Table 3. Prevalence (%) of portential associated factors for knee osteoarthritis (KOA) classified by the absence or presence of KOA.

	Total			Men			Women		
	KOA–	KOA+	p	KOA–	KOA+	p	KOA–	KOA+	p
Residing in coastal area	65.6	32.1	0.000	60.8	26.7	0.000	69.0	34.3	0.000
Current smoking	16.7	9.5	0.000	34.7	23.5	0.012	3.92	3.53	0.060
Current alcohol drinking	46.2	33.4	0.000	68.1	65.3	0.475	30.8	20.2	0.000
Bicycling every day in the past 12 mo	52.6	59.3	0.006	55.1	55.1	0.998	50.8	61.0	0.001
Regular exercise such as football, tennis, baseball, and golf	18.3	10.6	0.000	34.9	30.0	0.209	6.53	2.51	0.001
Past injury of either knee	2.4	2.8	0.560	1.4	4.1	0.046	3.1	2.4	0.466

OW was significantly positively associated with KOA (OR 2.65, 95% CI 1.98–3.54, p < 0.001). Logistic regression analysis using the same objective and explanatory factors and stratified according to sex indicated that, in both sexes, OW was the only factor that was significantly associated with KOA (men: OR 1.64, 95% CI 1.04–2.59, p < 0.05; women: OR 3.64, 95% CI 2.48–5.34, p < 0.001), while in men, there was weak but not significant association between HTN and KOA (OR 1.61, 95% CI 0.99–2.60, p = 0.053). These results suggest that obesity, among the various components for MS, was most significantly correlated to KOA.

Prevalence of KOA and its association with the number of components for MS. Table 4 shows the prevalence of KOA classified by the number of components for MS: the prevalence of KOA tended to increase with the increase in the number of MS components (p for trend < 0.001) in the total population. However, the prevalence of KOA in men and women did not tend to increase monotonically. Thus, in men, the prevalence of KOA in the groups with 2 MS components was lower than that in the groups with 1 component. Similarly, in women, the prevalence of KOA in the group with 2 MS components was higher than that in the group with 3 or more components.

To clarify the effect of the accumulation of MS components on the presence of KOA, logistic regression analysis was performed using the presence of KOA as the objective variable and the MS components (OW, HTN, DL, and IGT) present as explanatory variables after adjustment for age and sex. Compared to the reference condition (no MS components), increasing the number of components of MS significantly increased the OR for the presence of KOA (vs no component; 1 component: OR 1.18, 95% CI 0.87–1.61, p = 0.273; 2 components: OR 1.74, 95% CI 1.25–2.44, p = 0.001; more than 3 components: OR 2.15, 95% CI 1.44–3.23; p < 0.001). Again, the same analysis was also performed stratified by sex. In men, although no dose-response effects of the accumulation of MS components on KOA were observed when the number of the components was 1 or 2, the accumulation of 3 or more components of MS tended to be significantly associated with a higher OR of KOA (vs no component; 1 component: OR 1.94, 95% CI 1.11–3.39, p = 0.021; 2 components: OR 1.61, 95% CI 0.89–2.91, p = 0.117; more than 3 components: OR 2.96, 95% CI 1.5–5.85, p = 0.002). In contrast, in women, no significant difference was observed between the presence of no components and 1 component; however, 2 or more components of MS increased the risk of KOA significantly (vs no component; 1 component: OR 0.89, 95% CI 0.61–1.29, p = 0.527; 2 components: OR 1.94, 95% CI 1.27–2.96, p = 0.002; more than 3 components: OR 1.71, 95% CI 1.01–2.87, p = 0.044).

Table 4. Prevalence (%) of knee osteoarthritis, classified by the number of components of metabolic syndrome (MS). MS components consisted of obesity, hypertension, dyslipidemia, and impaired glucose tolerance.

No. MS Components	Total	Men	Women
0	32.5	24.8	35.4
1	49.9	44.8	52.9
2	60.5	42.7	71.8
≥ 3	62.2	51.3	69.4

Logistic regression analysis was performed using the presence of KOA as the objective variable and the number of MS components present (OW, HTN, DL, and IGT) as explanatory variables, after adjustment for age, sex, regional difference, smoking habit, alcohol consumption, physical activities, regular exercises, and history of knee injuries. Figure 1 shows the OR of the association between accumulation of components of MS and presence of KOA. Compared to the reference condition (no components of MS), increasing the number of components of MS significantly increased the OR for the presence of KOA (vs no component; 1 component: OR 1.21, 95% CI 0.88–1.68, p = 0.237; 2 components: OR 1.89, 95% CI 1.33–2.70, p < 0.001; > 3 components: OR 2.72, 95% CI 1.77–4.18, p < 0.001). Again, the same analysis was also performed stratified by sex. In men, although no dose-response effects of the accumulation of MS components on KOA were observed when the number of the components was 1 or 2, the accumulation of 3 or more components of MS tended to be significantly associated with a higher OR of KOA (vs no com-

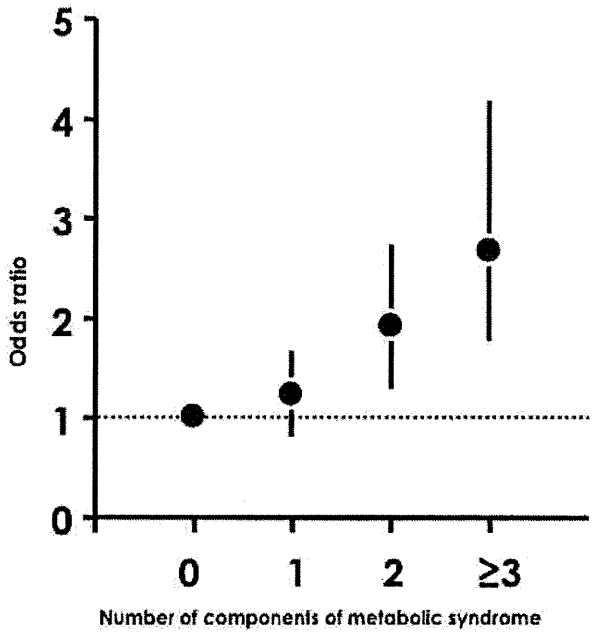

Figure 1. Odds ratios of the association between the number of components of metabolic syndrome and the presence of knee osteoarthritis, compared to no components present.

ponent; 1 component: OR 2.07, 95% CI 1.15–3.74, p = 0.016; 2 components: OR 1.68, 95% CI 0.89–3.17, p = 0.110; more than 3 components: OR 3.88, 95% CI 1.87–80.6, p < 0.001). In contrast, in women, no significant difference was observed between the presence of no component and 1 component; however, 2 or more components of MS increased the OR of KOA significantly (vs no component; 1 component: OR 0.88, 95% CI 0.59–1.32, p = 0.541; 2 components: OR 2.13, 95% CI 1.36–3.34, p = 0.001; > 3 components: OR 2.17, 95% CI 1.25–3.77, p = 0.006).

Joint space narrowing and areas of osteophytes in the knee, and their association with components of MS. Tables 5A and 5B show the mean measurements of indices for KOA, medial MJSW (mm), lateral MJSW (mm), medial JSA (mm^2), lateral JSA (mm^2), and OPA (mm^2), classified by the number of components of MS. The values of medial MJSW tended to be significantly lower, and those of OPA significantly higher, with the increasing number of components of MS. The values of medial JSA in women belonging to the group with no component of MS were significantly higher than in those belonging to the groups with 1, 2, 3, or more components of MS, but no such tendency was observed in men. There was no relationship between the values of lateral MJSW, lateral JSA, and the number of components of MS.

Multiple regression analysis was performed using values of medial MJSW as the objective variable and the number of components of MS present as explanatory variables, after adjustment for age, sex, regional difference, smoking habit, alcohol consumption, physical activities, regular exercises, and history of knee injuries. In the overall population, we found that the number of components of MS was inversely related to the values of medial MSJW (ß = –0.148, R^2 = 0.21, p < 0.001). An analysis performed using the same objective and explanatory factors and stratified by sex showed the same tendency in both men and women (men: ß = –0.152, R^2 = 0.14, p < 0.001; women: ß = –0.149, R^2 = 0.18, p < 0.001).

Multiple regression analysis was then performed using OPA values as the objective variable and the number of components of MS present as explanatory variables, after adjustment for age, sex, regional difference, smoking habit, alcohol consumption, physical activities, regular exercises, and history of knee injuries. The analysis revealed that the number of components of MS was positively related to OPA values (ß = 0.12, R^2 = 0.11, p < 0.001). An analysis performed using the same objective and explanatory factors and stratified by sex showed the same tendency in both men and women (men: ß = 0.15, R^2 = 0.08, p < 0.001; women: ß = 0.11, R^2 = 0.11, p < 0.001).

In women, multiple regression analysis was performed using values of medial JSA as the objective variable and the number of components of MS present as explanatory variables, after adjustment for age, regional difference, smoking habit, alcohol consumption, physical activities, regular exercises, and history of knee injuries. The analysis revealed that the number of components of MS was inversely related to the values of medial JSA in women (ß = –0.096, R^2 = 0.18, p = 0.001).

DISCUSSION

We found that an increase in the number of components of MS was significantly associated with the presence of KOA diagnosed by using the KL scale in Japanese men and women. We also clarified that the values of medial MJSW and OPA in men and women, and medial JSA in women as features of KOA, were significantly associated with the increase in the number of MS components.

