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Progression, incidence, and risk factors for intervertebral disc degeneration in a longitudinal population-based cohort: the Wakayama Spine Study

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SUMMARY

Objective: The present study examined the progression, incidence, and risk factors for intervertebral disc degeneration (DD) throughout the lumbar spine using magnetic resonance imaging (MRI) in a large population-based cohort.
Methods: We followed up 617 subjects for more than 4 years as part of the Wakayama Spine Study. 1) "Progression of DD" in each of the entire, upper (L1/2 to L3/4) and lower (L4/5 and L5/S1) lumbar spine was defined as Pfirrmann grade progression at follow-up in at least one disc in the affected region. 2) "Incidence of DD" in each of these regions was defined if all discs were grade 3 or lower (white disc) at baseline, and at least one disc had progressed to grade 4 or higher (black disc) at follow-up. Logistic regression analyses were used to determine the risk factors for progression and incidence of DD.
Results: DD progression and incidence in the entire lumbar spine were 52.0% and 31.6% in men, and 60.4% and 44.7% in women, respectively. Women was associated with DD progression in the upper lumbar spine (odds ratio [OR] = 1.68, 95% confidence interval [CI] = 1.18–2.42). Aging was associated with the incidence of DD in each region (entire: OR = 1.14, CI = 1.06–1.14; upper: OR = 1.10, CI = 1.05–1.15; lower: OR = 1.11, CI = 1.05–1.19). Diabetes mellitus (DM) was associated with the incidence of DD in the upper lumbar spine (OR = 6.83, CI = 1.07–133.7).
Conclusion: This 4-year longitudinal study is the first to demonstrate DD progression and incidence in the lumbar spine and their risk factors in a large population-based cohort.

Introduction

Low back pain causes functional impairment, diminished quality of life, loss of working ability, and increased health care costs[1–4]. Intervertebral disc degeneration (DD) in the lumbar spine is one of the causes of low back pain[3,4]. Although many studies have been directed at identifying risk factors for DD, aging remains the only established risk factor for DD progression[2–7]. Factors, such as smoking, obesity, diabetes mellitus (DM), hypertension (HT), and physical activity, such as driving and lifting weight, might enhance DD progression[2–15]; however, these associations are still unclear. This may be due to limitations of previous studies, such as insufficient sample size, variability in subject age, ethnicity, and radiological acquisition, and use of a cross-sectional study design[2–15]. Moreover, to our knowledge, no longitudinal study with a large population-based cohort has investigated the progression, incidence, and risk factors for DD in the lumbar spine.

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DD etiology in the lumbar spine is also unclear. Importantly, some investigators have emphasized the importance of examining the upper and lower lumbar spine separately, as they are differentially influenced by genetic, environmental, and metabolic factors[16,17]. However, previous studies have mostly focused on the lumbar spine as a whole, with DD regarded a result of aging and mechanical injuries throughout the entire lumbar spine[2–15]. Thus, the present study aimed to examine the progression, incidence, and risk factors for DD in the entire lumbar spine, in the upper and lower lumbar spine separately, and at each intervertebral level by using a large-scale, population-based study: the Wakayama Spine Study.

Patients and methods

Participants for the Wakayama Spine Study

Our study was based on the Wakayama Spine Study[3,14,18] which was a sub-cohort of the Research on Osteoarthritis/Osteoporosis Against Disability (ROAD) study[19–21]. ROAD participants were recruited from resident registration listings in three communities with varying geographical characteristics: an urban region in I town (Tokyo), a mountainous region in H town (Wakayama), and a coastal region in T town (Wakayama). Upon the second visit of the ROAD study to H and T towns (conducted between 2008 and 2010), 1063 volunteers were recruited for magnetic resonance imaging (MRI). Among the 1063 volunteers, 52 declined to attend the examination; therefore, 1011 inhabitants were recruited for the baseline survey of the Wakayama Spine Study (Fig. 1). The second survey of the Wakayama Spine Study was conducted 4 years after the baseline, and consisted of the same interview, examination, biochemical measurements, and radiographic assessment performed at baseline. Among the 1011 participants who participated in the baseline survey, 275 and 816 were mountainous and coastal region inhabitants, respectively. In this follow-up study, however, we recruited only the 816 coastal region participants because MRI was not performed in the mountainous region during the second survey owing to cost and time.

