10.4	0.21
I work in the production section	0.2	0.1	0.5	0.0001
I sometimes trip	4.0	1.6	9.9	0.003
My walking pace has become slow	1.5	0.8	3.0	0.25
I cannot walk about 1 km continuously	0.1	0.1	0.6	0.01
I have dizziness or staggering	1.2	0.6	2.5	0.65
I have difficulties in hearing	1.4	0.6	3.4	0.46
I'm worried about forgetfulness	1.2	0.6	2.4	0.60
I'm anxious about the possibility of falls	1.2	0.4	3.6	0.76
There are obstacles in a corridor, in a living room, or at the entrance hall	1.4	0.7	2.6	0.34
There are step height differences at home	3.0	1.3	6.8	0.009

Multivariate logistic regression analysis was performed to investigate factors at baseline that were associated with the falls during the previous year as the dependent variable (without fall experience=0; with fall experience=1). The independent variables were items with p values<0.1 when comparing persons who did and did not fall in year prior to the baseline survey.
CI, confidence interval

duction section; sometimes tripped; had a walking pace that was becoming slow; could not walk about 1 km continuously; had dizziness or staggered; had difficulties hearing; was worried about forgetfulness; was anxious about the possibility of falls; had obstacles in a corridor, living room, or entrance hall; had differences in the step heights at home; and had a fall score over 10 points. Then, multivariate logistic regression analysis was performed using these variables and age as independent variables. Subjects with fall experience generally could not walk about 1 km continuously (OR 0.1; 95% CI 0.1-0.6); sometimes tripped (OR 4.0; 95% CI 1.6-9.9); had step height differences at home (OR 3.0; 95% CI 1.3-6.8); and worked in the production section (OR 0.2; 95% CI 0.1-0.5) (Table 3).

Self-check risk assessment of falls and other accidents in workplace

For physical function measurements, there were no differences between subjects who did and those who did not experience falls in the intermittent year between surveys (Table 4). Table 4 also presents the distribution of workers among different scales of physical functions, for all test items. The physical function test has a scale of 1 to 5 and the values 1 and 2 denote a high risk of fall.

The *questionnaire of self-check risk assessment of falls*

Table 4. Corresponding numbers of subjects for each scale score for physical functional items and comparisons of the prevalence (%) of abnormal values between workers who did or did not experience falls in the year between surveys. The physical function (n) values 1 and 2 are abnormal.

Physical function item	Measurement item	Distribution of workers in different scale of physical function (n)					% of subjects without fall experience n=291	% of subjects with fall experience n=43	*p* value
		1	2	3	4	5			
Two-step test (n=333)	Muscle strength (including walking ability)	8	6	21	116	182	3.4[a)]	9.3	0.92
Stepping test in the seated position (n=334)	Agility	9	20	250	38	17	8.2	11.6	0.40
Functional reach (n=335)	Balance (dynamic)	2	22	64	56	191	6.9	9.1[b)]	0.54
Standing on one leg with closed eyes (n=334)	Balance (static)	25	61	136	46	66	25.4	27.9	0.71
Standing on one leg with open eyes (n=334)	Balance (static)	11	20	42	30	231	8.2	16.3	0.10

All values for scale scores are the numbers of subjects who received that score.
Physical function measurements were selected from the *self-check risk assessment of falls and other accidents in the workplace*.
[a)] n=290, [b)] n=44

Table 5. Odds ratio (OR) for falls in the year between surveys by multivariate logistic regression analysis using the *self-check risk assessment of falls and other accidents in the workplace*

Variable in the *self-check risk assessment of falls and other accidents in the workplace*	OR	95% CI		*p* value
Male	0.4	0.1	1.3	0.36
50 years and older	0.6	0.1	2.6	0.51
I work in the production section	0.1	0.03	0.69	0.02
I'm not confident in my physical strength when compared with the persons of the same age	0.4	0.1	1.6	0.20
I do not think that the response of my body to sudden situations is quick	0.9	0.2	3.9	0.91
I do not think that I can take a next step just after I tripped over a small height difference during walking	0.7	0.2	2.5	0.55
I take prescription drugs and/or commercial drugs for treatment	0.6	0.2	2.1	0.47