KOA and MS share age and OW as risk factors[1,7,8,9,10,11]. We have already reported that higher BMI was associated with radiographic KOA based on an analysis using the same population evaluated in our study[36], and it was also clarified that OW was the strongest factor that influenced the prevalence of KOA.

Regarding the association between clustering of metabolic factors and KOA, Hart, *et al* found that metabolic factors including blood glucose, hypercholesterolemia, and HTN were associated with both unilateral and bilateral KOA and were independent of OW[20]. Sowers, *et al*[21] defined the presence of ≥ 2 of the following criteria as cardiometabolic clustering: low levels of HDL cholesterol, elevated levels of low-density lipoprotein cholesterol, TG, BP, C-reactive protein, waist/hip ratio, glucose levels, and dia-

Table 5A. Mean (SD) of medial and lateral minimum joint space width (MJSW) classified by the number of components of metabolic syndrome (MS). MS components consisted of obesity, hypertension, dyslipidemia, and impaired glucose tolerance.

No. MS Components	Medial MJSW, mm			Lateral MJSW, mm		
	Total	Men	Women	Total	Men	Women
0	2.98 (0.81)	3.33 (0.66)	2.85 (0.82)	4.00 (1.18)	4.37 (1.13)	3.86 (1.17)
1	2.69 (1.01)[a]	3.05 (0.97)	2.49 (0.98)[a]	3.96 (1.13)	4.43 (1.05)	3.70 (1.08)
2	2.43 (1.19)[ab]	2.87 (1.10)[a]	2.15 (1.17)[ab]	3.85 (1.19)	4.15 (1.10)	3.66 (1.22)
≥ 3	2.42 (1.22)[ab]	2.73 (1.24)[a]	2.22 (1.17)[a]	4.06 (1.27)	4.26 (1.29)	3.93 (1.24)

[a] Significantly different from values obtained in the absence of components ($p < 0.05$). [b] Significantly different from values obtained with 1 component ($p < 0.05$).

Table 5B. Mean (SD) of medial and lateral joint space area (JSA) and area of osteophytosis (OPA), classified by number of components of metabolic syndrome (MS). MS components consisted of obesity, hypertension, dyslipidemia, and impaired glucose tolerance.

No. MS Components	Medial JSA, mm^2			Lateral JSA, mm^2			OPA, mm^2		
	Total	Men	Women	Total	Men	Women	Total	Men	Women
0	96.3 (27.6)	111.4 (25.6)	98.8 (26.2)	111.0 (33.2)	132.2 (34.2)	103.3 (29.2)	1.81 (6.42)	0.93 (2.97)	2.13 (7.26)
1	90.2 (31.7)[a]	104.0 (30.7)	82.3 (29.6)[a]	111.0 (32.4)	131.2 (30.5)	99.5 (27.5)	3.06 (7.89)	1.33 (4.26)	4.05 (9.21)
2	85.2 (36.7)[a]	101.1 (34.3)	75.0 (34.6)[ab]	111.7 (32.2)	128.9 (29.6)	100.6 (28.8)	5.34 (11.25)[ab]	2.45 (5.36)	7.18 (13.44)[ab]
≥ 3	88.2 (39.3)	102.0 (40.1)	79.1 (36.0)[a]	118.2 (35.3)	132.5 (34.7)	108.8 (32.5)[b]	6.26 (9.59)[ab]	3.82 (8.70)[ab]	7.86 (9.85)[ab]

[a] Significantly different from values obtained in the absence of components ($p < 0.05$). [b] Significantly different from values obtained with 1 component ($p < 0.05$).

betes mellitus, and assessed the association between cardiometabolic clustering and KOA. They found that KOA was significantly more frequent in obese women with cardiometabolic clustering compared with those without it[21]. Using data from the National Health and Nutrition Examination Survey III (NHANES III), Singh, *et al* suggested that adults with OA in the United States have a high prevalence of CVD risk factors[19], and Puenpatom and Victor demonstrated that each of the 5 cardiovascular risk factors that comprise MS, HTN, abdominal OW, hyperglycemia, elevated TG, and low HDL cholesterol, was more prevalent in the population with OA than in the population without OA[22]. However, to our knowledge, few population-based studies have shown a dose-response relationship between the presence of KOA and the accumulation of the number of MS components.

In our study, the logistic regression analysis revealed that only OW was significantly associated with KOA, and other components were not significant, using the presence of KOA as an objective variable and all components for MS, such as OW, HTN, DL, and IGT as explanatory variables and after adjustment for potential confounders. However, we found that the higher the number of components of MS, the greater the OR of the presence of KOA. This result indicates that, even if the effect of each component of MS on KOA may be weak, accumulation of the number of components may significantly worsen KOA.

In addition, we found that medial MJSW values in men and women, and medial JSA values in women tended to be significantly lower with the increase in the number of components of MS. In contrast, OPA values became significantly higher with the increase in the number of components of MS. Regarding the association between JSW and KOA, Sowers, *et al* used statistical models that included variables representing obesity, cardiometabolic status, and lateral and medial JSW differences to show that a 1-mm increase in the difference between lateral and medial JSW was associated with 2.1 times greater odds of having KOA, and subjects who were obese with cardiometabolic clustering had 4.5 times greater odds of having KOA[21]. However, no other reports have addressed direct associations between indices of KOA, such as MJSW, JSA, and OPA values, with the accumulation of the number of components of MS. In our study, we confirmed that the accumulation of the number of MS components present influenced the values of both MJSW, JSA (women only), and OPA, which determine the features and severity of KOA.

Regarding the association of clustering of components for MS and KOA, a few hypotheses have been suggested. Hart, *et al* attributed the effect of excess endogenous estrogens to the aromatization of estrone in fat tissue[20]. Regarding the endogenous secreted products, Sowers, *et al* suggested that leptin and adiponectin levels influenced the development of OA[21]. They stated that leptin concentrations

in the synovial fluid of patients with OA correlated with their BMI, and levels of adiponectin are low in obese individuals and in those with CVD. Another hypothesis states that atherosclerotic change may play a role in the development of OA. Kornaat, *et al* reported the association between increased popliteal artery vessel wall thickness and generalized OA[37]. It has been hypothesized that atherosclerotic changes and obesity-associated metabolic changes in the subchondral bone are associated with OA[37,38]. In obese subjects, metabolic changes in the striated muscles induced by the interaction of insulin resistance and systemic inflammation might lead to fatigue and muscle weakness, which influences the balance between damage and repair mechanisms leading to OA[37,39]. In our study, we could not substantiate these hypotheses because of the lack of relevant measurements. However, in the followup study, we will obtain the ankle brachial pressure index and pulse wave velocity of the ROAD subjects, and thus we will further the evidence regarding the association between arteriosclerosis and KOA.

In our study, a sexual dimorphism pattern was shown in prevalence of KOA (women > men) and components of MS such as values of BMI (men > women), BP (men > women), and HDL cholesterol (women > men). Regarding KOA, being female is well known as a strong risk factor, according to our previous survey and other studies[27,40,41,42,43,44], possibly implicating an involvement of muscle strength to compensate for the mechanical stress, since women are known to have less muscle strength than men[45]. Sex differences in the prevalence of MS might be partly explained by endogenous sex steroids. As mentioned, Hart, *et al* attributed the effect of excess endogenous estrogens to the aromatization of estrone in fat tissue[20]. Recent systematic review and metaanalysis of observational studies concluded that there is a sex-dependent association between levels of testosterone and occurrence of MS[46]. In addition, the difference in prevalence of associated confounding factors may influence the effect of sex difference on the occurrence of MS. In our study, there are sex differences in lifestyle-related factors, which might influence the occurrence of MS. For example, the proportions of smokers and alcohol consumers are both significantly higher in men than in women (both $p < 0.001$). Regarding the physical activities, the proportion of men who exercised regularly was significantly higher than that of women ($p < 0.001$). Therefore, for the statistical analyses, we adjusted not only for age and sex, but also for such potentially confounding factors to show the association between components of MS and KOA.

With regard to ethnic differences in MS, Hoang, *et al* reviewed epidemiological studies and reported that the prevalence of MS in East Asians was lower than that in whites[28]. However, the prevalence of MS may increase rapidly. Nestel reported a dramatic increase in the prevalence of MS in a cohort from Beijing, from 9% to 21%, between 1992 and 2002[47]. In addition, as reported, the prevalence of KOA in Japanese as well as Chinese cohorts is significantly higher than in whites[27,36]. In light of the rapidly increasing population in Asian countries, prevention strategies for obesity-related chronic diseases, such as MS and KOA, should be implemented immediately. In our study, we clarified that components of MS and their accumulation were associated with KOA in Asian subjects. Based on these findings, the prevention of MS may be useful in the prevention of not only CVD, but also KOA, in both Asian and Western countries, and may lead to a reduction in the number of patients who have a disability arising from joint disorders.