Inclusion criteria were the ability to walk to the survey site, report data, and provide informed consent. Participants with known spine tumors, infections, chronic inflammatory conditions, posterior spinal fusion operations, MRI-sensitive implanted devices (e.g., pacemakers), and/or other disqualifiers (e.g., pregnancy) were excluded. The Wakayama Spine Study was approved by the local ethics committee of the University of Tokyo, the Tokyo Metropolitan Institute of Gerontology, and Wakayama Medical University. All participants provided written informed consent.

Eligible subjects

We attempted to trace and review all 816 coastal participants in the Wakayama Spine Study by inviting them to attend a follow-up interview and undergo repeated whole-spine MRI. Among them, 23 participants (2.8%) had died by the time of review 4 years later, 6 (0.7%) did not participate in the follow-up study due to poor health, 13 (1.6%) had moved, and 32 (3.9%) did not participate for unknown reasons. Therefore, 755 participants attended the second survey of the Wakayama Spine Study. We also identified participants who attended the second visit but declined MRI because they were not qualified to participate (94 participants). Among the 661 individuals who participated in the follow-up study, we excluded one participant (0.2%) who underwent a posterior spinal fusion surgery and 43 (6.5%) who had incomplete lumbar spine MRI at baseline or follow-up (Fig. 1).

We therefore enrolled 617 participants (75.6% of baseline participants; 178 men) 4 years after the baseline study. The mean age

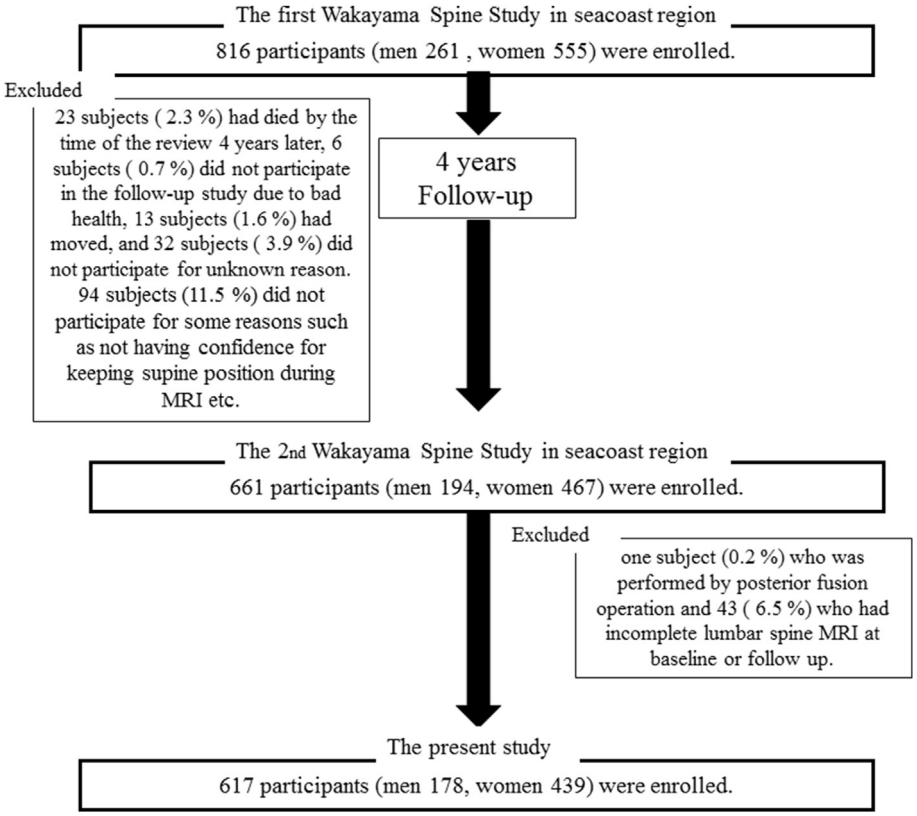

Fig. 1. Flow diagram for the present study.