Osteoarthritis and Cartilage (2008) 16, 647–653
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doi:10.1016/j.joca.2007.10.007

Osteoarthritis and Cartilage

International Cartilage Repair Society

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The contribution of selected non-articular conditions to knee pain severity and associated disability in older adults

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Summary

Objective: To estimate the contribution of selected non-articular conditions (NACs) to pain severity and functional limitation in community-dwelling older adults with knee pain.

Design: Population-based, cross-sectional study of 745 adults aged 50 years and over with knee pain. Self-complete questionnaires, clinical history and physical examination were used to identify the presence of selected NACs that could cause pain around the knee. Regression analyses were used to compare levels of knee pain severity (0–20) and functional limitation (0–68) (Western Ontario and McMaster Universities osteoarthritis index physical function subscale [WOMAC-PF]), between those with one or more NACs and those with none (NACs-absent).

Results: Two hundred and seventy-three (36.6%) participants had at least one NAC: widespread pain, $n = 159$; low back pain with index leg referral, $n = 102$; full-leg pain, $n = 88$; hip arthritis, $n = 65$; prepatellar, infrapatellar or pes anserine bursitis, $n = 35$. The NACs group had significantly higher levels of pain severity and functional limitation than the NACs-absent group: 8.2(±4.6) vs 5.4(±3.8) and 27.9(±15.8) vs 16.8(±13.2), respectively. The groups did not differ with respect to severity of radiographic osteoarthritis (ROA). Having one or more NACs accounted for a significant proportion of the variance in WOMAC scores, above that which could be explained by age, gender, body mass index and severity of ROA.

Conclusion: NACs appear to be common in older adults with knee pain. They make a significant contribution to knee pain severity and functional limitation and are likely to represent additional, rather than alternative, causes of knee pain/functional limitation to osteoarthritis (OA). These factors should be taken into account in epidemiological studies of knee pain and OA.
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Key words: Knee pain, Knee pain causes, Knee osteoarthritis, Referred pain, CAS(K).

Background

Knee pain is commonplace in older adults in the community and is often associated with significant disability[1,2]. Much of this pain is assumed to be due to osteoarthritis (OA)[3], which is the third most common diagnosis made in primary care[4]. Indeed, joint pain in older adults is often used in epidemiological research as a proxy for OA. It is clear, however, that there is a range of conditions, affecting structures external to the knee joint proper, that may give rise to pain in and around the knees of older adults. These may be characterised as 'non-articular conditions' (NACs), and include referred pain from the low back[5–7] and hip[8–10], bursitides[11], generalised lower limb pain in conditions such as peripheral vascular disease[12], and widespread body pain[13]. Any one of these may provide alternative explanations, or make additional contributions to knee pain severity and associated disability. The failure to account for these may partly explain the commonly observed discordance between radiographic OA (ROA) and pain severity in epidemiological studies[14]. This cross-sectional analysis aims to describe the occurrence of selected NACs in community-dwelling older adults with knee pain. It further aims to describe the characteristics of individuals with each of these NACs. Finally, the contribution of the NACs to knee pain severity and associated disability will be assessed.

Method

THE CLINICAL ASSESSMENT STUDY OF THE KNEE – CAS(K)

The sample investigated for this study consisted of participants in the baseline phase of the Clinical Assessment Study of the Knee (CAS(K)). The CAS(K) is a population-based prospective observational cohort study of 819 individuals, aged 50 years and over, registered with three general practices. The study was approved by North Staffordshire Local Research Ethics Committee. Full details of the study design, methods and recruitment have been previously presented[15–17]. Briefly, a two stage postal survey, consisting of one general health questionnaire and one regional pains questionnaire, was sent to all adults aged 50 years and over who were registered with the three practices. Most people in the UK are registered with general practices, so this provides a convenient sampling frame for studies of the general population. Between August 2002 and September 2003, 3106 respondents to both questionnaires, who reported having experienced some pain in the knee in the last year, were invited to attend a research clinic at a local hospital. The clinic included a standardised clinical interview and physical examination and plain radiographs of both knees. The standardised clinical interviews and physical examinations were carried out, in each instance, by one of six research therapists who had been licensed for a median of 10.5 years (range 8–12 years). Each of these therapists received several hours of training in the standardised clinical interview and physical examination. Each was provided with a detailed Observer Manual, which contained in-depth protocols for the clinical interview and examination, for reference during the entire study period. Quality control sessions were arranged with each examiner after every 100 patients recruited to the study.