There are several limitations in our study. First, although the ROAD study includes a large number of participants, these participants may not be truly representative of the general population. To confirm whether the participants of the ROAD study are representative of the Japanese population, we compared anthropometric measurements and the frequencies of smoking and alcohol consumption between study participants and the general Japanese population, and no significant differences were found, except that male ROAD study participants aged 70–74 years were significantly smaller in terms of body structure than the overall Japanese population ($p < 0.05$)[29]. This difference should be considered when evaluating the potential risk factors for men aged 70–74 years; factors such as body build, particularly heavy weight, are known to be associated with the presence of MS and KOA. Thus, our results might represent an underestimation. Second, this was a cross-sectional study, and the causal relationship between metabolic factors and KOA remains unclear. Metabolic factors may have changed recently or been longstanding; this can only be ascertained by a longitudinal study that clarifies the incidence and/or progression rates of KOA in the same cohort. The first such followup of the ROAD cohort is in progress; it intends to clarify the causal relationships between musculoskeletal diseases and MS for early prevention of the disabilities. Third, we categorized MS by using the criteria defined by the Examination Committee of Criteria for Metabolic Syndrome in Japan[29], except for the definition of overweight. We used BMI ≥ 25 as the criterion for OW status, as defined by the Japan Society for the Study of Obesity[30]. In addition, since the blood samples obtained were not always from participants under fasting conditions, we used serum HDL cholesterol level < 40 mg/dl to indicate DL, and serum HbA1c level ≥ 5.5% to indicate IGT, which are indices used by the National Health and Nutrition Survey in Japan[32]. These differences in the definition of MS may skew the true association between MS and KOA. However, our aim was to determine how the accumulation of MS components was related to KOA, and we believe the indices we used for OW, HTN, DL, and IGT accurately reflected the participants' physical condition.

Our study evaluated a large-scale population from the

ROAD study and revealed that the presence of KOA was significantly associated with increases in the number of components of MS. Additionally, the number of components of MS was inversely related to medial MSJW values and positively related to OPA values. The prevention of MS may be useful for both CVD and KOA in Asian populations. Further investigations, along with continued longitudinal surveys in the ROAD study, will elucidate the components of MS and occurrence or progress of KOA.

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ORIGINAL ARTICLE

Prevalence of Falls and the Association With Knee Osteoarthritis and Lumbar Spondylosis As Well As Knee and Lower Back Pain in Japanese Men and Women

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Objective. **There is little information on falls by sex and age strata in Japan, and few factors associated with falls have been established. However, the association between bone and joint diseases and falls remains unclear. We examined prevalence of falls by sex and age strata, determined its association with radiographic osteoarthritis (OA) of the knee and lumbar spine, and determined knee and lower back pain after single and multiple falls.**

Methods. **A questionnaire assessed the number of falls during 12 months preceding baseline. Knee and lumbar spine radiographs were read by Kellgren/Lawrence (K/L) grade; radiographic knee OA and lumbar spondylosis were defined as a K/L grade of 3 or 4. Knee and lower back pain were estimated by an interview.**

Results. **A total of 587 men and 1,088 women (mean ± SD age 65.3 ± 12.0 years) were analyzed. During 1 year, 79 (13.5%) men and 207 (19.0%) women reported at least 1 fall. With increasing age, the prevalence of multiple falls was higher in women, but lower in elderly men age >60 years. In men, few factors were significantly associated with falls. In women, radiographic knee OA and lumbar spondylosis, as well as knee and lower back pain, were significantly associated with multiple falls without adjustment. Lower back pain and knee pain were independently associated with multiple falls in women after adjustment.**

Conclusion. **Lower back pain and knee pain were significantly associated with multiple falls in women.**

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, fall and fracture 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 for prevalence of fall based on sex and age strata. Further, in terms of factors associated with falls, muscle strength, balance, vision, and functional capacities, there are traits that diminish with aging, and these factors have been suggested as predictive risk factors for falls and fractures (4). Cognitive impairment has also been established as a risk factor for falls (5), but the association of bone and joint diseases, especially osteoarthritis (OA), with falls remains unclear.

The representative sites of OA are the knee and lumbar spine. Knee OA and lumbar spondylosis (LS) are major public health issues since they cause chronic pain and disability (6–11). The prevalence of radiographic knee OA and LS is high in Japan (12,13), with 25,300,000 and 37,900,000 subjects ages ≥40 years estimated to experience radiographic knee OA and LS, respectively (14). The National Livelihood Survey ranked OA fourth among diseases that cause disabilities and subsequently require sup-

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Significance & Innovations

- During 1 year, 13.5% of men and 19.0% of women reported at least 1 fall.
- With increasing age, prevalence of multiple falls was higher in women, but lower in elderly men age >60 years.
- Lower back pain and knee pain were independently associated with multiple falls in women.

port with activities of daily living (3), but there have been few studies of the association between falls and OA (15,16). In previous studies, knee OA was assessed only by interview and not by radiography. The principal clinical symptom of knee OA is pain (17), but its correlation with the radiographic severity of knee OA is not as strong as expected (12,18–20). In fact, in a study in Japan, ~20% of the subjects without knee OA had knee pain, and 30% of the subjects with severe knee OA had no knee pain (12). Therefore, 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 (12). Furthermore, knee OA is conventionally defined according to Kellgren/Lawrence (K/L) grade (21), and our previous study showed that the association of a K/L grade of 2 (knee OA with pain) was weak, but that a K/L grade of 3 or 4 (knee OA with pain) was strong (12); therefore, the association of knee OA with falls may be different between a K/L grade of 2 for knee OA and a K/L grade of 3 or 4 for knee OA. However, there are no population-based studies on the association of severity of knee OA with falls. With regard to LS, to the best of our knowledge, there have been no population-based studies regarding its association with falls.

Previous studies have shown that associations between individual risk factors and a single fall are few in number and weak compared to risk factors for multiple falls (16), indicating that single and multiple falls may have different backgrounds. Therefore, to determine factors associated with falls, single and multiple falls should be analyzed separately.

The objectives of this study were to clarify prevalence of single and multiple falls by sex and age strata in Japan using a large-scale, population-based cohort study known as Research on Osteoarthritis/osteoporosis Against Disability (ROAD). Further, we examined the associations of radiographic knee OA and LS, as well as knee and lower back pain, with single and multiple falls in Japanese men and women.

PATIENTS AND METHODS

Patients. The ROAD study is a nationwide prospective study designed to establish epidemiologic indexes for 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 3 communities in Japan. A detailed profile of the ROAD study has been described elsewhere (12–14,22); 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) with a mean age of 70.6 years (range 23–95 years), who were recruited from resident registration listings in 3 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 list of the relevant region. The participants in the urban region were recruited from a randomly selected cohort from the Itabashi-ward residents' registration database (22). The participation rate was 75.6%. The participants in mountainous and coastal regions were also recruited from the resident-registration lists, and the participation rates in these 2 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 their 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. All subjects were interviewed with regard to falls and fractures by experienced interviewers and were asked the following questions: "Have you experienced falls during the 12 months preceding baseline, and if yes, how many falls did you experience?" and "Have you experienced any fractures when you fell?" According to a previous study on falls (23), 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 also interviewed by experienced orthopedists (SM and HO) with regard to knee pain and lower back pain and were asked the following questions: "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. 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 (SM) using the K/L radiographic atlas

(21) to determine the severity of K/L 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 a K/L grade of ≥3 in at least 1 knee and 1 intervertebral level, respectively. To evaluate the intraobserver variability of K/L 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 2 experienced orthopedic surgeons (SM and HO) using the same atlas for interobserver variability. The intra- 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).

Covariates. Anthropometric measurements included height, weight, and body mass index (BMI; kg/m^2). Grip strength was measured on bilateral sides using a TOEI LIGHT handgrip dynamometer, and the best measurement was used to characterize maximum muscle strength. To measure physical performance, the time taken to walk 6 meters at normal walking speed in a hallway was recorded. Subjects were told to walk from a marked starting line to a 6-meter 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. The average of 2 trials was recorded. These gait-speed trial measurements are considered highly reliable in community-dwelling elderly subjects (24–27).

The time taken for 5 consecutive chair rises without the use of hands was also recorded. Hands were folded in front of the chest with feet flat on the floor, following the protocol described by Guralnik et al (28) and used by other researchers (25,29,30). Time was measured in seconds with a stopwatch and rounded to the nearest hundredth of a second. Timing began with the command "go" and ended when the buttocks contacted the chair on the fifth landing. The reliability of this protocol is adequate (25,28,29). Cognition was also evaluated for all subjects using a Mini-Mental State Examination, and a cutoff score of <24 was used to select participants with cognitive impairment (31).

Statistical analyses. The differences in age, anthropometric measurements, and physical performance measurements between men and women were examined by Student's unpaired *t*-test, and among groups of nonfallers, single fallers, and multiple fallers using one-way analysis of variance (ANOVA). The prevalence of cognitive impairment, radiographic knee OA and LS, and knee and lower back pain was compared between men and women, and among nonfallers, single fallers, and multiple fallers by using the chi-square test. The prevalence of single and multiple falls was also compared between men and women, among subjects with no knee OA (K/L grade 0 or 1), with K/L grade 2 for knee OA and K/L grade 3 or 4 for knee OA, and among subjects with no LS (K/L grade 0 or 1), with K/L grade 2 for LS, and K/L grade 3 or 4 for LS by using the chi-square test. The association of knee pain and lower back pain with physical performance was determined by logistic regression analysis. Multinomial logistic regression analysis was also used to determine the association of anthropometric measurements, physical performance, cognitive impairment, radiographic knee OA and LS defined as K/L grade 3 or 4, and knee and lower back pain, with single and multiple falls compared with nonfalls. Further, to determine the independent association of radiographic knee OA and LS, and knee and lower back pain with single and multiple falls compared with nonfalls, we first used multinomial logistic regression analysis with age, BMI, cognitive impairment, radiographic knee OA and LS, and knee and lower back pain as independent variables. In addition to the above independent variables, we additionally adjusted for grip strength, 6-meter walking time, and chair stand time. Data analyses were performed using SAS software, version 9.0.

