

CONCISE REPORTS

Radiographic osteoarthritis of the knee classified by the Ahlbäck and Kellgren & Lawrence systems for the tibiofemoral joint in people aged 35-54 years with chronic knee pain

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Abstract

Objectives—To determine the prevalence of tibiofemoral radiographic knee osteoarthritis (OA) in people aged 35-54 years associated with chronic (> 3 months) knee pain using two different radiographic grading systems.

Methods—Population based postal survey in a random sample of inhabitants in a district in southern Sweden followed by clinical examination and plain postero-anterior, weight bearing radiographical examination. The Ahlbäck criteria (focusing on joint space narrowing) and the Kellgren & Lawrence classification for knee OA were used for diagnosing tibiofemoral OA.

Results—A questionnaire was sent to 2000 randomly selected people aged 35-54 years. The response rate was 92.6%. Fifteen per cent of these people reported chronic knee pain. This group (n=279) was offered a clinical and radiographic examination of the knee joint and 204 persons agreed to participate. According to the Kellgren & Lawrence classification 28 subjects had OA of the knee grade 2 or more and 16 grade 3 or more. Radiographically detected OA of the knee according to Ahlbäck was found in 20 cases. The minimum prevalence of radiological tibiofemoral knee OA with knee pain was thus 1.5% for Kellgren & Lawrence grade 2 or more, 0.9% for grade 3 or more, and 1.1% according to the Ahlbäck classification. The agreement between the Kellgren & Lawrence grades 2-3 versus Ahlbäck grade I as well as grade 3-4 versus Ahlbäck grade I-II was good (κ 0.76 and 0.78 respectively).

Conclusion—The prevalence of radiographic tibiofemoral OA combined with chronic knee pain in people aged 35-54 years was around 1% as estimated by either the Kellgren & Lawrence or the Ahlbäck classifications systems. Prospective follow up of this cohort should elucidate the significance of knee pain as a sign of developing OA.

Osteoarthritis (OA) is a common cause of pain and disability in the population and thus of great socioeconomic significance.¹

Radiographic OA of the knee joints is believed to be the most common manifestation of pathology in this joint² and different grading systems have been used, for example, the Kellgren & Lawrence system³ and the Ahlbäck classification.⁴ Depending on the populations studied and the epidemiological techniques used, the prevalence figures for radiographic OA of the knees (with or without symptoms) vary between 14 and 30% (over the age of 45 years).⁵

Between 40 and 80% of subjects with radiographic OA in higher age groups are reported to have symptomatic disease.^{5,6} There is a correlation between the degree of radiographic changes (and thus for age) and the degree of pain and other symptoms.⁷

As most studies in the past have focused on people over 50 years, knowledge about the prevalence of radiographic OA in subjects with knee pain in younger age groups is limited. Furthermore, by identifying middle aged people with knee pain it should be possible to monitor subjects at risk of developing knee joint OA and thus be able to find stages of the disease previously difficult to study. We here describe the prevalence of symptomatic tibiofemoral OA in people aged 35-54 years defined by the Kellgren & Lawrence or the Ahlbäck classification systems.

Methods

STUDY DESIGN

A district in the southwest of Sweden with low migration rate and mixed urban and rural population was chosen to identify a group of people with longstanding knee pain.

The study cohort was formed by sending a questionnaire to 2000 people (963 women and 1037 men), comprising a random sample (evenly distributed for age and sex) from the central population register (covering all inhabitants) of the 5254 persons aged 35-54 years in the district. The 2000 subjects were asked for 'pain in any of your knees practically daily for the last three months' and all with chronic knee

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Table 1 The Ahlbäck classification of radiographic knee OA of the tibiofemoral joint and the Kellgren and Lawrence grading system (adapted)^{3,4}

Ahlbäck grade	Ahlbäck definition	Kellgren & Lawrence grade	Kellgren & Lawrence definition
Grade I	Joint space narrowing (joint space < 3 mm)	Grade 1 'Doubtful'	Minute osteophyte, doubtful significance
Grade II	Joint space obliteration	Grade 2 'Minimal'	Definite osteophyte, unimpaired joint space
Grade III	Minor bone attrition (0–5 mm)	Grade 3 'Moderate'	Moderate diminution of joint space
Grade IV	Moderate bone attrition (5–10 mm)	Grade 4 'Severe'	Joint space greatly impaired with sclerosis of subchondral bone
Grade V	Severe bone attrition (>10 mm)	Grade 4 'Severe'	Joint space greatly impaired with sclerosis of subchondral bone

pain were offered radiographic and clinical examination. Ethical approval was obtained from the Ethics Committee, Lund University.