Multivariate logistic regression analysis was performed for the occurrence falls in the year between surveys as the dependent variable (without fall experience=0; with fall experience=1). The independent variables were items with p values<0.1 when comparing persons who did and did not fall in the year between surveys.

and other accidents in the workplace was analyzed using multivariate logistic regression, just as was performed for the *fall score questionnaire.* Multivariate logistic regression included sex, age group, position, and items with significant results ($p<0.1$) from previous analyses (lack of confidence in physical strength when compared with persons of the same age, thought that their body was not quickly responsive to sudden changes, could not take an additional step just after tripping during walking, and were taking prescription drugs and/or commercial drugs). However, no item in the *questionnaire of self-check risk assessment of falls and other accidents in the workplace* was significantly associated with the occurrence of falls during the year between surveys (Table 5).

Falls while working

After completion of the survey in 2014, 10 subjects (three males and seven females) experienced falls in the workplace. The fall rate was 2.7%, amounting to 2.5% in subjects aged <50 years and 1.2% in those aged ≥50 years. According to the 2015 survey, 13 subjects (six males and seven females) experienced falls in the workplace. The fall rate was 3.5%, with rates of 3.1% in subjects aged <50 years and 2.4% in subjects aged ≥50 years.

In the production section, the causes of falls included tripping on the production floor, over a palette, or due to height differences of the stairs. In the non-production section, the causes of falls were most often walking up or down on stairs (nine), with one case attributed to tripping on a palette in the workshop and a slope (Supplementary

Supplementary Table 1. Site of workplace falls

Position	Age	Sex	Number of falls in 2014	Place	Scene	Situation	Frequency of falls in 2015	Place	Scene	Situation
Production section	25-	Male					1	Workplace	Walking	Got leg caught by a palette
	45-	Male	1	Stairs in the business institution	Down stairs	Missed footing				
	55-	Female	1	Production floor	In operation	Tripped	1	Production floor	In operation	Tripped
Non-production section	20-	Female	3	Stairs in the business institution	Up stairs	Tripped	3	Stairs in the business institution	Up stairs	Tripped
	25-	Male	1	Floor under common ownership	Walking	Slipped				
	25-	Female					2	Stairs in the business institution	Walking	Made a misstep
	25-	Female					1	Stairs in the business institution	Up stairs	Tripped over height difference
	35-	Female	2	Stairs in the business institution	Down stairs	Slipped	1	Stairs in the business institution	Back to the office	Slipped
	40-	Male					1	Stairs in the business institution	Walking	Made a misstep
	40-	Male					1	Workplace	Production control	Tripped over a palette
	40-	Male					1	Stairs in the business institution	Down stairs	Down stairs usually
	40-	Female	1	Stairs in the business institution	Up stairs, empty-handed	Tripped over stairs				
	40-	Female	2	Production floor	About to do a test	Did not notice that there was an empty palette	1	Stairs in the business institution	To go to the office; up stairs	There was a person behind me
	40-	Male	1	Stairs at a station during business trip	Down stairs	Made a misstep				
	40-	Female	1	Stairs at a warehouse during business trip	Up stairs	Foot did not go up				
	45-	Male					1	Slope		
	45-	Female	1	Stairs in the business institution	Up stairs	Missed footing				

Supplementary Table 1. Site of workplace falls (continued)

Position	Age	Sex	Number of falls in 2014	Place	Scene	Situation	Frequency of falls in 2015	Place	Scene	Situation
Non-production section	50-	Male					2	Stairs in the business institution	Up stairs	Missed footing
	60-	Female					5	Stairs in the business institution	Up stairs, holding documents	Tripped on the toe

Table 1).

Discussion

The present study showed that a fall history during the past year in the fall score questionnaire could be a good indicator of the risk of falls in the next year (OR 5.0; 95% CI 2.5-9.7). A fall history in the workplace during the past year was also associated with the occurrence of falls of the next year (OR 9.2; 95% CI 1.4-62.6). On the other hand, physical function measurements were not significantly associated with the occurrence of falls. A questionnaire assessing fall history during the past year may be a useful and simple assessment of future falls in the workplace. The remainder of this section discusses some important factors noted in this study.