RESULTS

Of the 1,690 subjects in the mountainous and seaside cohorts at baseline, 15 subjects provided incomplete fall questionnaires, leaving a total of 1,675 subjects (587 men, 1,088 women). Table 1 shows the age, anthropometric measurements, and physical performance of the participants in the present study. Regarding physical performance, grip strength, 6-meter walking time, and chair stand time were significantly better in men than in women. The prevalence of cognitive impairment was not significantly different between men and women. The prevalence of radiographic knee OA and knee pain was significantly higher in women than in men, while that of LS and lower back pain was not different between men and women.

During the 12 months preceding the baseline examination, 79 men (13.5%, 95% confidence interval [95% CI] 10.9–16.5%) and 207 women (19.0%, 95% CI 16.8–21.5%) reported at least 1 fall, and 48 men (8.2%, 95% CI 6.2–10.7%) and 80 women (7.4%, 95% CI 5.9–9.1%) reported multiple falls. Chi-square test showed that the prevalence of single and multiple falls were significantly different between men and women ($P < 0.0001$). Among 286 subjects with at least 1 fall, 6 subjects (2.1%) had a wrist fracture, 2 (0.7%) had a proximal humerus fracture, 1 (0.3%) had a vertebral fracture, and 12 (4.2%) had fractures at other sites. With increasing age, the prevalence of falls was lower in elderly men age >60 years; however, the prevalence of falls was higher in women with increasing age (Table 2). Moreover, with increasing age, the prevalence of multiple falls was also lower in elderly men age >60 years, but it was higher in women with increasing age (Table 2). The prevalence (95% CI) of a single fall (%) was similar among age strata in men and women (for men: 5.3% [1.8–14.4%], 6.8% [3.3–13.4%], 3.2% [1.4–7.3%], 5.5% [3.2–9.4%], and 7.4% [1.0–12.5%] in the age subgroups of <50 years, 50–59 years, 60–69 years, 70–79 years, and ≥80 years, respectively; for women: 11.9% [7.5–18.5%], 11.1% [7.5–16.1%], 12.0% [8.9–16.0%], 11.6% [8.6–15.6%], and 11.4% [6.7–18.9%] in the age subgroups of <50 years, 50–59 years, 60–69 years, 70–79 years, and ≥80 years, respectively).

Table 3 shows the age, anthropometric measurements,

Table 1. Characteristics of participants*

	Overall	Men	Women
Subjects, no.	1,675	587	1,088
Age, years	65.3 ± 12.0	66.3 ± 11.7	64.7 ± 12.1†
Height, cm	155.1 ± 9.3	163.4 ± 7.2	150.6 ± 6.9†
Weight, kg	55.6 ± 10.8	62.3 ± 10.9	52.0 ± 8.9†
BMI, kg/m^2	23.0 ± 3.4	23.3 ± 3.2	22.9 ± 3.5†
Grip strength, kg	27.4 ± 9.8	35.7 ± 9.3	22.9 ± 6.8†
6-meter walking time, seconds	5.5 ± 2.5	5.3 ± 2.2	5.6 ± 2.6†
Chair stand time, seconds	10.1 ± 4.4	9.7 ± 3.6	10.4 ± 4.8†
Cognitive impairment, %	4.5	5.2	4.2
Radiographic knee OA, %	20.3	15.0	23.0‡
Radiographic lumbar spondylosis, %	37.1	37.7	36.9
Knee pain, %	24.4	18.9	27.4‡
Lower back pain, %	20.1	21.7	21.2

* Values are the mean ± SD unless indicated otherwise. BMI = body mass index; OA = osteoarthritis.
† $P < 0.05$ vs. men by Student's unpaired *t*-test.
‡ $P < 0.05$ vs. men by chi-square test.

physical performance, and prevalence of cognitive impairment among nonfallers, single fallers, and multiple fallers. One-way ANOVA showed that there were no significant associations of age, anthropometric measurements, physical performance, and prevalence of cognitive impairment with falls in men, while age and BMI were higher in multiple fallers than in nonfallers in women. With regard to physical performance, grip strength was lower and 6-meter walking time and chair stand time were longer in multiple fallers than in nonfallers and single fallers in women. Further, prevalence of cognitive impairment was also different among nonfallers, single fallers, and multiple fallers in women. Further, to determine the association of anthropometric measurements, physical performance, and cognitive impairment with single and multiple falls, we also used multinomial logistic regression analysis and found that age (odds ratio [OR] 1.04, 95% CI 1.02–1.06), BMI (OR 1.10, 95% CI 1.03–1.17), grip strength (OR 0.92, 95% CI 0.89–0.96), 6-meter walking time (OR 1.10, 95% CI 1.02–1.17), chair stand time (OR 1.06, 95% CI 1.02–1.10), and cognitive impairment (OR 3.86, 95% CI 1.67–3.83) were significantly associated with multiple falls in women.

To determine the association of the severity of knee OA with falls, we classified subjects as those with no knee OA (K/L grade 0 or 1), with K/L grade 2 for knee OA, and with K/L grade 3 or 4 for knee OA. The prevalence of falls in subjects with no knee OA, K/L grade 2 for knee OA, and K/L grade 3 or 4 for knee OA was 11.8%, 17.1%, and 12.5%, and 17.7%, 17.6%, and 25.6% in men and women, respectively. There were no significant associations between falls and the severity of knee OA in men (chi-square test; $P = 0.27$), while prevalence of falls was higher in women with K/L grade 3 or 4 for knee OA than those with no knee OA and K/L grade 2 for knee OA ($P = 0.01$). Similar to knee OA, we classified subjects as those with no LS (K/L grade 0 or 1), those with K/L grade 2 for LS, and those with K/L grade 3 or 4 for LS. The prevalence of falls in subjects with no LS, K/L grade 2 for LS, and K/L grade 3 or 4 for LS was 16.3%, 11.3%, and 14.0%, and 17.0%, 20.5%, and 20.7% in men and women, respectively. There were no significant associations between falls and the severity of LS in men and women (chi-square test, $P = 0.38$ and 0.32, respectively). We next used the chi-square test to determine the association of single and multiple falls with knee OA and LS defined as K/L grade 3 or 4 (Table 4). A chi-square test showed that no significant factors were associated with falls in men, but radiographic knee OA, knee pain, and lower back pain were significantly associated with falls in women.

Multinomial logistic regression analysis also showed that radiographic knee OA, LS, and knee and lower back pain were significantly associated with multiple falls in women (Table 5). Because knee pain and lower back pain were also significantly associated with grip strength, 6-meter walking time, and chair stand time in men and women

Table 2. Prevalence of falls by age strata in men and women*

	Single fall		Multiple falls	
Age, years	Men	Women	Men	Women
<50	15.8 (8.5–27.4)	13.4 (8.7–20.2)	10.5 (4.9–21.1)	1.5 (0.4–5.3)
50–59	10.7 (6.1–18.1)	17.4 (12.8–23.1)	3.9 (1.5–9.6)	6.3 (3.7–10.4)
60–69	16.7 (11.6–23.3)	18.8 (14.9–23.4)	13.5 (9.0–19.7)	6.8 (4.5–10.1)
70–79	12.4 (8.7–17.5)	21.1 (16.9–25.9)	6.9 (4.2–11.1)	9.4 (6.7–13.1)
≥80	11.1 (5.2–22.2)	23.8 (16.7–32.8)	3.7 (1.0–12.5)	12.4 (7.4–20.0)

* Values are the percentage (95% confidence interval).

Table 3. Comparison of characteristics among nonfallers, single fallers, and multiple fallers in men and women*

	Men				Women			
	Nonfallers	Single fallers	Multiple fallers	*P*	Nonfallers	Single fallers	Multiple fallers	*P*
Subjects, no.	508	31	48		881	127	80	
Age, years	66.4 ± 11.7	67.6 ± 11.9	64.6 ± 11.3	0.50	64.4 ± 12.1	64.3 ± 12.2	69.1 ± 10.4	0.004
Height, cm	163.5 ± 7.4	162.3 ± 6.3	162.9 ± 5.9	0.56	150.9 ± 6.8	150.7 ± 7.7	148.5 ± 7.0	0.01
Weight, kg	62.6 ± 11.1	60.7 ± 10.4	60.3 ± 9.0	0.27	51.8 ± 8.8	53.3 ± 9.2	52.8 ± 8.9	0.15
BMI, kg/m^2	23.3 ± 3.2	23.0 ± 3.1	22.7 ± 2.8	0.27	22.7 ± 3.4	23.4 ± 3.6	23.9 ± 3.7	0.002
Grip strength, kg	35.8 ± 9.3	34.0 ± 9.6	35.5 ± 9.1	0.57	23.3 ± 6.8	22.6 ± 6.5	19.9 ± 5.3	< 0.001
6-meter walking time, seconds	5.2 ± 2.2	5.8 ± 2.5	5.6 ± 2.3	0.21	5.5 ± 2.6	5.7 ± 2.6	6.3 ± 2.7	0.03
Chair stand time, seconds	9.6 ± 3.6	10.3 ± 3.8	10.2 ± 3.3	0.30	10.2 ± 4.8	10.5 ± 4.6	11.9 ± 5.1	0.01
Cognitive impairment, %	4.6	6.5	10.6	0.26	3.3	5.6	11.7	0.008

* Values are the mean ± SD unless indicated otherwise. One-way analysis of variance was used to determine the differences in age, height, weight, body mass index (BMI), grip strength, 6-meter walking time, normal step length, and chair stand time among nonfallers, single fallers, and multiple fallers. Chi-square test was used to determine the differences in prevalence of cognitive impairment among nonfallers, single fallers, and multiple fallers.