Participants were excluded from the analysis if they had not experienced knee pain within 6 months prior to clinic attendance, had a pre-existing

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Received 7 August 2007; revision accepted 7 October 2007.

Table I
Definitions of non-articular causes of knee pain

Non-articular cause	Defining features	Source
Full-leg pain in the index leg	Pain in both the thigh and lower leg on the index side	Body pain manikin
Widespread pain*	Pain in the axial skeleton or lower back and in at least two sections of two contralateral limbs	Body pain manikin
Suspected hip arthritis in the index leg†	Hip pain and a range of passive internal hip rotation of $\leq 23°$	Body pain manikin and physical exam
LBP with suspected index leg referral‡	LBP with posterior thigh or calf pain in the index leg	Body pain manikin
Suspected bursitides in the index leg	Pain, tenderness and swelling in one or more of the following sites: • Prepatellar • Infrapatellar • Pes anserinus	Record of pain from clinical interview and swelling and tenderness from physical examination

*After Macfarlane *et al.*[32].
†After Birrell *et al.*[33].
‡After Papageorgiou *et al.*[34].

diagnosis of inflammatory arthropathy in the medical records, had a total knee replacement in their most affected leg, or had incomplete X-ray data.

PLAIN X-RAYS

Three views of the knees were obtained for each participant at clinic; the weight-bearing posteroanterior (PA) semiflexed/metatarsophalangeal (MTP) view according to the Buckland-Wright protocol[18], a skyline view and a lateral view. The latter two views were obtained in the supine position with the knee flexed to 45°.

A single reader, blinded to all other information on participants scored all films. Films were scored for individual radiographic features, including osteophytes, joint space width, sclerosis, subluxation and chondrocalcinosis. The Altman Atlas[19] and scoring system[20] were used for the PA and skyline views and the Burnett Atlas[21] for the lateral view. Additionally, PA and skyline views were assigned a Kellgren and Lawrence (K&L) grade[22].

The presence of any ROA in the knee joint was defined as: K&L score ≥ 2 in the PA and/or K&L score ≥ 2 in the skyline and/or the presence of superior and/or inferior patella osteophytes on the lateral and/or the presence of posterior tibial osteophytes on the lateral view. The definition of moderate/severe ROA was based on the worst score at any location within each knee e.g., if a participant scored PA K&L $= 3$, skyline K&L $= 2$, lateral osteophytes $= 0$ and posterior osteophytes $= 2$, they were assigned to the moderate/severe group. The definitions of radiographic severity used for the whole knee joint have been previously published[23,24].

DEFINITIONS OF NON-ARTICULAR CONDITIONS RELEVANT TO KNEE PAIN

Data derived from the participants' shading of a manikin to denote any pains they might have experienced for a day or longer in the past 4 weeks, in combination with the results of the standardised physical examination and interview, were used to determine individual participants' membership of the following five Non-articular conditions ("NACs") (Table I). In each case, the knee that the participant identified as their affected or more-affected was designated the 'index knee', with the ipsilateral leg being likewise designated the 'index leg'.

Participants who did not satisfy the criteria for any of the NACs were defined as having no identifiable NACs ("NACs-absent").