Fall history

Fall history is considered one of the most important fall factors for the community-living elderly. According to the falls prevention guideline[17] jointly developed by the American Geriatrics Society, the British Geriatrics Society, and the Surgeons Panel on Falls Prevention of the American Academy of Orthopedic Surgeons, the factor predicting the highest relative risk for falls was muscle weakness, followed by fall experience during the past year. Similar findings were shown in earlier studies[18,19]. In Japan, Suzuki et al. demonstrated that falls during the previous year were the strongest risk factor for several falls[20] and future falls leading to fractures[21]. Our study is the first survey performed for workers aged 20-60 years old in a workplace. In accordance with earlier studies on the elderly, the present results indicated that fall history during the previous year could be an important assessment to identify workers at high risk of falls in the workplace as well.

Physical function

There were no physical function items that were significantly associated with future falls. In the *research study report on promotion for reduction of disaster risk according to the change of physical characteristics in older workers*, there were differences for all five physical functions between persons with and without fall experiences. However, 80% of our subjects were younger than 50 years of age, and physical functions are affected by aging, which may have contributed to the lack of association in this study[22-24]. In our study, workers with a fall history during the past year also had the following characteristics could not walk 1 km continuously and sometimes tripped. Toba et al. reported that these factors, along with others included in the fall scores, were specific factors that depict muscle weakness in the lower limbs[14]. In a meta-analysis of prospective cohort studies on falls by Moreland et al., muscle weakness in the lower limbs (OR 1.76; 95% CI 1.31-2.37) and muscle weakness in the lower limbs after several falls (OR 3.06; 95% CI 1.86-5.04) were risk factors for future falls[25]. Workers with a fall history may have potential muscle weakness in the lower limbs, which may also be related to falls.

Production section

The one-year fall rate in this study was higher among workers in the non-production section than among those in the production section. The most common site from the 23 total falls was stairs (14 falls, 61%) in the business institution. In the non-production section, falls while walking on the stairs in the business institution accounted for approximately 70% of all falls. These results suggest the necessity of an assessment and measurement of the risk of falls on stairs. The next most common cause of falls was tripping on a pallet in the workplace. Maintenance of the workplace environment, including the arrangement of palettes, is also important. For environmental maintenance in the workplace, measures to prevent falls should be targeted toward height differences in stairs and tripping on palettes.

Recommendations

Falls result not only from occupation-related factors but also due to personal and environmental factors. Previous studies on interventions for fall prevention showed that individual exercise interventions to improve muscle strength as well as balance and walking ability were more

effective than exercise interventions through group education (relative risk 0.80; 95% CI 0.66-0.98)[26] in improving the risk for falls. The present study has also suggested the necessity of maintenance of the work environment to prevent falls. Additionally, annual individual checks for fall occurrence during the past year may become a part of fall prevention programs in the workplace.

Limitations

The surveyed subjects were limited to employees working in a single manufacturing industry. In addition, the number of the subjects was small. Further examination of many subjects working for various industries is required to confirm our results. In addition, data on falls was based on self-reporting. Only 62 people experienced falls and even fewer people experienced falls in the workplace (10 subjects). Therefore, a detailed factor analysis of fall experience in the workplace was not possible. Although these limitations exist, this study was the first survey to assess falls in 20-50-year-old workers in the workplace and showed that questionnaires asking about fall history during the past year may be a useful and simple assessment of the risk for future falls in the workplace. Furthermore, we suggest a possible association of slipping accidents with physical strength[27-30]. However, slipping can also be caused by wet, oily or icy flooring, which makes it difficult to explain the observed results in terms of physical factors alone.

Conclusion

This study showed that fall history during the past year was a good predictor for falls in the next year. With aging of the population, investigating risk factors for fall-related occupational accidents could contribute to fall prevention programs in the workplaces.

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