(logistic regression analysis; $P < 0.05$); to examine the independent association between radiographic knee OA, knee pain, radiographic LS, and lower back pain in women, we first used multinomial logistic regression analysis with age, BMI, cognitive impairment, radiographic knee OA, knee pain, radiographic LS, and lower back pain as independent variables (Table 5). In this analysis, only lower back pain was independently associated with multiple falls in women. In addition to the above independent variables, we also adjusted for grip strength, 6-meter walking time, and chair stand time, and found that the significant association of lower back pain with multiple falls disappeared, while knee pain was independently associated with multiple falls in women (Table 5).

DISCUSSION

The present study is the first large-scale population-based cohort study of the prevalence of single and multiple falls and their association with radiographic knee OA and LS, as well as pain in Japanese men and women. We found that lower back pain and knee pain were independently associated with multiple falls in women.

There were distinct associations between age strata and single and multiple falls. We found that several factors were associated with multiple falls in women, but no factors were associated with a single fall in women. Previous studies have shown that associations between individual risk factors and a single fall are few in number and weak compared with risk factors for multiple falls (16). A single fall in a year could be accidental and occur due to individual as well as environmental factors, which may partly explain why there were no factors significantly associated with a single fall in our study. In contrast, several factors were associated with multiple falls in the present study, indicating that multiple falls may occur primarily due to individual factors.

In women, the prevalence of multiple falls was higher with increasing age, but in men, the prevalence of multiple falls was lower in subjects ages >60 years, although this could be a random error because of small prevalence, particularly in men. This may be partly explained by the

Table 4. Comparison of radiographic knee OA and LS, as well as knee and lower back pain, among nonfallers, single fallers, and multiple fallers in men and women*

	Men				Women			
	Nonfallers	Single fallers	Multiple fallers	*P*	Nonfallers	Single fallers	Multiple fallers	*P*
Subjects, no.	508	31	48		881	127	80	
Radiographic knee OA†	77/507 (15.2)	4/31 (12.9)	7/47 (14.9)	0.9417	186/875 (21.3)	31/127 (24.4)	33/79 (41.8)	0.0002
Knee pain‡	97/508 (19.1)	3/31 (9.7)	11/48 (22.9)	0.3268	224/880 (25.5)	37/127 (29.1)	37/80 (46.3)	0.0003
Radiographic LS	190/508 (37.4)	12/31 (38.7)	19/48 (39.6)	0.9490	318/881 (36.1)	45/127 (35.4)	38/80 (47.5)	0.1210
Lower back pain§	99/508 (19.5)	10/31 (32.3)	9/48 (18.8)	0.2203	177/880 (20.1)	31/127 (24.4)	28/80 (35.0)	0.0062

* Values are the number/total number (percentage) unless otherwise indicated. The chi-square test was used to determine the differences in radiographic findings and pain among nonfallers, single fallers, and multiple fallers. Radiographic knee OA and LS were defined as Kellgren/Lawrence grade 3 or 4. OA = osteoarthritis; LS = lumbar spondylosis.
† Nine subjects with total knee arthroplasty were excluded.
‡ One subject with incomplete information regarding knee pain was excluded.
§ One subject with incomplete information regarding lower back pain was excluded.

Table 5. Association of radiographic knee OA and LS, as well as knee and lower back pain, with single and multiple falls in women*

	Crude OR (95% CI)		Adjusted OR_1 (95% CI)†		Adjusted OR_2 (95% CI)‡	
	Single falls	Multiple falls	Single falls	Multiple falls	Single falls	Multiple falls
Radiographic knee OA	1.20 (0.76–1.83)	2.66 (1.64–4.26)	1.07 (0.63–1.82)	1.43 (0.78–2.61)	1.04 (0.60–1.77)	1.31 (0.70–2.43)
Knee pain	1.20 (0.79–1.81)	2.52 (1.58–4.02)	1.00 (0.62–1.61)	1.61 (0.92–2.79)	0.99 (0.60–1.61)	1.87 (1.06–3.28)
Radiographic LS	0.97 (0.65–1.43)	1.60 (1.01–2.54)	0.87 (0.57–1.32)	1.12 (0.68–1.85)	0.88 (0.57–1.33)	1.04 (0.61–1.74)
Lower back pain	1.28 (0.82–1.96)	2.14 (1.30–3.46)	1.34 (0.84–2.08)	1.72 (1.01–2.88)	1.33 (0.84–2.08)	1.58 (0.91–2.70)

* Radiographic knee osteoarthritis (OA) and lumbar spondylosis (LS) were defined as Kellgren/Lawrence grade 3 or 4. Multinomial logistic regression analysis was used to calculate the odds ratio (OR) and 95% confidence interval (95% CI) compared with nonfallers. Eight subjects with total knee arthroplasty or incomplete information regarding pain were excluded.
† Adjusted OR_1 was calculated using multinomial logistic regression analysis with age, body mass index, cognitive impairment, radiographic knee OA, knee pain, radiographic LS, and lower back pain as independent variables.
‡ Adjusted OR_2 was calculated using multinomial logistic regression analysis with grip strength, 6-meter walking time, and chair stand time in addition to the above independent variables.

fact that elderly men generally retire from their occupations at approximately ages 60–70 years; therefore, their environment may change and men may become more sedentary as they age, leading to lower risks of falls. Women, however, must often continue to do household chores even after age 60 years, and their environment may therefore change to a smaller extent than that of men, but their health or muscle strength continues to decline (32), leading to the higher risk of falls.

Our study is the first population-based study to examine the association between knee OA and LS diagnosed by radiography and falls in Japanese men and women. Radiographic knee OA and LS were significantly associated with multiple falls in women, but not in men, although no significant association of radiographic knee OA or LS with falls may be due to the small number of falls in men. The sex differences identified in the association between radiographic knee OA and falls may be partly explained by the weaker quadriceps muscles and increased postural sway associated with knee OA (33,34), both of which are known to be independent risk factors for falls (16,35). In men, muscle strength was higher than that in women in all decades (32), which may obscure the association between radiographic knee OA and falls. LS was also significantly associated with falls in this study, but the OR was lower than that for knee OA. Therefore, falls may be more strongly associated with problems of the lower extremities rather than the trunk.

After adjustment for age, BMI, and cognitive impairment, lower back pain was independently associated with multiple falls, and after adjustment for age, BMI, grip strength, cognitive impairment, 6-meter walking time, and chair stand time, knee pain was independently associated with multiple falls. Given that the significant association of radiographic knee OA and LS with multiple falls disappeared after adjustment, multiple falls may occur due to symptoms such as pain caused by radiographic knee OA or LS rather than radiographic changes in the knee or lumbar spine itself. A previous study also suggested that subjects with knee pain had an increased risk of falls (15). In other words, falls may be preventable when pain is relieved by medical care, even if subjects have radiographic knee OA or LS.

The present study has several limitations. First, this is a large-scale population-based study with a cross-sectional analysis of baseline data. Therefore, causal relationships could not be determined. The ROAD study is a longitudinal survey; therefore, further progress may help elucidate any causal relationships. Second, our subjects lived in the community, and therefore our findings may not apply to elderly persons residing in institutions. Third, we did not include other weight-bearing OA diseases, such as hip OA, in the analysis, although this disorder also affects falls (36). However, the prevalence of K/L grade 3 or 4 for hip OA is 1.4% and 3.5% in Japanese men and women (37), respectively, which is smaller than that of K/L grade 3 or 4 for knee OA in the present study. Therefore, it is possible that hip OA would not strongly affect the results of the present study. Fourth, the prevalence of fall was comparably small, particularly in men. Therefore, our results regarding the prevalence may include random error, but the present study is the first large-scale, population-based cohort study of the prevalence of falls in Japanese men and women.

In conclusion, the present cross-sectional analysis using a large-scale population from the ROAD study revealed the prevalence and factors associated with falls in men and women. In women, lower back pain and knee pain were significantly associated with multiple falls. 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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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Muraki had full access to all of the data in the study and takes

responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Muraki, Akune, Oka, En-yo, Yoshida, Nakamura, Kawaguchi, Yoshimura.

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EPIDEMIOLOGY

Health-Related Quality of Life in Subjects With Low Back Pain and Knee Pain in a Population-Based Cohort Study of Japanese Men

The Research on Osteoarthritis Against Disability Study

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Study Design. Cross-sectional surveys of health-related quality of life (QOL) in subjects with low back pain and knee pain using a population-based cohort.

Objective. The purpose of the present study was to clarify the impact of low back pain and knee pain on QOL in men. In addition, we analyzed the impacts of vertebral fracture (VFx), lumbar spondylosis, and knee osteoarthritis (OA) on the magnitude of QOL loss in men with low back pain and knee pain.

Summary of Background Data. Low back pain and knee pain are major public health issues causing disability among the elderly men, but there were no population-based studies to compare the impact of low back pain on QOL with that of knee pain in Japanese men.