STATISTICAL ANALYSIS

Descriptive characteristics were calculated for all eligible participants on a range of psychological, clinical and radiographic features. These included age and gender; the severity of knee pain (11-point numerical rating scale [NRS]) and of disability (Western Ontario and McMaster Universities Osteoarthritis Index physical function subscale [WOMAC-PF][25] and the Chronic Pain Grade [CPG][26]); temporal aspects of knee pain (time since onset of current problem and persistence of pain); physical examination findings (body mass index [BMI] and point tenderness around the index knee), severity of ROA (none, mild, and moderate/severe) and anxiety and depression

Table II
Demographic characteristics of all responders to the questionnaires who reported knee pain and of all research clinic attendees

	n (%)	
	Reported knee pain in last 12 months ($n = 3106$)	Attended research clinic ($n = 819$)
Age (years)		
50–59	898 (29)	236 (29)
60–69	964 (31)	312 (38)
70–79	822 (26)	222 (27)
80+	422 (14)	49 (6)
Gender		
Female	1832 (59)	440 (54)
Male	1274 (41)	379 (46)
Marital status		
Married/co-habiting	1985 (65)	599 (74)
Divorced/separated	219 (7)	45 (6)
Widowed	705 (23)	137 (17)
Single	153 (5)	27 (3)
Higher education		
Yes	327 (11)	117 (15)
No	2685 (89)	684 (85)
Employment status		
Employed	668 (22)	167 (21)
Retired	1760 (59)	481 (61)
Unable due to illness	299 (10)	76 (10)
Unemployed	31 (1)	9 (1)
Housewife	187 (6)	46 (6)
Other	53 (2)	15 (2)
Occupational class		
Higher managerial	92 (3)	55 (7)
Higher professional	39 (1)	16 (2)
Lower managerial/ professional	303 (11)	122 (16)
Intermediate	302 (11)	108 (14)
Self-employed	174 (6)	52 (7)
Lower supervisory/ technical	213 (8)	63 (8)
Semi-routine	712 (25)	190 (25)
Routine	979 (35)	167 (22)

(Hospital Anxiety and Depression Scale [HADS][27]). These descriptive characteristics were examined in the whole cohort and for those groups of participants who satisfied each set of criteria for the five NACs. Next, the descriptive characteristics of those participants who had at least one NAC (the NACs group) were statistically compared with those of the NACs-absent group (categorical data: chi-square tests; continuous data: *t* test for normally distributed data; Mann–Whitney *U* test for discrete data). Finally, in a sensitivity analysis, the characteristics of the NACs and NACs-absent groups were visually compared according to whether any ROA was present in their index knee.

Linear regression analysis was used to examine the associations between self-reported pain and disability levels on the one hand, and the presence of each NAC and ROA severity on the other. These analyses were repeated in those individuals without any anxiety or depression in order to ascertain the role of psychological affect on these associations.

Results

Table II shows the demographic characteristics of the research clinic attendees, alongside those of all the respondents who reported knee pain in the last 12 months ($n = 3106$). This comparison demonstrates that over 80-year-old, females, people who were not married or co-habiting and people with lower educational attainment or from lower socioeconomic groups were relatively under-represented in the clinical assessment study sample.

A total of 745 of 819 participants were eligible for inclusion (reasons for exclusion: no knee pain in last 6 months ($n = 32$), pre-existing diagnosis of inflammatory disease ($n = 16$), total knee replacement in index knee ($n = 15$), incomplete X-ray data ($n = 11$)). They had a mean age of 65.3 years (standard deviation [SD], 8.6 years), 54.2% of them were female and 68.4% had ROA according to our definition. Nevertheless, the large majority of all participants had non-persistent pain, defined as pain of less than 90 days duration in the last 6 months (73.4%), and low levels of disability, defined as a CPG of I or II (80.4%).

Of these 745 individuals, 273 (36.6%) satisfied the criteria for at least one of the selected NACs. The most common was widespread pain ($n = 159$), followed by low back pain (LBP) with suspected index leg referral ($n = 102$). By far the least common was the suspected bursitides (prepatellar bursitis, $n = 11$; infrapatellar bursitis, $n = 24$; and pes anserine bursitis, $n = 11$), together accounting for only 35 cases (4.6%). Descriptive statistics for participants with each of the NACs are given in Table III (the suspected bursitides are considered together as one category); descriptive statistics for the whole cohort of 745 individuals are also given for comparison. Those individuals with full-leg pain or LBP with suspected index leg referral were the least likely to have ROA (57% and 61%, respectively, compared to 69% of those in the NACs-absent group). By contrast, those with suspected bursitides were most likely to have ROA (71%). This latter group was predominantly female (71.4%); they were most likely to have had a long-standing problem (57%) and tended to rate the severity of their pain more highly than those in any other group (mean pain on 0–10 NRS = 5.0; SD, 2.6).

