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Incidence and risk factors for radiographic lumbar spondylosis and lower back pain in japanese men and women: the road study

Q5 S. Muraki †*, T. Akune †, H. Oka ‡, Y. Ishimoto §, K. Nagata §, M. Yoshida §, F. Tokimura ||, K. Nakamura ¶, H. Kawaguchi #, N. Yoshimura ‡

† *Department of Clinical Motor System Medicine, 22nd Century Medical & Research Center, Faculty of Medicine, the University of Tokyo, Tokyo, Japan*
‡ *Department of Joint Disease Research, 22nd Century Medical & Research Center, Faculty of Medicine, the University of Tokyo, Tokyo, Japan*
§ *Department of Orthopaedic Surgery, Wakayama Medical University, Wakayama, Japan*
|| *Department of Orthopaedic Surgery, Tokyo Geriatric Medical Center, Tokyo, Japan*
¶ *Rehabilitation Services Bureau, National Rehabilitation Center for Persons with Disabilities, Saitama, Japan*
\# *Department of Sensory & Motor System Medicine, Faculty of Medicine, the University of Tokyo, Tokyo, Japan*

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SUMMARY

Objective: To determine the incidence of radiographic lumbar spondylosis (LS)and lower back pain, and their risk factors in Japan using a large-scale population from the nationwide cohort Research on Osteoarthritis/osteoporosis Against Disability (ROAD) Study.

Methods: Participants in the ROAD study who had been recruited between 2005 and 2007 were followed up with lumbar spine radiography for 3 years. A total of 2,282 paired radiographs (75% of the original sample) were scored using Kellgren and Lawrence (KL) grades, and the incidence and progression rate of radiographic LS was analyzed. The incidence of lower back pain was also examined. In addition, associations between risk factors and incident and progressive radiographic LS as well as incident lower back pain were tested.

Results: Given a 3.3-year follow-up, the incidence of KL $\geq$ 2 radiographic LS was 50.0% and 34.4% (15.3% and 10.5% per year), while that of KL $\geq$ 3 LS was 15.3% and 23.7% (4.6% and 7.2% per year) in men and women, respectively. The progression rate of LS was 20.5% and 27.4% (6.2% and 8.3% per year) in men and in women, respectively. In addition, the incidence of lower back pain was 28.3% and 31.2% (8.6% and 9.5% per year) in men and women. Lower back pain was not significantly associated with incident radiographic LS, while a more severe KL grade at baseline was associated with incident lower back pain.

Conclusion: The present longitudinal study revealed a high incidence of radiographic LS in Japan.

Introduction

Lumbar spondylosis (LS) and lower back pain are considered a major public health issue causing chronic disability of the elderly in most developed countries[1,2,3–8]. The prevalence of radiographic LS is high in Japan[3], with an estimated 37,900,000 individuals aged ≥40 years being affected by radiographic LS[9]. According to the recent National Livelihood Survey of the Ministry of Health, Labour and Welfare in Japan, lower back pain is rated first among symptoms that send men to the hospital[10]. Despite the urgent need for strategies to prevent and treat this condition, several cross sectional studies have investigated the prevalence of radiographic LS[3,9,11–16], but only a few have examined the incidence and progression of radiographic LS or their risk factors[17–21]. In addition, although lower back pain is believed to be the principal clinical symptom of LS, the correlation is not as close as would be expected, and the findings of cross sectional studies have often indicated a disconnect between them[3,11]. However, the incidences of radiographic LS and lower back pain have never been simultaneously analyzed in a longitudinal study.

The objective of the present study was to clarify the incidence and progression rate of radiographic LS as well as the incidence rate of lower back pain in Japanese men and women using the large-scale, population-based cohort study known as Research on Osteoarthritis/osteoporosis Against Disability (ROAD). In addition, we examined risk factors for the incidence and progression of LS as well as the incidence of lower back pain.

* Address correspondence and reprint requests to: S. Muraki, Department of Clinical Motor System Medicine, 22nd Century Medical & Research Center, Faculty of Medicine, the University of Tokyo, Tokyo, Japan. Tel: 81-3-5800-9178; Fax: 81-3-5800-9179

E-mail address: murakis-ort@h.u-tokyo.ac.jp (S. Muraki).

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Subjects and methods

Subjects

The ROAD study was a nationwide prospective study of bone and joint diseases (with osteoarthritis and osteoporosis as representative bone and joint diseases) in population-based cohorts established in several communities in Japan. A detailed profile of the ROAD study has already been described elsewhere[3,10,22,23], and thus a brief summary is provided here. Between 2005 and 2007, we created a baseline database that included clinical and genetic information about 3,040 inhabitants (1,061 men; 1,979 women) in the age range of 23–95 years (mean, 70.6 years), recruited from listings of resident registrations in three communities: an urban region in Itabashi, Tokyo; a mountainous region in Hidakagawa, Wakayama; and a coastal region in Taiji, Wakayama. All participants provided written informed consent, and the study proceeded with the approval of ethics committees of the University of Tokyo and the Tokyo Metropolitan Institute of Gerontology. Participants completed an interviewer-administered questionnaire of 400 items that included lifestyle information such as smoking habits, alcohol consumption, family history, and medical history. Anthropometric measurements included height and weight, from which the body mass index (BMI) (weight [kg]/height^2 [m^2]) was calculated. . Experienced orthopaedists also asked all participants the question regarding lower back pain: "Have you experienced lower back pain on most days during the past month, in addition to now?" Those who answered "yes" were defined as having lower back pain based on previous studies[3].

Between 2008 and 2010, we attempted to trace and review all 3,040 participants by inviting them to attend a follow-up interview and undergo repeat radiography. The interviews included questions about current lower back pain and were conducted by the same trained orthopaedists who undertook the baseline study between 2005 and 2007. Anthropometric data including height and weight, were also obtained at follow-up.

Radiographic assessment

Plain radiographs of the lumbar spine at baseline and follow-up were taken in anteroposterior and lateral positions, and the images were downloaded into Digital Imaging and Communication in Medicine (DICOM) files to assess radiographic spondylosis. We used contrast-adjusted images to detect osteophytes and intervertebral spaces when the original images were obscure. Osteophytes were analyzed at endplates. LS at baseline and follow-up was read in pairs according to the Kellgren and Lawrence (KL) grading[24] (without blinding to baseline and follow-up status) at each intervertebral level from L1/2 to L5/S by a single experienced orthopaedist (S.M.), who was blinded to the background of each patient. The KL scale defines radiographic OA in 5 categories: KL grade 0, no radiographic features of OA; KL grade 1, minimal osteophytosis only; KL grade 2, definite osteophytosis with some sclerosis of the anterior part of the vertebral plate; KL grade 3, marked osteophytosis and sclerosis of the vertebral plates with slight narrowing of the disc space; and KL grade 4, large osteophytes, marked sclerosis of the vertebral plates, and marked narrowing of the disc space. To evaluate the intraobserver variability of the KL grading, 100 randomly selected radiographs of the lumbar spine were scored by the same observer more than 1 month after the first reading. Furthermore, 100 other radiographs were scored by two experienced orthopaedic surgeons (S.M. and H.O.) using the same radiographic atlas to determine interobserver variability. Intra- and interobserver variability was evaluated by kappa analysis. These variabilities in the KL grading on lumbar radiographs were sufficient for assessment (0.84 and 0.76, respectively).

For the purposes of this study, we defined three LS outcomes. Incident KL ≥ 2 radiographic LS was defined if all vertebral interspaces had less than grade 2 disease at baseline, and if at least one vertebral interspace had grade ≥ 2 disease at follow-up. Incident KL ≥ 3 radiographic LS was defined if all vertebral interspaces had less than grade 3 disease at baseline, and if at least one vertebral interspace had $\geq$ grade 3 disease at follow-up. Progressive LS was defined as KL ≥ 2 LS at baseline, excluding subjects with KL $= 4$ LS at all vertebral interspaces because it cannot progress, and an increase of at least one grade in the affected vertebral interspace at follow-up.