Methods. From 3040 participants in the Research on Osteoarthritis Against Disability study, data from 767 men older than 40 years who completed questionnaires (mean age = 69.7 years) were examined. To carry out the QOL assessment, the Medical Outcomes Study Short Form 8 (SF-8) and EuroQol (EQ-5D) were used. We examined the association of low back pain and knee pain with QOL. Furthermore, we also examined the presence of VFx and the severity of lumbar spondylosis and knee OA with the magnitude of QOL loss in men with low back pain and knee pain, respectively.

Results. The impact of low back pain on QOL was larger than that of knee pain. In men with low back pain, there were few associations between Kellgren-Lawrence grade and QOL, whereas VFx was associated with physical QOL. For men with knee pain, Kellgren-Lawrence grade equal to 4 knee OA was associated with QOL.

Conclusion. This study revealed that low back pain has a larger impact than knee pain on QOL. Furthermore, low back pain with VFx is strongly associated with physical QOL loss.

Key words: knee pain, low back pain, osteoarthritis, quality of life, vertebral fracture. **Spine 2011;36:1312–1319**

Low back pain and knee pain are major public health issues causing disability among the elderly in most developed countries.[1–3] The prevalence of low back pain and knee pain is high in the elderly in Japan, ranging from 25% to 30%.[2,3] According to the recent National Livelihood Survey of the Ministry of Health, Labour, and Welfare in Japan, low back pain is rated first among symptoms that send men to the hospital.[4] Thus, it is important to clarify the impact of low back pain and knee pain on quality of life (QOL). Several studies have focused on the association of low back pain with

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The manuscript submitted does not contain information about medical device(s)/drug(s).

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The present study was conducted with the approval of ethical committees of the University of Tokyo and the Tokyo Metropolitan Institute of Gerontology.

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QOL in whites,[5–8] but for knee pain, there are few studies regarding its association with QOL.[9] Furthermore, to the best of our knowledge, there are no population-based studies that examine the impact of low back pain and knee pain on QOL in the same population using the same tool, although low back pain and knee pain may not be independent. Furthermore, the presence of pain at both sites may have more impact on QOL than pain at a single site. One of the main causes of low back pain in the elderly is vertebral fracture (VFx).[10] Low back pain is also believed to be one of the principal clinical symptoms of lumbar spondylosis, although the magnitude of the impact of lumbar spondylosis on low back pain is not as strong as one would expect.[2,11,12] A significant part of knee pain is caused by knee osteoarthritis (OA),[13,14] and the prevalence of knee pain increases as knee OA becomes more severe.[3] Thus, the impact of pain on QOL may differ on the basis of the cause and severity of the underlying disease. However, to the best of our knowledge, there are no population-based studies that examine the association of pain with QOL according to the cause or severity of the underlying disease.

Furthermore, sex differences have been observed in low back pain and knee pain. The prevalence of low back pain and knee pain differs between men and women,[2,3] and low back pain is rated as the first symptom that sends men to the hospital, although it is rated as the second symptom for women.[4] Thus, the impact of this pain on QOL may be stronger in men than in women. Although studies have examined the association of low back pain[5–8] or knee pain[9] with QOL, neither men nor women were analyzed separately[5,6,9] or the studies focused only on women.[7,8] There are no large-scale population-based studies examining the impact of low back pain or knee pain on QOL in men alone.

The objective of the present study was to clarify the independent association of low back pain and knee pain with QOL among 767 men using cohorts from Research on Osteoarthritis Against Disability (ROAD). We also examined whether the presence of both low back pain and knee pain had a larger impact on QOL than pain at only one site. Furthermore, we analyzed the impact of VFx, lumbar spondylosis, and knee OA on the magnitude of loss of QOL in men with low back pain and knee pain.

MATERIALS AND METHODS

Subjects

The ROAD study is a nationwide prospective study for bone and joint diseases (with OA and osteoporosis as the representative bone and joint diseases) consisting of population-based cohorts established in several communities in Japan. As detailed profile of the ROAD study has been described elsewhere,[15,16] and only a brief summary is provided here. To date, we have completed the creation of a baseline database including clinical and genetic information of 3040 inhabitants (1061 men and 1979 women) aged 23 to 95 years (mean = 70.6 years), who were recruited from listings of resident registrations in three communities: an urban region in Itabashi, Tokyo; a mountainous region in Hidakagawa, Wakayama; and a seacoast region in Taiji, Wakayama. All participants provided written informed consent, and the study was conducted with the approval of ethical 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 health-related QOL. We also examined the presence of cerebral stroke, diabetes mellitus, cardiac disease, and hypertension using an interviewer-administered questionnaire, as QOL may be affected by these comorbidities. Furthermore, because a lower level of physical activity may affect the association of pain with QOL, we obtained a history of leisure physical activity, including information on participation in sports and the frequency and duration of other leisure activities such as walking, jogging, swimming, playing tennis, playing baseball, playing golf, and muscle strength training. Anthropometric measurements included height and weight, and body mass index (BMI; weight [kg]/height^2 [m^2]) was calculated. All subjects were interviewed by experienced orthopedists regarding low back pain and knee pain and were asked, "Have you experienced low back pain on most days in the past month, in addition to now?" and "Have you experienced knee pain on most days in the past month, in addition to now?," respectively. Those who answered yes were defined as having pain. From the baseline data of the overall participants, the present study analyzed 767 men aged 40 years or older who completed a questionnaire of the Medical Outcomes Study Short Form 8 (SF-8) and the EuroQol (EQ-5D).

Radiographic Assessment

All participants underwent radiographic examination of the lumbar spine including intervertebral levels L1–L2 to L5–S with anteroposterior and lateral views, and both knees using anteroposterior and lateral views with weight-bearing and foot map positioning. Lumbar spine and knee radiographs were read without knowledge of participant clinical status by a single experienced orthopedist (S. M.). VFx was assessed by lateral radiographs of the lumbar spine (L1–L5) in terms of a wedge, biconcave, or crush appearance according to the Japanese Society of Bone and Mineral Research criteria[17] (Figure 1). Lumbar spondylosis and knee OA were assessed using the Kellgren-Lawrence (KL) radiographic atlas, and the

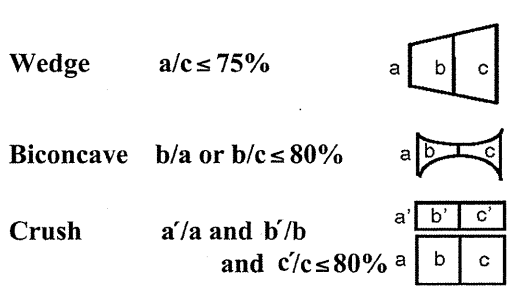

Figure 1. Diagnostic criteria for vertebral fractures according to the Japanese Society for Bone and Mineral Research.

severity was determined by KL grading.[18] We defined lumbar spondylosis and knee OA as KL 2 or more in at least one knee and one intervertebral level, respectively.

Instruments

The SF-8 scale was used for the QOL assessment. The SF-8 was constructed to provide a shorter alternative to the SF-36,[19] the most widely used patient-based health status survey, for use in large population-based surveys of general and specific populations. The SF-8 measures eight concepts: general health (GH), physical function (PF), role physical (RP), bodily pain (BP), vitality (VT), social function (SF), mental health (MH), and role emotional (RE). The SF-8 was scored by assigning the mean SF-36 scale score from the 2002 general Japanese population to each response category of the SF-8 measuring the same concept, and then weighting each SF-8 item to compute aggregate physical component scores (PCS) and mental component scores (MCS) summary scale measures. The SF-8 can be scored using a published algorithm for Japanese versions of the SF-8, which have been well-validated.[20] We also used the EuroQol (EQ-5D) questionnaire,[21] which was translated into Japanese.[22] The five-dimensional health care classification includes questions on the status of morbidity, self-care, usual activities, pain/discomfort, and anxiety/depression. Participants were asked to indicate current health status by choosing the most appropriate of the three statements about each of the five QOL dimensions. Each statement represents an increasing degree of severity. These results were coded and converted to a score of utility using a table of values.[22]

Statistical Analysis

We used the nonpaired student *t* test to examine differences between subjects with and without low back pain and knee pain. To determine the independent impact of low back pain and knee pain on QOL, multiple regression analysis was used with age, BMI, low back pain, and knee pain as independent variables. Furthermore, to examine the impact of the presence of both low back pain and knee pain on QOL, QOL scores in subjects with both low back pain and knee pain, with low back pain only, with knee pain only, and without these conditions were compared using the Tukey Honestly Significant Difference (HSD) test after adjustment for age and BMI. We further examined the association of KL grade at the lumbar spine and knee with the magnitude of QOL loss in subjects with low back pain and knee pain, respectively, using the Tukey HSD test after adjustment for age and BMI. If a subject had pain in both knees, the more severe KL grade was used for that subject. For the lumbar spine, the most severe KL grade among all intervertebral spaces was used. We also examined the association of the presence of VFx with the magnitude of QOL loss in subjects with low back pain using multiple regression analysis after adjustment for age, BMI, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension. The association of physical activity with the magnitude of QOL loss in subjects with low back pain and in those with knee pain was determined using multiple regression analysis after adjustment for age, BMI, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension. Data analyses were performed using SAS version 9.0 (SAS Institute Inc., Cary, NC).

RESULTS

Characteristics of the 767 participants aged 40 years and older in the ROAD study are shown in Table 1. The prevalence of low back pain and knee pain was approximately 15% and 21%, respectively. The prevalence of lumbar spondylosis and knee OA was 80% and 42%, respectively, which was high compared with that of VFx.