RADIOGRAPHIC AND CLINICAL EXAMINATION

Posteroanterior radiographs with straight knees in the weightbearing position with the weight equally distributed on both legs were taken. They were read by an experienced radiologist without knowledge of clinical data (after exclusion of those with known causes of knee pain, except OA) and classified blindly on two separate occasions according to the Ahlbäck classification⁵ and the Kellgren & Lawrence system⁴ (table 1). The radiographs were reread (using both methods) by the same observer two weeks later without knowledge of the results of the first readings or other data.

The subjects were examined by the same rheumatologist for effusion and tenderness of their knee joints, a medical history was obtained and based on the clinical findings patients with inflammatory rheumatic diseases were excluded from the prevalence calculations. 'Post-trauma knee pain' was defined by a history of major trauma to the knee, leading to persistence of symptoms despite primary or secondary surgical intervention. 'Unexplained knee pain' was defined as the presence of chronic pain in the knee without any current or former evidence of arthritis or trauma.

STATISTICAL METHODS

Comparisons between groups were performed using the Mann-Whitney U test. A p value <0.05 was considered significant. The 95% confidence intervals (CI) for the prevalence figures were calculated according to the formula: CI= prevalence \pm 1.96 \times SEM of the prevalence using the normal approximation to the binomial. Sex distribution between different groups was analysed by the χ^2 test and interrater agreement was calculated using κ statistics.

Results

With a response rate of 92.6% (1853 of 2000 completed the questionnaire about knee pain), the prevalence of current chronic knee pain

was 15% (279 of 1853) (95% CI=13.38, 16.62). A total of 204 of 279 accepted further examination. The age and sex distribution in this subgroup did not differ significantly from the initial population.

Thirteen of the 204 subjects had arthritides other than OA (rheumatoid arthritis two, psoriatic arthritis two, primary Sjögren's syndrome one, reactive arthritis and other seronegative arthritides four, and unclassifiable synovitis four). Six had chronic knee pain resulting from a defined knee trauma ('post-trauma knee pain'). In the remaining 185 cases no obvious cause of chronic knee pain was found ('unexplained knee pain').

The radiographs of those with 'unexplained pain' (n=185) were graded according to the Kellgren & Lawrence classification where 28 people had OA of the knee grade 2 or more (tables 1 and 2), and the Ahlbäck classification where 18 subjects had OA grade I and two subjects grade II or more (tables 1 and 2). Bilateral radiographic OA according to Ahlbäck was found in four of the 20 cases and according to Kellgren & Lawrence in 7 of 28 with grade 2 or more and 3 of 16 with grade 3 or more.

The prevalence of radiological knee OA with knee pain was 1.5% (28 of 1853) for Kellgren & Lawrence grade 2 or more, 0.9% (16 of 1853) grade 3 or more and 1.1% (20 of 1853) according to the Ahlbäck classification (table 2). Radiographic OA was found in all age groups with 5 of 20 cases in the age group 35–44 years according to Ahlbäck and 9 of 28 with Kellgren & Lawrence grade 2 or more and 4 of 16 with grade 3 or more, respectively.

The agreement between the Kellgren & Lawrence grades 2–3 and Ahlbäck grade I as well as grades 3–4 versus Ahlbäck grades I–II was good (κ 0.76 and 0.78 respectively). The κ value was very good (0.88) for the rereadings according to both classifications.