Statistical analysis

Differences in age, height, weight, and BMI between men and women were examined using a non-paired Student's *t*-test. The prevalence of radiographic LS and lower back pain between men and women was compared the chi-squared test. We determined risk factors for incident and progressive LS and incident lower back pain using a univariate logistic regression analysis. Independent risk factors were determined by multiple logistic regression analysis with significant risk factors in a univariate logistic regression analysis with age, gender and BMI, as independent variables. Incident lower back pain was defined as no lower back pain at baseline and lower back pain at follow-up. Associations between the number of affected vertebral interspaces and incident lower back pain were assessed using the Cochran-Armitage test for trends. The odds ratio (OR) and 95% confidence interval (CI) of the number of affected vertebral interspaces with incident lower back pain compared with no affected vertebral interspaces was determined using a logistic regression analysis with adjustment for age and BMI. Data were analyzed using SAS version 9.0 software (SAS Institute Inc., Cary, NC).

Results

Of the 3,040 participants in the baseline study between 2005 and 2007, 125 (4.1%) had died by the time of the review 3 years later, 123 (4.0%) did not participate in the follow-up study due to bad health, 69 (2.3%) had moved, 83 (2.7%) declined the invitation to attend the follow-up study and 155 (5.1%) did not participate for other reasons. Among the 2,485 individuals who participated in the follow-up study, we excluded 186 (6.1%) who did not undergo plain radiography and 17 (0.6%) who provided incomplete pain questionnaires, leaving a total of 2,282 (74.4%; 758 men; 1,524 women) from whom paired radiographs and complete pain histories were obtained. Their median age at follow-up was 72.1 $\pm$ 11.5 years. The duration of follow-up between the initial and second radiographs was 3.3 $\pm$ 0.6 (mean $\pm$ SD) years. Those participating in the follow-up study were younger than those who did not survive or who did not participate for other reasons (responders 68.8 years, nonresponders 74.8 years; $P < 0.0001$). The follow-up study participants were also more likely to be women (responders 66.8% women, nonresponders 60.0% women; $P = 0.0007$) and were less likely to have LS at the baseline examination than either those who did not survive to follow-up or those who did not participate for other reasons (responders 68.1%, nonresponders 77.5%; $P < 0.0001$). The prevalence of lower back pain was similar between responders and nonresponders (responders 19.0%, nonresponders 18.7%; $P = 0.91$).

Table I shows the characteristics of the 2,282 participants at baseline in the ROAD study. Men were significantly older than women, and the BMI was higher in men than women. The prevalence of KL ≥ 2 LS was significantly higher in men than women at

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Table I
Characteristics of participants at baseline

	Men	Women	*P*-values
Number of subjects	758	1,524	
Age at baseline, years	69.8 ± 11.0	68.3 ± 11.3	0.003
Height at baseline, cm	163.0 ± 6.6	150.4 ± 6.4	<0.0001
Weight at baseline, kg	62.0 ± 9.7	52.1 ± 8.6	<0.0001
BMI at baseline, kg/m^2	23.3 ± 3.0	23.0 ± 3.4	0.054
Grip strength at baseline, kg	34.3 ± 8.7	22.2 ± 6.1	<0.0001
Prevalence at baseline			
KL ≥ 2 (%)	79.9	62.3	<0.0001
KL ≥ 3 (%)	43.1	44.6	0.531
Lower back pain (%)	16.9	20.0	0.073
Smoking (%)	21.5	3.2	<0.0001
Alcohol (%)	63.2	23.0†	<0.0001

Except where indicated otherwise, values represent mean ± SD.
*$P < 0.05$ vs. men by non-paired Student's *t*-test; †$P < 0.05$ vs men by chi squared test. Q4

baseline, while that of KL ≥ 3 LS and lower back pain was similar between men and women.

Table II shows the rates of incident and progressive radiographic LS as well as that of incident lower back pain. Given the 3.3-year follow-up, the rates of incident KL ≥ 2 and ≥3 LS and progressive LS, and incident lower back pain were 38%, 21%, 25%, and 30%, respectively. The incidence of KL ≥ 2 LS was significantly lower, but that of KL ≥ 3 LS was significantly higher in women than in men. The rate of progressive LS was also significantly higher in women than men. The rate of incident and progressive LS increased with age in men and women ($P < 0.05$) (Fig. 1). The rate of incident lower back pain was not age-dependent in either men or women ($P = 0.44$ and 0.85, respectively) (Fig. 1). We also showed incidence and progression of LS at each vertebral interspace in Supplementary Table. Among the vertebral interspaces, the incident rate of KL ≥ 2 LS was highest at the L2/3 interspace. While, the incident rate of KL ≥ 3 LS was highest at the L4/5 interspace.

Table III shows baseline risk factors for radiographic LS. Multiple logistic regression analysis showed that age was a risk factor for KL ≥ 2 and KL ≥ 3 LS and that higher BMI was a risk factor for KL ≥ 2, but not for KL ≥ 3. Female gender was a protective factor against the incidence of KL ≥ 2 LS but was a risk factor for the incidence of KL ≥ 3 LS. A higher KL grade at baseline was a risk factor for KL ≥ 3 LS. Lower back pain at baseline, smoking and alcohol consumption were not associated with incident KL ≥ 2 or KL ≥ 3 LS. We further examined the risk factors for progressive LS in individuals with KL ≥ 2 LS, excluding those with KL = 4 LS at all vertebral interspaces (Table IV). Age and female gender were also risk factors for progressive LS, whereas BMI, lower back pain at baseline, smoking and alcohol consumption were not associated with progressive LS. A grade of KL ≥ 3 at baseline was a risk factor for progressive LS compared with KL = 2.

We next examined the risk factors for incident lower back pain (Table IV). KL ≥ 3 LS was associated with incident lower back pain compared with KL = 0 or 1, whereas age, BMI, gender, smoking and alcohol consumption were not associated with incident lower back pain. We next examined the association between KL grade at each vertebral interspace and incident lower back pain (Table V). In women, KL ≥ 3 LS at L2/3, 3/4, 4/5, and 5/S and the most severely affected interspaces were significantly associated with incident lower back pain compared with KL < 3 at the corresponding interspaces. KL ≥ 3 LS at L2/3, 3/4, 4/5 and 5/S in men tended to be associated with incident lower back pain compared with KL < 3 at the corresponding interspaces, but these findings did not reach statistical significance except for the L3/4 and L5/S interspaces. KL ≥ 3 LS at the L1/2 interspace was not associated with incident lower back pain in men or women. Thus, we further examined the number of KL ≥ 3 vertebral interspaces among L2/3, 3/4, 4/5 and 5/S interspaces (Supplementary Fig. 1). The Cochran-Armitage test for trends showed that the incidence rate of lower back pain significantly increased as the number of affected vertebral interspaces increased in women ($P < 0.001$), but not in men ($P = 0.09$). In addition, multiple logistic regression analysis after adjustment for age and BMI showed that having three or more KL ≥ 3 vertebral interspaces was significantly associated with incident lower back pain in men (OR 1.69 95% CI 1.03–2.76) and in women (OR 1.77, 95% CI 1.34–2.34).

Discussion

This is the first population-based study to examine the rates of incident and progressive radiographic LS as well as incident lower back pain, and their risk factors in Japanese men and women. We found high rates of incident and progressive LS and incident lower back pain in Japanese men and women.

Few population-based studies have examined incident radiographic LS [17,18]. Symmons *et al.* examined radiographic changes in the lumbar spines of Dutch women (mean age, 54 years) using KL grade[17] and found that 4.2% per year of individuals with no disc degeneration (KL grade 0/1) but with recurrent back pain, and 3.2% per year of those with no disc degeneration and no back pain at baseline, had disc degeneration at follow-up. The present study found a 27.6% incidence rate of KL ≥ 2 LS in women aged in their 50s over a period of 3.3 years (9.0% per year), and thus the incidence of KL ≥ 2 LS is apparently considerably higher in Japanese than Caucasian women, although a strict comparison may be limited because of differences in definition of the incidence of LS. Considering the definition of the KL grade, this may suggests that the incidence of osteophytosis is higher in Japanese women than in Caucasian women.