TABLE 1. Characteristics of Participants

N	767
Age, yr	69.7 ± 10.5
Height, cm	162.8 ± 6.7
Weight, kg	61.5 ± 10.8
BMI, kg/m^2	23.1 ± 3.4
Low back pain, %	15.4
Knee pain, %	20.6
Vertebral fracture, %	11.6
Lumbar spondylosis, %	80.0
Knee osteoarthritis, %	42.1
Comorbidities, %	
Cerebral stroke	5.8
Diabetes mellitus	13.8
Cardiac disease	13.4
Hypertension	41.1
Medical Outcomes Study Short Form 8	
GH	50.2 ± 5.5
PF	49.9 ± 6.2
RP	50.2 ± 6.7
BP	50.4 ± 9.2
VT	50.4 ± 6.3
SF	52.4 ± 5.5
MH	54.4 ± 5.3
RE	52.0 ± 5.2
PCS	47.4 ± 6.8
MCS	53.4 ± 5.3
EQ-5D	0.91 ± 0.14

Values are mean ± SD unless otherwise indicated.

BMI indicates body mass index; BP, bodily pain; EQ-5D, EuroQol; GH, general health; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; VT, vitality;

TABLE 2. Mean (SD) Scores of All Domains, PCS, and MCS in the SF-8 and EQ-5D in Men with and Without Low Back Pain and Knee Pain

	Low Back Pain			Knee Pain		
	No	Yes	Adjusted Beta*	No	Yes	Adjusted Beta*
Medical Outcomes Study Short Form 8						
GH	50.5 (5.4)	48.3† (5.6)	−0.105‡	50.5 (5.4)	49.1† (5.5)	−0.100‡
PF	50.5 (5.8)	47.0† (7.5)	−0.135‡	50.4 (5.7)	48.2† (7.6)	−0.085‡
RP	50.7 (6.4)	47.4† (7.7)	−0.102‡	50.7 (6.2)	48.7† (7.9)	−0.073‡
BP	51.4 (9.2)	44.6† (7.2)	−0.235‡	51.1 (9.2)	47.6† (8.7)	−0.119‡
VT	50.8 (6.3)	48.4† (5.8)	−0.110‡	50.8 (6.1)	49.0† 6.5)	−0.109‡
SF	52.8 (5.0)	50.5† (7.5)	−0.100‡	52.5 (5.3)	52.4 (5.8)	0.028
MH	54.6 (5.1)	53.1† (6.0)	−0.078‡	54.4 (5.2)	54.6 (5.3)	0.034
RE	52.3 (4.9)	50.6† (5.5)	−0.087‡	52.1 (4.9)	51.9 6.2)	−0.0001
PCS	48.2 (6.5)	43.3† (7.2)	−0.191‡	48.1 (6.5)	44.8† (7.2)	−0.147‡
MCS	53.4 (5.1)	53.1 (6.3)	−0.010	53.2 (5.2)	54.2 (5.6)	0.076‡
EQ-5D	0.93 (0.13)	0.83† (0.17)	−0.180‡	0.92 (0.13)	0.87† (0.16)	−0.099‡

Values are mean (SD) unless otherwise indicated.

**The adjusted beta values are shown using multiple regression analysis after adjustment for age, body mass index, the other pain, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension.*

†P < 0.05 versus subjects without the corresponding pain by nonpaired student t test.

‡P < 0.05 by multiple regression analysis.

BP indicates bodily pain; EQ-5D, EuroQol; GH, general health; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; SF-8, 8-Item Short Form Health Survey; VT, vitality.

Table 2 shows the scores for all domains in the SF-8 and the EQ-5D utility score by the presence of low back pain and knee pain. We further examined the independent association of low back pain and knee pain with QOL using multiple regression analysis after adjustment for age, BMI, cerebral stroke, diabetes mellitus, cardiac disease, hypertension, and the other pain. Low back pain was significantly associated with lower QOL scores in all the domains of the SF-8 except for MCS, and in the EQ-5D utility scores, whereas knee pain was associated with lower scores of GH, PF, RP, BP, VT, and PCS in the SF-8 and the EQ-5D utility score, but not with SF, MH, and RE. For the MCS, knee pain was associated with higher scores. The adjusted beta values of low back pain were larger than those of knee pain in almost all QOL domains.

To examine the impact of the presence of both low back pain and knee pain on QOL, we next compared the QOL scores in the subjects with both low back pain and knee pain, only low back pain, only knee pain, and without any pain (Table 3). The Tukey HSD test after adjustment for age, BMI, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension showed that the scores for almost all physical domains in the SF-8 were significantly lower in subjects with both low back pain and knee pain, only low back pain, and only knee pain than in those without pain. The EQ-5D utility score was also significantly lower in subjects with both low back pain and knee pain, those with only low back pain, and those with only knee pain than in those without pain. There were no significant differences in any domains between subjects with both low back pain and knee pain and those with only low back pain. Some domains tended to be lower in subjects with pain in both sites than in those with only knee pain, but differences were not significant.

Next, to clarify the impact of VFx and lumbar spondylosis on the magnitude of QOL loss in men with low back pain, we examined the association of KL grade of lumbar spine and the presence of VFx with QOL in the subjects with low back pain (Table 4). In men with low back pain, there were no associations of KL grade with any domain of the SF-8 and the EQ-5D utility scores, whereas the RP and PCS scores were significantly lower in subjects with VFx than in those without fracture.

Likewise, we examined the association of KL grade of knee with QOL in the subjects with knee pain (Table 5). After adjustment for age and BMI, the Tukey HSD test showed that the PCS in the SF-8 was significantly lower in men with KL 4 knee OA than in those with KL 0 or 1.

We next analyzed the association of physical activity with QOL in subjects with low back pain and in those with knee pain (see Table, Supplemental Digital Content 1, http://links.lww.com/BRS/A519). Multiple regression analysis

TABLE 3. Mean (SD) Scores of All Domains, PCS, and MCS in the SF-8 and EQ-5D in Men by the Combination of Low Back Pain and Knee Pain

	Low Back Pain and Knee Pain	Only Low Back Pain	Only Knee Pain	No Low Back Pain or Knee Pain
Prevalence, %	5.2	9.8	15.5	69.6
Medical Outcomes Study Short Form 8				
GH	48.2* (5.4)	48.7* (5.7)	49.3* (5.5)	50.8 (5.3)
PF	47.7* (6.2)	46.8* (8.2)	48.4* (8.1)	50.9 (5.0)
RP	48.0 (6.9)	47.6* (8.0)	49.0* (8.3)	51.1 (5.8)
BP	45.3* (7.7)	44.6* (6.9)	48.4* (8.9)	52.1 (9.1)
VT	47.9* (6.1)	48.8* (5.7)	49.3* (6.6)	51.1 (6.1)
SF	51.1 (6.5)	50.7 (7.9)	52.8 (5.5)	52.8 (4.8)
MH	54.4 (4.8)	52.7* (6.4)	54.7 (5.4)	54.6 (5.0)
RE	51.6 (5.0)	50.4* (7.2)	52.0 (6.5)	52.3 (4.4)
PCS	43.4* (6.5)	43.5* (7.5)	45.3* (7.4)	48.8 (6.1)
MCS	54.1 (5.6)	53.0 (6.7)	54.3 (5.5)	53.2 (5.0)
EQ-5D	0.82* (0.17)	0.84* (0.16)	0.88* (0.15)	0.94 (0.12)

Values are mean (SD) unless otherwise indicated.

**Significantly lower than that of subjects with no low back pain or knee pain by the Tukey Honestly Significant Difference test after adjustment for age, body mass index, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension.*

BP indicates bodily pain; EQ-5D, EuroQol; GH, general health; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; SF-8, 8-Item Short Form Health Survey; VT, vitality.

after adjustment for age, BMI, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension showed that physical activity was not associated with any QOL parameter in subjects with low back pain or in those with knee pain.

DISCUSSION

This is the first large-scale, population-based cohort study in Japanese men that examined the impact of low back pain and knee pain on QOL measured by the SF-8 as well as the EQ-5D. In the present study, low back pain and knee pain were significantly associated with QOL in men, and multiple regression analysis showed that the adjusted beta values of low back pain were larger than that of knee pain in almost all QOL domains. Furthermore, in men with low back pain, VFx was significantly associated with QOL loss. For men with knee pain, KL 4 knee OA was strongly associated with magnitude of QOL loss compared with KL 0 or 1.

Previous studies showed that low back pain was associated with QOL,[5–8] but no studies focused on men, although sex differences were found in low back pain.[2,4] In addition, although low back pain and knee pain may not be independent, and the presence of pain at both sites may have more impact on QOL loss than pain at one site, no studies have examined the impact of low back pain and knee pain on QOL simultaneously in the same population. In the present study, low back pain and knee pain were significantly associated with lower QOL scores in men. The adjusted beta values of low back pain were higher than that of knee pain in almost all QOL domains, suggesting that low back pain had more impact on QOL loss than knee pain, although we did not evaluate the pain severity of low back pain and knee pain. Furthermore, the pain thresholds and pain onset in daily living in low back pain are not the same as in knee pain, so strict comparisons between low back pain and knee pain are limited, even though we examined the association of low back pain and knee pain with QOL in the same populations using the same method. The presence of both low back pain and knee pain was also significantly associated with QOL loss compared with no low back pain or knee pain, whereas there were no differences in QOL parameters between subjects with both low back pain and knee pain and those with only low back pain. These findings suggest that when both low back pain and knee pain exist, the combination may not result in any additional impact on QOL than pain in single site; it is possible that the impact of knee pain on QOL may be obscured by low back pain, because the impact of low back pain on QOL was larger than that of knee pain.