Discussion

This study shows that knee pain is common in the age group 35–54 with radiographic evidence of OA according to either the Kellgren & Lawrence or the Ahlbäck classifica-

Table 2 Prevalence 1 assuming none of the non-attenders with pain (n=75 of 279) had OA, prevalence 2 assuming that the prevalence of OA was the same in those with pain not attending (75 of 279) as in the group examined (n=204)

Diagnostic group	Number of people with radiographic tibiofemoral OA	Prevalence 1 (%)	Prevalence 2 (%)	Sex (female/male)	Age median (range)	BMI median (range)
Ahlbäck \geq grade 1	20	1.1 (0.63–1.57)	1.4 (0.87–1.93)	10/10	50.0 (38–54)	26.0 (20.3–32.7)
KL \geq grade 2	28	1.5 (0.95–2.05)	2.1 (1.45–2.75)	13/15	49.5 (35–54)	26.0 (20.3–37.5)
KL \geq grade 3	16	0.9 (0.44–1.28)	1.2 (0.71–1.69)	6/10	45.5 (35–54)	25.7 (18.3–28.9)

The figures in parentheses in the prevalence columns denote the 95% CI. KL= Kellgren & Lawrence. The age was significantly higher in the groups with radiographic OA (without any differences between the different groups) according to Ahlbäck and Kellgren & Lawrence grade 3 or more (p<0.05) compared with those without radiographic OA. The BMI values did not differ significantly between any of the groups.

tions in a smaller proportion. It is interesting to note that for most people with chronic knee pain no structural changes were found on radiographs.

Longstanding knee pain (≥ 1 month) in populations aged 55 years or above has been found to be strongly associated with disability, irrespective of underlying diagnosis.⁸

The prevalence of knee pain in the adult population, previously studied mainly without attempt to correlate to the presence of OA have shown prevalence figures of 14.2% for men and 12.7% for women (ages 18–84)⁹ and 17% for men and 23% for women aged 55–59,⁸ respectively. In our study, prevalence figures of 15% show that the problem of chronic knee pain is not restricted to higher ages.

The diagnosis of OA in epidemiological studies is most often based on the results of evaluation of standard radiographs with or without symptoms⁶ where the classification according to Kellgren & Lawrence³ (focusing on osteophytes or joint space narrowing, or both) is the most widely used. The Ahlbäck classification system primarily focuses on reduction of the joint space as an indirect sign of cartilage loss. Joint space narrowing has been suggested as the best variable in assessing radiographic progression of knee OA.^{10,11} The Ahlbäck classification has been used for different studies of knee OA especially in northern Europe^{12,13} but no valid comparisons between the two systems have been performed.¹⁰ In our study, we use the two different systems for identification of subjects estimating prevalence figures of tibiofemoral OA. As the agreement between the two systems was good ($\kappa = 0.76$ and 0.78 respectively), the Ahlbäck system can be used for diagnosing tibiofemoral OA, at least in people aged 35–54 with knee pain.

Only a few studies consider the question of symptomatic radiographic knee OA in middle aged people. In the Chingford population of women aged 45–64 the occurrence of tibiofemoral, symptomatic OA on weight bearing radiographs was 5.8% (grade 2 or more on the Kellgren & Lawrence scale). Data from the NHANES I survey showed for the age group 45–54 corresponding prevalence figures of 1.4/0.2% for Kellgren & Lawrence grade 2 or more and grades 3–4, respectively,⁷ however, the radiographs in this survey were taken under non-weight-bearing conditions. Lawrence *et al* found in a survey of the adult population (in which the radiographic technique was not described in detail) that of the men 0.4/0.1% and of the women 0.5/0.1% (ages 35–44) had OA with pain according to Kellgren & Lawrence (grade 2+ and 3+ respectively).¹⁴ The overall prevalence of symptomatic knee OA in that study in the group aged 35–54 was according to Kellgren & Lawrence 1.2/0.4% (grade 2+ and 3+ respectively). This should be compared with the higher figures of this study where we found a prevalence of symptomatic knee OA (weight bearing radiographs) of 1.5/0.9% (Kellgren & Lawrence grade 2+ and 3+) and 1.1% (Ahlbäck grade \geq I) for the whole group aged 35–54. Interestingly, although radiographic OA was most common

in the higher age groups in this study, 5 of 20 cases according to Ahlbäck were found in people 44 years or younger giving a prevalence of 0.3% and using the Kellgren & Lawrence scale 9 of 28 (grade 2+) and 4 of 16 (grade 3+) respectively were aged 35–44. Thus, presence of radiographic OA in people with longstanding knee pain must be considered also below the age of 45.