Regarding progression of radiographic LS, Symmons *et al.* reported that 63.1% (7.0% per year) of individuals with disc degeneration and with recurrent back pain, and 55.4% (6.2% per year) of those with disc degeneration but without back pain at baseline, had worse disc degeneration at follow-up[17]. The present

Table II
Incidence of radiographic LS and progressive LS as well as incidence of lower back pain

	KL ≥ 2 LS		KL ≥ 3 LS		Progressive LS		Lower back pain	
	No. at risk	Incidence (%)	No. at risk	Incidence (%)	No. at risk	Incidence (%)	No. at risk	Incidence (%)
Overall	727	274 (37.7)	1,276	266 (20.8)	1,530	378 (24.7)	1,849	558 (30.2)
Men	152	76 (50.0)	431	66 (15.3)	599	123 (20.5)	630	178 (28.3)
Women	575	198 (34.4)*	845	200 (23.7)*	931	255 (27.4)*	1,219	380 (31.2)

Incident KL ≥ 2 and ≥3 radiographic LS at the overall vertebral interspace was defined as all vertebral interspaces having less than grade 2 or 3 disease at baseline, and if at least one vertebral interspace was grade 2 or higher or grade 3 or higher at follow-up, respectively.
Progressive LS in the overall inter spaces was defined as KL ≥ 2 LS at baseline, excluding subjects with KL = 4 LS at all vertebral interspaces because it cannot progress, and an increase by at least 1 grade in the affected vertebral interspace at follow-up.
Incident lower back pain was defined as no lower back pain at baseline and lower back pain at follow-up.
*$P < 0.05$ vs men by chi square test.

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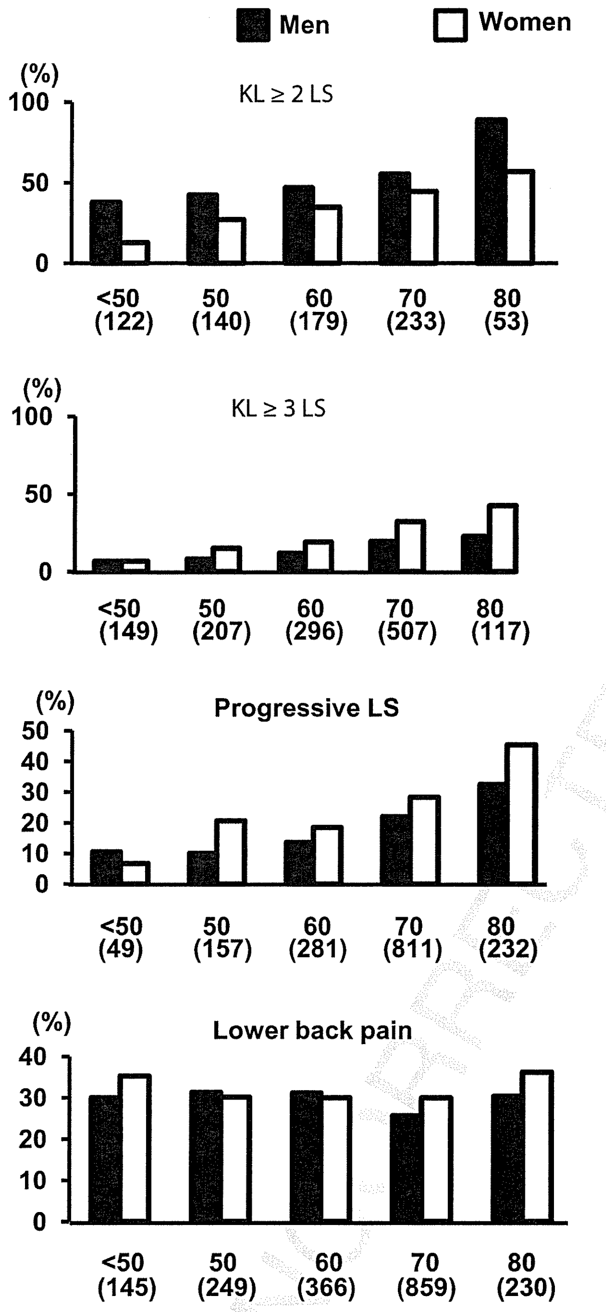

Fig. 1. Ratios (%) of individuals with incident radiographic LS (KL ≥ 2 and KL ≥ 3), progressive LS and incident lower back pain in each age stratum (<50, 50–59, 60–69, 70–79 and ≥80 years). Data in brackets are the number of individuals in each group.

study found that the progression rate of LS in women aged in their 50s was 20.9% over a period of 3.3 years (6.3% per year) and thus the progression rate of LS appears similar between Japanese and Caucasian women. In the present study, progression of radiographic LS was defined as KL ≥ 2 LS at baseline and an increase of at least one grade in the affected vertebral interspace at follow-up. Considering the definition of the KL grade, progression of radiographic LS may mean incidence or progression of disc space narrowing in subjects with osteophytosis, thus, our results may indicate that the incidence or progression of disc space narrowing is similar between Japanese and Caucasian women.

Furthermore, the present study included an investigation of KL ≥ 3 LS. To the best of our knowledge, incident KL ≥ 3 LS has never been investigated in a population-based study. LS was not defined according to KL grade but according to osteophytosis and disk space narrowing in the Chingford study[18]. That study showed that the progression of disk space narrowing was 3.2% per year in women whose mean age was 54 years at baseline. Our results regarding incident KL ≥ 3 LS might be comparable to these, considering the definition of KL grade, although a detailed comparison provides only limited accuracy. The incidence rate of KL ≥ 3 LS was 15.0% (4.5% per year) in Japanese women aged in their 50s at baseline in the present study, which was also higher than that in Caucasian women. This might in part be related to ethnic variations.

The incidence of KL ≥ 2 spondylosis was notably higher in men than in women, while that of KL ≥ 3 spondylosis was higher in women in the present study. Considering the definition of KL grade, this might mean that the incidence of osteophytosis is higher in men, whereas the incidence of disk space narrowing is higher in women. In fact, osteophytosis of the lumbar spine is more common in men than in women[11,12], whereas disc space narrowing is more prevalent in women[12]. A cross-sectional study that investigated the extent, prevalence and distribution of spinal spondylosis in women also showed that osteophytosis and disc space narrowing significantly correlated, but each predicted only 19% of the variation in the other[13]. This discordance suggests that different mechanisms influence the initiation of osteophytosis (the principal abnormality in KL grade 2 disease) and disk space narrowing (a principal abnormality in KL grade 3 disease). Our findings have implications for understanding of the pathogenesis of LS, as well as for designing preventive strategies.

In the present study, age, BMI, gender and KL grade at baseline were significantly associated with incident LS; this result differed from the findings of previous studies[19–21]. The UK twin spine study[19] using magnetic resonance imaging (MRI) showed that age, BMI and gender had no detectable effect on the progression of lumbar disc degeneration. The Finnish twin spine study also showed that body weight was not associated with progression of lumbar disc degeneration[20]. These differences may be explained not only by the differences in the definition of progressive LS, but also the ages of the subjects between these previous studies and the present study. The subjects in the UK twin study and Finnish twin study were quite younger at baseline than those in the present study (55 years, 49 years and 69 years, respectively). The association of these factors with LS may change among the age strata. In addition, racial differences may exist in the association of these factors with LS, because the prevalence or incidence of LS is different among races[3]. Age, BMI and female gender were not risk factors for lower back pain in the present study. Lower back pain occurrence might be mainly due to environmental, rather than to individual factors. Elderly men in particular generally retire at around age 60–70 years, and thus the load on the lower back might be greater in men aged below 60 years compared with those over 60 years, which might partly explain the lack of a significant association between age and the incidence of lower back pain. KL ≥ 3 LS was significantly associated with incident lower back pain compared with the absence of LS. Cross sectional studies have shown that the correlation between LS and lower back pain is not as strong as would be expected, and they are often disconnected[3,11]. However, this longitudinal study discovered that severe radiographic LS is a risk factor for lower back pain. We further found that the association between the number of KL ≥ 3 vertebral interspaces and the incidence of lower back pain differed between men and

Table III
Baseline risk factors for incident radiographic LS.