Previous clinical studies showed that strong impacts of clinical VFx on QOL were observed.[23,24] The present study also clarified that VFx had significant associations with the magnitude of QOL loss measured by RP and PCS of the SF-8 in subjects with low back pain, indicating that low back pain with VFx has a more severe impact on physical QOL than low back pain without VFx in men. This means that VFx may not

TABLE 4. Mean (SD) Scores on the SF-8 and EQ-5D by Vertebral Fracture and Kellgren-Lawrence Grade in Subjects with Low Back Pain

	Vertebral Fracture			Lumbar Spondylosis		
	No	Yes	KL 0,1	KL 2	KL 3	KL 4
Prevalence, %	**18.6**	**81.4**	**16.2**	**35.0**	**28.2**	**20.5**
Medical Outcomes Study Short Form 8						
GH	48.6 (5.6)	47.2 (5.9)	46.8 (6.8)	49.9 (5.3)	47.8 (5.4)	47.4 (5.3)
PF	47.5 (7.6)	44.8 (7.0)	48.6 (5.7)	49.4 (5.7)	43.6 (9.6)	46.3 (6.7)
RP	48.1 (7.3)	44.3* (8.7)	49.1 (6.9)	49.3 (6.9)	45.5 (8.5)	45.5 (8.2)
BP	44.9 (7.4)	43.2 (6.2)	42.3 (4.9)	46.2 (7.6)	45.2 (6.8)	43.2 (8.2)
VT	48.7 (6.0)	47.0 (5.0)	47.6 (7.7)	48.8 (5.3)	47.9 (5.5)	48.9 (5.6)
SF	50.4 (7.8)	51.2 (6.2)	49.4 (8.8)	52.6 (4.9)	49.6 (8.4)	49.0 (8.4)
MH	52.5 (6.1)	55.4 (4.5)	51.7 (7.6)	55.3 (4.0)	51.6 (6.1)	52.0 (6.4)
RE	50.2 (6.9)	52.2 (3.6)	49.0 (8.3)	52.6 (3.3)	49.1 (8.3)	50.5 (5.6)
PCS	44.2 (6.6)	39.4* (8.2)	44.0 (5.0)	44.9 (7.1)	41.9 (8.0)	42.0 (7.5)
MCS	52.4 (6.2)	56.4 (5.8)	51.0 (8.5)	54.9 (4.5)	52.2 (6.1)	52.8 (6.7)
EQ-5D	0.82 (0.17)	0.85 (0.16)	0.86 (0.15)	0.87 (0.14)	0.78 (0.17)	0.80 (0.19)

Values are mean (SD) unless otherwise indicated.

**P < 0.05 versus no vertebral fracture by the Tukey Honestly Significant Difference test after adjustment for age, body mass index, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension.*

BP indicates bodily pain; EQ-5D, EuroQOL; GH, general health; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; SF-8, 8-Item Short Form Health Survey; VT, vitality.

only be a cause of low back pain but also worsen the severity of low back pain. Meanwhile, the severity of lumbar spondylosis was not significantly associated with magnitude of QOL loss in subjects with low back pain. This finding may be partly explained by the weak association between lumbar spondylosis and low back pain reported by us and others.[2,11,12] Indeed, disc degeneration was reported to be detected by magnetic resonance imaging in at least one lumbar level in all but one asymptomatic volunteer in a group with volunteers aged 60 to 80 years.[25] Regarding the knee, the adjusted beta values of knee pain on QOL were weak compared with low back pain, whereas the KL 4 knee OA was significantly associated with magnitude of PCS loss in subjects with knee pain compared with KL 0 or 1. The PCS in subjects with KL 2 knee OA were similar to those with KL 0 or 1. Considering the definition of the KL grade, this may also mean that osteophytosis and joint space narrowing, which are representative features of knee OA, have a different impact on QOL; that is, osteophytosis may have a weak impact on QOL, whereas joint space narrowing may have a strong impact.

As measured by MCS of the SF-8, low back pain was not significantly associated with lower scores in the present study, whereas knee pain was significantly associated with higher scores on MCS, and significantly lower PCS scores. Several factors may contribute to the dissociation between MCS and PCS for low back pain and knee pain. First, MCS questions within the SF-8 include generic questions about energy levels, feelings of being "downhearted and blue," and interference in daily activities as a result of emotional problems. These questions are less sensitive to the presence of mental health issues than disease-specific scales such as the Kessler psychological distress scale.[26] In fact, Hill et al[27] showed that psychological distress has been shown to be significantly more frequent in those with arthritis than those without, although scores on MCS were not significantly different between these two groups. Second, the dissociation may be due to a disability paradox,[28] which suggests that people with chronic disabilities report serious limitations in Activities of Daily Living (ADL) and problems in performing social roles, yet state that they have excellent or good QOL. Low back pain and knee pain lead to functional impairment. This may be associated with lower PCS scores, but the individual may not feel that the impairment of social activity or ADL was due to mental factors. Particularly in elderly individuals, pain may be considered a natural consequence of being elderly and thus may not lead to lower MCS.

There are several limitations to the present study. First, this is a large-scale population-based study, but a cross-sectional study of baseline data, so a causal relationship could not be determined. The ROAD study is a longitudinal survey, so further progress will elucidate any causal relationships. Second, among the 1047 men 40 years or older in the ROAD

TABLE 5. Mean (SD) Scores of the SF-8 and EQ-5D by KL Grade in Subjects with Knee Pain

	KL 0,1	KL 2	KL 3	KL 4
Prevalence, %	**57.9**	**30.1**	**7.8**	**4.2**
Medical Outcomes Study Short Form 8				
GH	48.8 (5.2)	50.0 (4.8)	49.2 (6.5)	47.3 (6.9)
PF	49.4 (6.1)	48.9 (7.2)	47.0 (10.1)	43.6 (9.3)
RP	49.6 (7.5)	49.5 (6.9)	46.2 (12.0)	46.2 (6.7)
BP	47.5 (8.2)	50.1 (8.6)	43.8 (8.2)	44.8 (9.5)
VT	49.8 (5.7)	49.6 (7.1)	47.1 (7.4)	46.2 (6.3)
SF	53.5 (4.2)	51.2 (6.8)	51.9 (7.2)	52.3 (6.0)
MH	54.9 (5.1)	54.2 (5.0)	54.2 (6.6)	55.4 (5.5)
RE	52.7 (3.9)	51.3 (6.6)	50.9 (9.9)	51.6 (7.0)
PCS	45.4 (6.6)	46.7 (6.3)	42.2 (9.6)	40.3* (6.8)
MCS	54.8 (4.7)	52.9 (5.2)	54.4 (7.3)	55.8 (6.8)
EQ-5D	0.90 (0.15)	0.88 (0.16)	0.81 (0.20)	0.80 (0.17)

Values are mean (SD) unless otherwise indicated.

**P < 0.05 versus KL 0,1 by the Tukey Honestly Significant Difference test after adjustment for age, body mass index, cerebral stroke, diabetes mellitus, cardiac disease, and hypertension.*

BP indicates bodily pain; EQ-5D, EuroQol; GH, general health; KL, Kellgren-Lawrence; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; SF-8, 8-Item Short Form Health Survey; VT, vitality.

study, 767 men had completed questionnaires for both the SF-8 and the EQ-5D, so the response rate was 73.7%. Subjects who completed questionnaires may have had better QOL than those who did not, so our results regarding QOL may have represented overestimations. Third, we did not include the onset of VFx in the analysis, although the severity of low back pain often appears to be associated with the interval from onset of VFx. In terms of clinical fractures, we examined the history of fracture, including VFx, in the ROAD study by self-report, and no clinical VFx occurred within the 1 month before baseline examination. However, we could not compare radiographs of the lumbar spine at baseline examination with those before the examination, as subjects had not undergone radiography of the lumbar spine before that examination. We were therefore unable to assess the incidence of subclinical fracture within the 1 month before baseline examination, although clinical and subclinical fractures are associated with lower QOL in women.[29] However, the association between severity of low back pain and the interval from onset of subclinical VFx may be weaker than that for clinical VFx, so the absence of data on the incidence of subclinical VFx may not strongly affect the present results.

In conclusion, the present study revealed that the impact of low back pain was larger than that of knee pain in almost all QOL domains. In men with low back pain, VFx had some association with physical QOL loss. In men with knee pain, KL 4 knee OA was strongly associated with QOL loss. Further progress will elucidate the backgrounds of low back pain and knee pain.

➢ Key Points

- ❑ Low back pain and knee pain are major public health issues causing disability among the elderly men, but there were no population-based studies to compare the impact of low back pain on QOL with that of knee pain in Japanese men.
- ❑ The objective of the present study was to clarify the independent association of low back pain and knee pain with QOL among 767 men using cohorts from ROAD.
- ❑ The impact of low back pain on QOL was larger than that of knee pain. In men with low back pain, there were few associations between KL grade and QOL, whereas VFx was associated with physical QOL, indicating that low back pain with VFx is strongly associated with physical QOL loss.

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