The response rate in our study was high (92.6%), but the frequency of participation in the clinical and radiographic examination was lower (73.1% of the initial subjects having knee pain). The method used for estimating minimum prevalence is based on the assumption that those with chronic knee pain not attending x ray examination (75 of 279) had no radiographic OA. However, one main reason for not participating in the examination might be an already diagnosed and treated OA, which would indicate even higher true prevalence figures. If we assume that the prevalence of radiographic OA according to Kellgren & Lawrence (grade 2 or more) is the same in the whole population with chronic knee pain ($n=279$) as in the group examined ($n=28$ of 204), the prevalence of OA combined with chronic knee pain would be 2.1% (table 2).

The radiographic criteria selected for the diagnosis of OA in this study focus on the tibiofemoral joint and no attempt was made to study the patellofemoral joint. Inclusion also of this joint has been advocated recently¹⁵ and in subsequent studies of this cohort, this joint will also be examined. If, however, patellofemoral changes had been included, the prevalence figures of symptomatic knee OA would conceivably have been higher.

Knee pain without radiographic changes could be interpreted as a possible sign of early OA. Prospective follow up of cohorts like the one described, particularly of the people with negative radiographs should offer possibilities to study early phases of developing OA by using novel sensitive techniques such as magnetic resonance imaging, bone scintigraphy, and biochemical markers of cartilage and bone turnover.

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- 1 Badley E, Tennant A. Impact of disablement due to rheumatic disorders in a British population: estimates from the Calderdale Rheumatic Disablement Survey. *Ann Rheum Dis* 1993;52:6-13.
- 2 Slemenda CW. The epidemiology of osteoarthritis of the knee. *Curr Opin Rheum* 1992;4:546-51.
- 3 Kellgren JH, Jeffrey M, Ball J. *Atlas of standard radiographs*. Vol 2. Oxford: Blackwell Scientific, 1963.
- 4 Ahlbäck S. Osteoarthrosis of the knee: a radiographic investigation. *Acta Radiol Stockholm* 1968; (suppl 277):7-72.
- 5 Spector T, Hart D. How serious is knee osteoarthritis? *Ann Rheum Dis* 1992;51:1105-6.
- 6 Spector TD, Hart DJ, Byrne J, Harris PA, Dacre JE, Doyle DV. Definition of osteoarthritis of the knee for epidemiological studies. *Ann Rheum Dis* 1993;52:790-4.
- 7 Davis M, Ettinger W, Neuhous J, Barclay J, Segal M. Correlates of knee pain among US adults with and without radiographic knee osteoarthritis. *J Rheumatol* 1992; 19:1943-9.

- 8 McAlindon TE, Cooper C, Kirwan JR, Dieppe PA. Knee pain and disability in the community. *Br J Rheumatol* 1992;31:189-92.
- 9 Andersson HA, Ejlertsson G, Leden I, Rosenberg C. Chronic pain in a geographically defined general population: Studies of differences in age, gender, social class, and pain localization. *Clin J Pain* 1993;9:174-82.
- 10 Hart DJ, Spector TD. The classification and assessment of osteoarthritis. In: Silman AJ, Symmons DPM, eds. *Classification and assessment of rheumatic diseases: Part I*. London: Baillière Tindall, 1995: 407-32.
- 11 Altman RD, Fries JF, Bloch DA, Carstens U, Cooke TD, Genant H, *et al*. Radiographic assessment of progression in osteoarthritis. *Arthritis Rheum* 1987;30:1214-25.
- 12 Bergström G, Bjelle A, Sundh V, Svanborg A. Joint disorders at ages 70, 75, and 79 years. A cross-sectional comparison. *Br J Rheumatol* 1986;25:333-41.
- 13 Schouten JSAG. A twelve year follow-up study on osteoarthritis of the knee in the general population. Rotterdam: Erasmus University, 1990.
- 14 Lawrence JS, Bremner JM, Bier F. Osteo-arthritis. Prevalence in the population and relationship between symptoms and x-ray changes. *Ann Rheum Dis* 1966; 25:1-24.
- 15 McAlindon TE, Snow S, Cooper C, Dieppe PA. Radiographic patterns of osteoarthritis of the knee joint in the community; the importance of the patellofemoral joint. *Ann Rheum Dis* 1992;51:844-9.