		KL ≥ 2					KL ≥ 3				
		No (%)	Crude OR	95% CI	Adjusted OR	95% CI	No (%)	Crude OR	95% CI	Adjusted OR	95% CI
Age, years			1.05	1.03–1.06	1.05	1.03–1.06		1.05	1.04–1.07	1.05	1.03–1.06
BMI, kg/m^2			1.07	1.02–1.12	1.07	1.02–1.13		1.01	0.97–1.06		
Gender											
Men		76/152 (50.0)	1.00	Reference	1.00	Reference	66/431 (15.3)	1.00	Reference	1.00	Reference
Women		198/575 (34.4)	0.53	0.37–0.76	0.50	0.34-0.72	200/845 (23.7)	1.71	1.27–2.34	2.19	1.54–3.17
Low back pain	No	223/607 (36.7)	1.00	Reference			219/1078 (20.3)	1.00	Reference		
	Yes	51/120 (42.5)	1.27	0.85–1.89			47/198 (23.7)	1.22	0.85–1.74		
Smoking	No	244/661 (36.9)	1.00	Reference			246/1136 (21.7)	1.00	Reference	1.00	Reference
	Yes	30/66 (45.5)	1.42	0.85–2.37			20/140 (14.3)	0.60	0.36–0.97	1.01	0.58–1.69
Alcohol	No	184/476 (38.7)	1.00	Reference			185/774 (23.9)	1.00	Reference	1.00	Reference
	Yes	90/251 (35.9)	0.89	0.64–1.22			81/502 (16.1)	0.61	0.46–0.82	0.87	0.63–1.20
KL grade											
KL = 0 or 1								1.00	Reference	1.00	Reference
KL = 2								1.66	1.27–2.19	1.67	1.24–2.25

The adjusted ORs were calculated by multiple logistic regression analysis after adjustment for all other significant variables without adjustment. We did not include KL grade in the analysis of incident KL ≥ 2 LS, because all subjects had KL = 0 or 1.

women. The incidence of lower back pain increased as the number of KL ≥ 3 vertebral interspaces increased in women, whereas the incidence was similar in men with 0, 1 and 2 KL ≥ 3 vertebral interspaces, and having 3 or more KL ≥ 3 vertebral interspaces suddenly increased the incidence of lower back pain.

There were several limitations in this study. First, we did not read the X-rays for osteophytes and joint space narrowing scored separately. Furthermore, in the KL classification, atrophic and degenerative features of LS, which likely have different aetiology, were combined; thus, the differences in associations with pain between these features may have been obscured. We are developing a computer-aided diagnostic program to enable fully automated measurements of the major features of LS, including disc space narrowing and osteophytosis on plain radiographs. The second limitation of our study was that a single orthopaedist read both films in pairs without being blinded to baseline and follow-up status. This may likely have caused the reader to over-read progression (i.e., inflate sensitivity) and therefore confer bias. This may be one reason for the higher incidence of LS in the present study compared with other studies. Third, we used only plain radiography to assess LS, although computed tomography (CT)/MRI is standard practice for evaluating nonspecific lower back pain in many countries. In addition, plain films can be affected by scoliosis, positioning and multiple other factors, which may have affected our results. Fourth, although experienced orthopaedists asked all participants the question regarding lower back pain based on previous studies[3,8], we defined lower back pain as present or absent, rather than as a continuous validated measure of pain, such as assessed by the Oswestry Disability Index[25]. Categorical methods are statistically less powerful than continuous methods. In addition, severity of lower back pain was not assessed in the present study. The association between lower back pain and other variables might have been underestimated in the present study. Furthermore, although the psychosocial dimension is an important factor for lower back pain[26], we did not include this in our analysis. Fifth, in the follow-up study, the responders was younger, more likely to be women and less likely to have LS at baseline compared with the nonresponders, which may have affected the results in the present study, because age, gender and KL grade were found to be associated with incident LS in the present study.

In conclusion, the present longitudinal study using a large-scale population from the ROAD study revealed a high incidence of radiographic LS in Japan. Gender seems to be distinctly associated with incident KL ≥ 2 and KL ≥ 3 LS, indicating that different

Table IV
Baseline risk factors for progressive LS and incident lower back pain

		Progressive LS					Lower back pain				
		No (%)	Crude OR	95% CI	Adjusted OR	95% CI	No (%)	Crude OR	95% CI	Adjusted OR	95% CI
Age, years			1.05	1.04–1.07	1.05	1.04–1.07		1.00	0.99–1.01	1.00	0.99–1.01
BMI, kg/m^2			1.01	0.98–1.05				1.01	0.98–1.04	1.01	0.98–1.04
Gender											
Men		123/599 (20.5)	1.00	Reference	1.00	Reference	178/630 (28.3)	1.00	Reference	1.00	Reference
Women		255/931 (27.4)	1.46	1.14–1.87	1.44	1.10–1.91	380/1219 (31.2)	1.15	0.93–1.42	1.12	0.90–1.39
Low back pain	No	302/1225 (24.7)	1.00	Reference							
	Yes	76/305 (24.9)	1.01	0.76–1.35							
Smoking	No	348/1385 (25.1)	1.00	Reference			503/1677 (30.0)	1.00	Reference		
	Yes	30/145 (20.7)	0.78	0.50–1.17			55/172 (32.0)	1.10	0.78–1.53		
Alcohol	No	253/958 (26.4)	1.00	Reference			360/1162 (31.0)	1.00	Reference		
	Yes	125/572 (21.9)	0.78	0.61–0.99			198/687 (28.8)	0.90	0.73–1.11		
KL grade											
KL = 0 or 1							177/607 (29.2)	1.00	Reference	1.00	Reference
KL = 2		103/549 (18.8)	1.00	Reference			118/471 (25.1)	0.81	0.62–1.06	0.86	0.64–1.14
KL ≥ 3		275/981 (28.0)	1.69	1.31–2.18			263/771 (34.1)	1.26	1.00–1.58	1.32	1.03–1.69

The adjusted ORs were calculated by multiple logistic regression analysis after adjustment for all other significant variables without adjustment. We did not include KL grade in the analysis of incident KL ≥ 2 LS, because all subjects had KL = 0 or 1.

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Table V
Association of KL ≥ 3 LS at baseline with incident lower back pain by each vertebral interspace and the severest space in 1,849 subjects with no lower back pain at baseline

		L1/2		L2/3		L3/4		L4/5		L5/S		The severest	
		No. (%)	OR (95% CI)	No.(%)	OR (95% CI)	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)
Men $N = 630$	KL < 3	154/552 (27.9)	1.00	142/528 (26.9)	1.00	136/512 (26.6)	1.00	117/424 (27.6)	1.00	130/496 (26.2)	1.00	98/368 (26.6)	1.00
	KL ≥ 3	24/78 (30.8)	1.20 (0.70–2.01)	36/102 (35.3)	1.57 (0.98–2.48)	42/118 (35.6)	1.62 (1.04–2.50)	61/206 (29.6)	1.15 (0.79–1.67)	48/134 (35.8)	1.65 (1.09–2.49)	80/262 (30.5)	1.26 (0.88–1.81)
Women $N = 1,219$	KL < 3	331/1,083 (30.6)	1.00	298/1,007 (29.6)	1.00	284/960(29.6)	1.00	236/828 (28.5)	1.00	284/971 (29.3)	1.00	197/710 (27.8)	1.00
	KL ≥ 3	49/136 (36.0)	1.28 (0.87–1.87)	82/212 (38.7)	1.52 (1.11–2.10)	96/259 (37.1)	1.43 (1.06–1.92)	144/391 (36.8)	1.50 (1.15–1.97)	96/248 (38.7)	1.56 (1.15–2.10)	183/509 (36.0)	1.51 (1.16–1.95)

Multiple logistic regression analysis after adjustment for age was used to calculate OR and 95% CI.

mechanisms might influence the initiation of osteophytosis and joint space narrowing. Lower back pain was not significantly associated with incident radiographic LS, whereas radiographic severe LS was a risk factor for incident lower back pain. Further progress, along with continued longitudinal surveys of the ROAD study, will elucidate the environmental and genetic background of LS.

Author contributions

All authors have made substantial contributions to all three of sections (1), (2) and (3) below;

(1) The conception and design of the study, or acquisition of data, or analysis and interpretation of data
(2) Drafting the article or revising it critically for important intellectual content
(3) Final approval of the version to be submitted

Conflicts of interest

There are no conflicts of interest.

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Supplementary material

Supplementary data related to this article can be found online at doi:10.1016/j.joca.2012.03.009

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Physical performance, bone and joint diseases, and incidence of falls in Japanese men and women: a longitudinal cohort study

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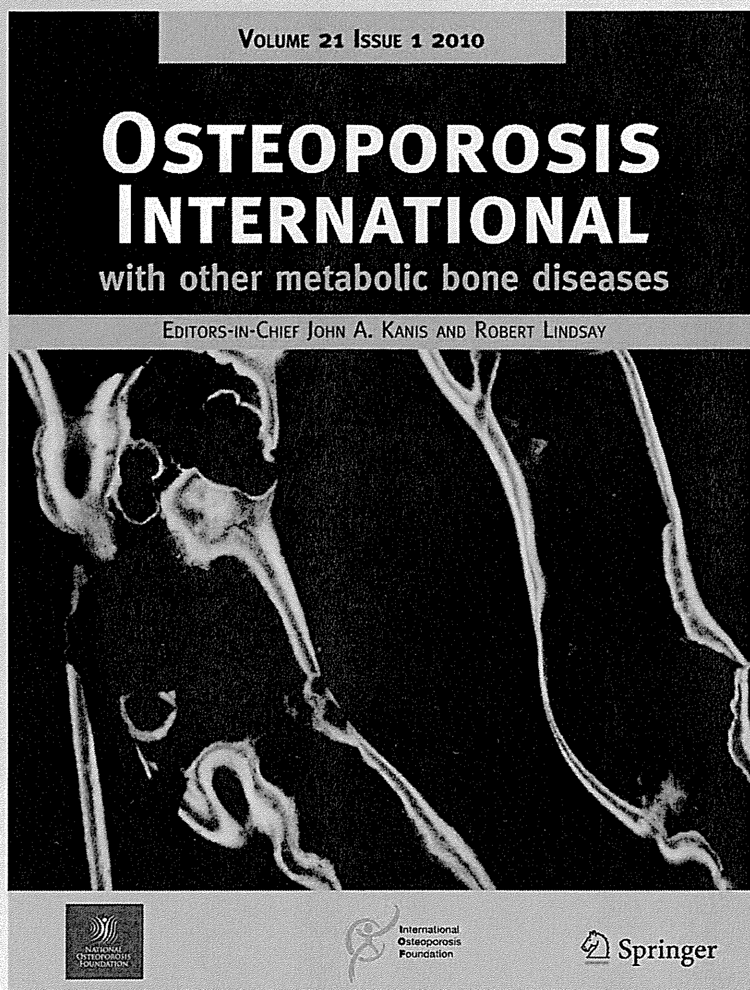

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ORIGINAL ARTICLE

Physical performance, bone and joint diseases, and incidence of falls in Japanese men and women: a longitudinal cohort study

S. Muraki · T. Akune · H. Oka · Y. Ishimoto · K. Nagata · M. Yoshida · F. Tokimura · K. Nakamura · H. Kawaguchi · N. Yoshimura

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Abstract
Summary This study examined whether physical performance and bone and joint diseases were risk factors for falls in 745 men and 1,470 women from the Research on Osteoarthritis/osteoporosis Against Disability (ROAD) study (mean, 69.7 years). Slower walking speed was a risk factor for falls in men and women. Knee pain was a risk factor for falls in women.

S. Muraki (✉) · T. Akune
Department of Clinical Motor System Medicine, 22nd Century Medical and Research Center, Faculty of Medicine, The University of Tokyo,
Hongo 7-3-1,
Bunkyo-ku, Tokyo 113-8655, Japan
e-mail: murakis-ort@h.u-tokyo.ac.jp

H. Oka · N. Yoshimura
Department of Joint Disease Research, 22nd Century Medical and Research Center, Faculty of Medicine, The University of Tokyo, Tokyo, Japan

Y. Ishimoto · K. Nagata · M. Yoshida
Department of Orthopaedic Surgery,
Wakayama Medical University,
Wakayama, Japan

F. Tokimura
Department of Orthopaedic Surgery,
Tokyo Metropolitan Geriatric Hospital,
Tokyo, Japan

K. Nakamura
Rehabilitation Services Bureau,
National Rehabilitation Center for Persons with Disabilities,
Saitama, Japan

H. Kawaguchi
Department of Sensory and Motor System Medicine,
Faculty of Medicine, The University of Tokyo,
Tokyo, Japan

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Introduction The objective of the present study was to clarify the incidence of falls by sex and age and to determine whether physical performance and bone and joint diseases are risk factors for falls in men and women using a large-scale population-based cohort of the ROAD.
Methods A total of 745 men and 1,470 women were analyzed in the present study (mean age, 68.5 years). A questionnaire assessed the number of falls during 3 years of follow-up. Grip strength and walking speed were measured at baseline. Knee and lumbar spine radiographs were read by Kellgren–Lawrence (KL) grade; radiographic knee osteoarthritis and lumbar spondylosis were defined as KL=3 or 4. Knee and lower back pain were estimated by an interview.
Results During a mean follow-up of 3 years, 141 (18.9 %) men and 362 (24.6 %) women reported at least one fall. Slower walking speed was a risk factor for falls in men (0.1 m/s decrease; odds ratio [OR], 1.15; 95 % confidence interval [CI], 1.09–1.23) and women (0.1 m/s decrease; OR, 1.05; 95 % CI, 1.01–1.10). Knee pain was also a risk factor for falls (OR, 1.38; 95 % CI, 1.03–1.84) in women, but lower back pain was not.
Conclusion We examined the incidence and risk factors for falls in men and women. Slower walking speed was a risk factor for falls in men and women. Knee pain was a risk factor for falls in women.

Keywords Falls · Longitudinal study · Osteoarthritis · Pain · Walking speed

Introduction

Falls are one of the main causes of injury, disability, and death among the elderly [1, 2]. In Japan, according to the recent National Livelihood Survey of the Ministry of Health, Labour and Welfare, falls and fractures are ranked fifth among diseases that cause disabilities and subsequently require support with activities of daily living [3]. However, there have been few population-based studies on the incidence of falls based on sex and age. Further, in terms of factors associated with falls, muscle strength, balance, vision, functional capacities, and cognitive impairment are traits that diminish with aging, and these factors have been suggested as predictive risk factors for falls and fractures [4, 5]. However, there have been few studies regarding the association of bone and joint diseases, especially osteoarthritis (OA), with falls [6–10].

The representative sites of OA are the knee and lumbar spine. Knee OA and lumbar spondylosis (LS) are major public health issues because they cause chronic pain and disability [11–16]. The prevalence of radiographic knee OA and LS is high in Japan [17, 18], with 25,300,000 and 37,900,000 subjects aged 40 years and older estimated to experience radiographic knee OA and LS, respectively [19]. The National Livelihood Survey ranked OA fourth among diseases that cause disabilities and subsequently require support with activities of daily living [3], but there have been few studies of the association between falls and OA [6–10]. In previous studies, knee OA was assessed only by interview and not by radiography [6, 7]. The principal clinical symptom of knee OA is pain [20], but its correlation with the radiographic severity of knee OA is not as strong as expected [17, 21–23]. Thus, knee OA diagnosed by interview could be limited by variable accuracy. In addition, men and women were not examined separately in these previous studies, although sex differences have been found in the prevalence of knee OA [17]. Further, prevalence of OA has been shown to be different between races [17]; thus, the association of OA with falls may be different among races. To the best of our knowledge, there are no population-based studies of Japanese men and women to determine the association of OA with falls in a longitudinal model. Our previous study showed that knee pain was significantly associated with falls in Japanese women [24], but that study used a cross-sectional design; thus, a causal relationship remains unclear. With regard to LS, to the best of our knowledge, there have been no population-based studies regarding its association with falls except for our previous cross-sectional study [24], which showed that LS was not significantly associated with falls.

Measuring walking speed is a simple way to assess health and function in older adults [25–27]. Walking speed has been found to be associated with falls in a few studies [4, 28–32], although most studies were limited by small sample size or cross-sectional design [29, 30] or evaluation of a single sex [4, 32]. In addition, although walking abnormalities such as slower walking speed are significantly associated with bone and joint diseases such as knee OA, LS, and their pain [24], there have been no longitudinal studies to determine the associations of falls with bone and joint diseases and walking abnormalities at the same time. Thus, whether the association of slower walking speeds with falls is independent of bone and joint diseases remains unclear.

The objectives of this study were to clarify the incidence of falls by sex and age in Japan using a population-based longitudinal cohort study known as Research on Osteoarthritis/osteoporosis Against Disability (ROAD). Further, we examined the associations of physical performance and bone and joint diseases with the incidence of falls in Japanese men and women.

Methods

Subjects

The ROAD study is a nationwide, prospective study designed to establish epidemiologic indexes for the evaluation of clinical evidence for the development of a disease-modifying treatment for bone and joint diseases (OA and osteoporosis are the representative bone and joint diseases, respectively). It consists of population-based cohorts in three communities in Japan. A detailed profile of the ROAD study has been described elsewhere [17–19, 33]; a brief summary is provided here. To date, we have completed the creation of a baseline database that includes clinical and genetic information for 3,040 subjects (1,061 men and 1,979 women) of age ranging from 23 to 95 years (mean, 70.6 years), who were recruited from resident registration listings in three communities: an urban region in Itabashi, Tokyo; a mountainous region in Hidakagawa, Wakayama; and a coastal region in Taiji, Wakayama.

Residents of these regions were recruited from the resident registration lists of the relevant region. Participants in the urban region were recruited from a randomly selected cohort from the Itabashi Ward residents' registration database [34]. The participation rate was 75.6 %. Participants in mountainous and coastal regions were also recruited from the resident registration lists, and the participation rates in these two areas were 56.7 and 31.7 %, respectively. The inclusion criteria, apart from residence in the communities mentioned above, were the ability to (1) walk to the survey site, (2) report data, and (3) understand and sign an informed consent form. The baseline survey of the ROAD study was completed in 2006. All participants provided written informed consent, and the study was conducted with the approval of the ethics committees of the University of Tokyo and the Tokyo Metropolitan Institute of Gerontology.

Falls assessment

In 2008–2010, we attempted to trace and review all 3,040 subjects; they were invited to attend a follow-up interview. All subjects were interviewed with regard to falls by experienced interviewers and were asked the following questions: "Have you experienced falls during 3 years of follow-up, and if yes, how many falls did you experience?" According to a previous study on falls [35], a fall is defined as a sudden, unintentional change in position causing an individual to land at a lower level on an object, the floor, or the ground, other than as a consequence of a sudden onset of paralysis, epileptic seizure, or overwhelming external force.

Pain assessment

All subjects were interviewed by experienced orthopedists with regard to knee pain and lower back pain at baseline and were asked the following questions based on previous studies [17, 18]: "Have you experienced knee pain on most days in the past year, in addition to now?" and "Have you experienced lower back pain on most days in the past year, in addition to now?" Those who answered yes were defined as having pain.

Radiographic assessment

At baseline, all participants underwent radiographic examination of both knees using anteroposterior and lateral views with weight-bearing and foot map positioning; radiographic examination of the anteroposterior and lateral views of the lumbar spine, including intervertebral levels L1/2 to L5/S, was also performed. Knee and lumbar spine radiographs were read without the knowledge of participant clinical status by a single, experienced orthopedist (S.M.) using the Kellgren–Lawrence (KL) radiographic atlas [36] to determine the severity of KL grading. Radiographs were scored as grade 0 through 4, with higher grades being associated with more severe OA. We defined knee OA and LS as KL ≥3 in at least one knee and one intervertebral level, respectively. To evaluate the intraobserver variability of KL grading, 100 randomly selected radiographs of the knee and the lumbar spine were scored by the same observer more than 1 month after the first reading. One hundred other radiographs were also scored by two experienced orthopedic surgeons (S.M. and H.O.) using the same atlas for interobserver variability. The intraobserver and interobserver variabilities evaluated were confirmed by kappa analysis to be sufficient for assessment (0.86 and 0.80 for knee OA and 0.84 and 0.76 for LS, respectively).

Physical performance

Anthropometric measurements included height, weight, and body mass index (BMI) (weight [in kilograms]/height^2 [in square meters]) at baseline. Grip strength was also measured on bilateral sides using a TOEI LIGHT handgrip dynamometer (TOEI LIGHT CO., LTD., Saitama, Japan) at baseline, and the best measurement was used to characterize maximum muscle strength. To measure physical performance, the time taken to walk 6 m at normal walking speed in a hallway was recorded. Subjects were told to walk from a marked starting line to a 6-m mark as if they were walking down their hallway at home. Time was measured in seconds with a stopwatch and rounded to the nearest hundredth of a second. These walking speed trial measurements are considered highly reliable in community-dwelling elderly subjects [34, 37–39].

Statistical analyses

The differences in age, anthropometric measurements, and physical performance measurements between men and women and between nonfallers and fallers were examined by a nonpaired Student's t test. The incidence of falls was also compared between men and women, among subjects with no severe knee OA (KL=0, 1, or 2) and KL=3 or 4 knee OA, among subjects with no severe LS (KL=0, 1, or 2) and KL=3 or 4 LS, among subjects with and without knee pain, and among subjects with and without lower back pain using the chi-square test. Multiple logistic regression analysis after adjustment for age and BMI was used to determine the association of anthropometric measurements, physical performance, radiographic knee OA and LS defined as KL= 3 or 4, and knee and lower back pain and with falls compared with nonfalls in men and women. Further, to determine an independent association of physical performance, radiographic knee OA, and knee pain with falls compared with nonfalls, we used multiple logistic regression analysis with age, BMI, walking speed, radiographic knee OA, and knee pain as independent variables. Data analyses were performed using SAS version 9.0 (SAS Institute Inc., Cary, NC,USA).

Results

Of the 3,040 subjects in the baseline study in 2005–2007, 125 (4.1 %) had died by the time of the review 3 years later, 123 (4.0 %) did not participate in the follow-up study due to bad health, 69 (2.3 %) had moved away, 83 (2.7 %) declined the invitation to attend the follow-up study, and 155 (5.1 %) did not participate in the follow-up study for other reasons. Among the 2,485 subjects who did participate in the follow-up study, 182 (6.0 %) provided incomplete fall questionnaires. In addition, 15 (0.5 %) provided incomplete pain questionnaires; these were excluded. We also excluded 14 (0.5 %) subjects who had undergone total knee arthroplasty at baseline. Further, 59 (1.9 %) subjects did not measure walking speed, leaving a total of 2,215 (72.9 %) subjects (745 men and 1,470 women) from whom radiographs at baseline and complete fall and pain histories were obtained. The mean ± SD duration of follow-up between initial and second surveys was 3.3±0.6 years.

Table 1 shows the age, anthropometric measurements, physical performance, and prevalence of radiographic knee OA and LS as well as knee and lower back pain of participants at baseline. Regarding physical performance, grip strength and walking speed were significantly better in men than in women. The prevalence of radiographic knee OA and knee pain was significantly higher in women than in men, whereas that of LS and lower back pain was not different between men and women.

During the approximately 3-year follow-up, 141 (18.9 % [95 % confidence interval [CI], 16.3–21.9]) men and 362 (24.6 % [95 % CI, 22.5–26.9]) women reported at least one fall. Chi-square test showed that the incidence of falls were significantly different between men and women ($p=0.0025$). With increasing age, the incidence of falls tended to increase in men and women (Fig. 1).

Table 2 shows the age, anthropometric measurements, and physical performance at baseline between nonfallers and fallers. Age was significantly higher in fallers than nonfallers in men and women. Height was higher in fallers than in nonfallers in women, whereas weight and BMI was not significantly different between nonfallers and fallers in men and women. Grip strength and walking speed were worse in fallers than nonfallers in men and women.

Figure 2 shows the incidence rate of falls according to knee OA, knee pain, LS, and lower back pain. The incidence rate of falls was higher in subjects with knee OA than those without knee OA in men (27.9 and 18.0 %, $p<0.05$, respectively) and women (33.1 and 22.6 %, $p<0.05$, respectively). The incidence rate of falls was also higher in subjects with knee pain than those without knee pain in men (30.4 and 17.1 %, $p<0.05$, respectively) and women (32.6 and 22.1 %, $p<0.05$, respectively). There were no significant differences in incidence rate of falls between subjects with and without LS in men (20.5 and 17.8 %, $p=0.35$, respectively) and women (25.5 and 23.5 %, $p=0.39$, respectively). Men with lower back pain had significantly higher incidence rate of falls than men without lower back pain (25.6 and 17.6 %, $p<0.05$, respectively), whereas women with lower back pain did not (23.8 and 24.8 %, $p=0.76$, respectively).

In men, multiple logistic regression analysis after adjustment for age and BMI showed that slower walking speed ($p<0.001$) and knee pain ($p=0.0046$) were risk factors for falls, but grip strength ($p=0.4903$), radiographic knee OA ($p=0.1569$), LS ($p=0.8312$), and lower back pain ($p=0.0553$) were not (Table 3). In women, multiple logistic regression analysis after adjustment for age and BMI showed that walking speed ($p=0.013$), knee OA ($p=0.0218$), and knee pain ($p=0.0021$) were risk factors for falls, whereas grip strength ($p=0.1209$) and lower back pain ($p=0.5293$) were not. LS was not significantly associated with falls in the crude model ($p=0.3890$). To determine independent associations of walking speed, radiographic knee OA, and knee pain, we used multiple logistic regression analysis with age, BMI, walking speed, radiographic knee OA, and knee pain as independent variables and found that slower walking speed was an independent risk factor for falls in men and women ($p<0.0001$ and $p=0.0104$, respectively). Knee pain was an independent risk factor for falls in women ($p=0.0305$), but not in men ($p=0.0632$).

Table 1 Characteristics of participants

	Overall	Men	Women
Number of subjects	2,215	745	1,470
Age (years)	68.5±11.3	69.4±11.1	68.1±11.4*
Height (cm)	154.7±8.8	163.2±6.6	150.4±6.3*
Weight (kg)	55.5±10.2	62.2±9.9	52.0±8.5*
BMI (kg/m^2)	23.1±3.3	23.3±3.0	23.0±3.4*
Grip strength (kg)	26.3±9.3	34.5±8.8	22.1±6.2*
Walking speed (m/s)	1.24±0.34	1.26±0.35	1.23±0.33*
Radiographic knee OA (%)	15.8	9.1	19.1**
Radiographic LS (%)	43.7	42.6	44.2
Knee pain (%)	20.8	13.7	24.4**
Lower back pain (%)	18.7	16.8	19.7

Values are presented as the mean ± SD, except where indicated

BMI body mass index, *OA* osteoarthritis

*$p<0.05$ vs. men by nonpaired Student's t test; **$p<0.05$ vs. men by chi-square test

Discussion

The present study is a large-scale, population-based cohort study regarding the incidence of falls and their association with physical performance and radiographic knee OA and LS as well as pain in Japanese men and women. We found that slower walking speed was a risk factor for falls in men and women and knee pain was a risk factor for falls in women only.

The present population-based longitudinal study determined whether radiographic knee OA is a risk factor for falls in Japanese men and women. Jones et al. showed that individuals with self-reported arthritis had an increased tendency to fall [8]. In the present study, after adjustment for age and BMI, radiographic knee OA was a risk factor for falls in women, but not in men. The sex differences identified in the association between radiographic knee OA and falls may be partly explained by the weaker quadriceps

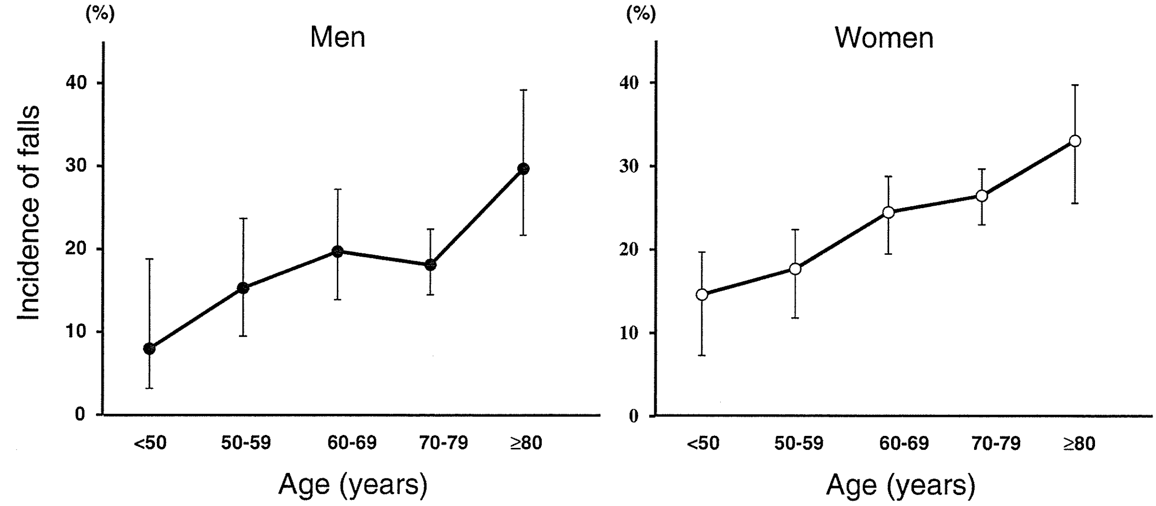

Fig. 1 Incidence rate of falls (95 % CI) by gender and age

muscles and increased postural sway associated with knee OA [8, 40], both of which are known to be independent risk factors for falls [7, 41]. In men, muscle strength is higher than that in women in all decades [42], which may obscure the association between radiographic knee OA and falls. LS was not a risk factor for falls in this study. Thus, falls may be more strongly associated with problems of the lower limbs rather than the trunk.

After adjustment for age, BMI, walking speed, and radiographic knee OA, knee pain was independently associated with the incidence of falls in women. Given that the significant association of radiographic knee OA with falls disappeared after adjustment, falls may occur due to symptoms such as pain caused by radiographic knee OA rather than radiographic changes in the knee itself. Our study and other previous cross-sectional studies also suggested that knee pain was significantly associated with falls [6, 24]. In addition, a prospective study also showed that knee pain increases in falls risk in Tasmanian men and women [10]. Jones et al. showed that, for the hand, the presence of pain is what weakens grip strength [43]. In a similar way, knee pain may weaken leg strength, leading to falls. In other words, falls may be preventable when pain is relieved by medical care, even if subjects have radiographic knee OA.

In the present study, after adjustment for knee OA and knee pain, slower walking speed was an independent risk factor for falls in men and women. Verghese et al. also showed that risk for falls increased to approximately 7 % as walking speed decreased per 0.1 m/s [44], although bone and joint diseases were not included and men and women were not separately analyzed in the study. In the present study, multiple logistic regression analysis after adjustment for knee OA and knee pain showed that, as walking speed decreased per 0.1 m/s, the risk for falls were 15 and 5 % higher in men and women, respectively, indicating that slower walking speed may more strongly affect the risk of falls in men than women. Although dependent on the availability of equipment, quantitative gait measures can be easily and quickly collected in clinical and research settings without requiring attachment of monitoring devices or extensive training. The present study may indicate that walking speed is a simple and quick option for measuring fall risk, particularly in men.

The present study has several limitations. First, our subjects lived in the community, and thus, our findings may not

Table 2 Comparison of characteristics among nonfallers and fallers in men and women

	Men			Women		
	Nonfallers	Fallers	*p* value	Nonfallers	Fallers	*p* value
Number of subjects	604	141		1,108	362	
Age (years)	68.9±11.2	71.8±10.2	0.003	67.3±11.4	70.3±10.8	<0.001
Height (cm)	163.3±6.9	162.6±5.4	0.18	150.8±6.2	149.0±6.5	<0.001
Weight (kg)	62.2±10.0	62.1±9.8	0.92	52.1±8.6	51.7±8.2	0.34
BMI (kg/m^2)	23.3±3.0	23.5±3.3	0.51	22.9±3.4	23.3±3.4	0.06
Grip strength (kg)	34.8±8.9	33.0±8.2	0.02	22.4±6.2	21.1±6.1	<0.001
Walking speed (m/s)	1.30±0.36	1.11±0.28	<0.001	1.25±0.33	1.15±0.33	<0.001

Values are presented as the mean ± SD, except where indicated. Nonpaired Student's *t* test was used to determine the differences in age, height, weight, BMI, grip strength, and walking speed between nonfallers and fallers

BMI body mass index

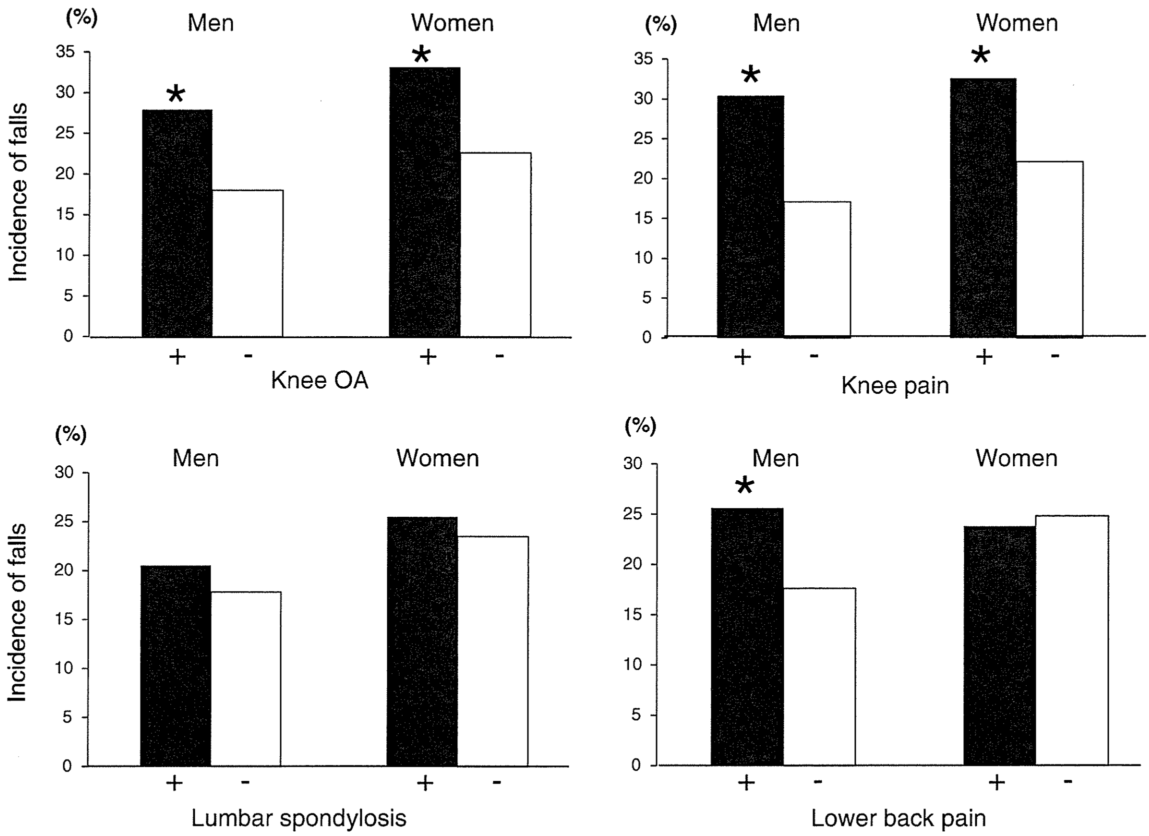

Fig. 2 Incidence of falls by knee OA, knee pain, LS, and lower back pain. *$p<0.05$ vs. subjects without knee OA, LS, knee pain, and lower back pain, respectively, by chi-square test

apply to elderly persons residing in institutions. Second, we did not include other weight-bearing OAs such as hip OA in the analysis, although this disorder also affect falls [45]. However, the prevalence of KL=3 or 4 hip OA is 1.4 and 3.5 % in Japanese men and women [46], respectively, which is smaller than that of KL=3 or 4 knee OA in the present study. Thus, it is possible that hip OA would not strongly affect the results of the present study.

In conclusion, the present longitudinal analysis using a large-scale population from the ROAD study revealed the incidence and risk factors for falls in men and women. Slower walking speed was a risk factor for falls in men

Table 3 Association of physical performance and bone and joint diseases with the incidence of falls in men and women

	Men			Women		
	Crude OR (95 % CI)	Adjusted OR_1 (95 % CI)	Adjusted OR_2 (95 % CI)	Crude OR (95 % CI)	Adjusted OR_1 (95 % CI)	Adjusted OR_2 (95 % CI)
Grip strength (5-kg decrease)	1.14 (1.02–1.27)	1.05 (0.92–1.20)	–	1.20 (1.09–1.33)	1.10 (0.98–1.25)	–
Walking speed (0.1-m/s decrease)	1.19 (1.11–1.25)	1.16 (1.10–1.25)	1.15 (1.09–1.23)	1.10 (1.05–1.14)	1.06 (1.02–1.11)	1.05 (1.01–1.10)
Radiographic knee OA	1.76 (0.98–3.06)	1.52 (0.83–2.67)	1.12 (0.59–2.08)	1.69 (1.27–2.24)	1.43 (1.05–1.93)	1.21 (0.87–1.66)
Knee pain	2.12 (1.31–3.36)	1.99 (1.22–3.18)	1.63 (0.96–2.70)	1.71 (1.31–2.22)	1.54 (1.17–2.02)	1.38 (1.03–1.84)
LS	1.19 (0.83–1.73)	1.04 (0.71–1.52)	–	0.90 (0.71–1.14)	0.74 (0.57–0.94)	–
Low back pain	1.61 (1.02–2.51)	1.59 (0.99–2.49)	–	0.95 (0.79–1.27)	0.91 (0.67–1.23)	–

Multiple logistic regression analysis was used to calculate the odds ratio (OR) and 95 % confidence interval (CI) compared with nonfallers. Adjusted OR_1 was calculated using multiple logistic regression analysis after adjustment for age and BMI. Adjusted OR_2 was calculated using multiple logistic regression analysis with age, BMI, walking speed, radiographic knee OA, and knee pain as independent variables. Radiographic knee OA and LS were defined as KL grade 3 or 4

OA osteoarthritis

and women. Knee pain was a risk factor for falls in women. Further studies, along with continued longitudinal surveys in the ROAD study, will help elucidate the background of knee OA and LS and their relationship with falls.

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Conflicts of interest None.

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Ｖ．資料

2009.8月

第2回 お達者整形外来問診票

このたびは、第２回お達者整形外来にご参加いただきありがとうございます。われわれ東京大学22世紀医療センターでは、東京都老人医療センターおよび東京都老人総合研究所と共同で、変形性関節症を中心としたお達者整形外来を東京都老人医療センターにて開催させていただいて参りました。

今回は、３年ぶりの開催になりますが、この３年の間に膝、腰椎、股関節がどのように変化をしたかを知るよい機会になると考えております。つきましては、下記問診票にご協力いただけましたら幸いです。

プライバシーの保持には万全を期しております。あなた様にご迷惑がかかるようなことは絶対にございませんので、どうぞよろしくお願いいたします。

生年月日：明治・大正・昭和 ＿＿ 年 ＿＿ 月 ＿＿ 日

性　別：　男　・　女

お 名 前：＿＿＿＿＿＿＿＿＿＿

ご 住 所：＿＿＿＿＿＿＿＿＿＿

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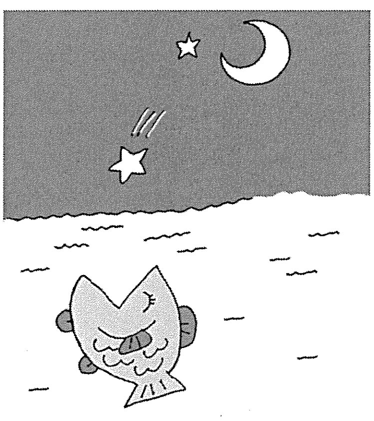

東京大学医学部附属病院22世紀医療センター
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臨床運動器医学講座
東京都健康長寿医療センター整形外科
東京都健康長寿医療センター研究所