Forty-three percent ($n = 117$) of the NACs group satisfied the definitions for more than one NAC (Fig. 1). To determine whether or not this occurred by chance, chi-square tests for association between each of the five groups were carried out (Table IV). These revealed significant associations for suspected bursitides with widespread pain, full-leg pain and LBP with suspected index leg referral, although considerable caution must be taken in interpreting these results in view of the small number of individuals that are being dealt with here ($n = 35$). They also revealed a significant association for full-leg pain and LBP with suspected index leg referral, suggesting that many cases of full-leg pain (i.e., pain both above and below the knee) may be due to referred LBP.

Table V provides descriptive statistics separately for the NACs and NACs-absent groups, together with the results of statistical tests of differences and associations. The NACs group had higher mean levels of pain severity/persistence and physical functional limitation/disability than the NACs-absent group (mean WOMAC pain: 8.2 vs 5.4; duration of pain ≥ 90 days: 33% vs 23%; mean WOMAC-PF: 25.9 vs 14.4; high disability [CPG III or IV]: 35% vs 11%). It also contained a higher proportion of individuals with definite anxiety or depression (definite anxiety: 25% vs 12%; and definite depression: 13% vs 3%). There was, however, no significant difference between the two groups in terms of the proportion with radiographic knee OA (69% vs 67%, $P = 0.51$).

The results of the sensitivity analysis are presented in Table VI. This table demonstrates that mean levels of

Table III

Summary descriptive statistics for the whole cohort of eligible participants and the five groups of individuals with non-articular conditions

	Whole cohort ($n = 745$)	Full-leg pain ($n = 88$)	Widespread pain ($n = 159$)	Suspected hip arthritis ($n = 65$)	LBP with suspected index leg referral ($n = 102$)	Suspected bursitides ($n = 35$)
Age (years)	65.3 (8.6)	65.3 (8.4)	63.7 (8.3)	65.5 (8.6)	65.1 (9.2)	67.9 (8.8)
% Female	54.2	61.4	62.5	49.2	59.8	71.4
BMI	29.6 (5.2)	30.3 (5.3)	31.1 (5.6)	31.3 (6.0)	30.7 (6.1)	32.4 (7.8)
% ROA	68.4	56.8	65.6	69.2	60.8	71.4
% ROA severity						
Mild	29.2	23.8	29.3	27.7	28.4	14.3
Moderate/severe	39.2	33.0	36.3	41.5	32.4	57.1
Pain (NRS)	3.3 (2.7)	4.2 (3.2)	4.1 (3.0)	4.6 (3.2)	4.1 (3.0)	5.0 (2.6)
WOMAC pain	6.4 (4.4)	9.3 (4.6)	8.5 (4.7)	8.7 (5.3)	8.7 (5.0)	8.6 (4.1)
% Duration ≥ 90 days	26.6	37.5	38.8	35.4	30.4	37.1
WOMAC function	18.6 (16.6)	31.0 (17.3)	28.9 (17.1)	29.0 (18.5)	27.1 (19.2)	25.8 (15.0)
% High disability (CPG III/IV)	19.6	43.2	39.6	33.8	38.2	37.1
% Time since onset > 10 years	32.7	26.1	35.0	32.3	31.4	57.1
% New problem in last year	12.3	11.4	6.3	10.8	8.8	2.9
% Definite anxiety	16.6	27.4	28.6	20.0	27.3	24.2
% Definite depression	6.5	16.7	17.5	15.0	16.2	6.1
% Tenderness count > 2	29.8	37.5	44.4	41.5	42.2	77.1

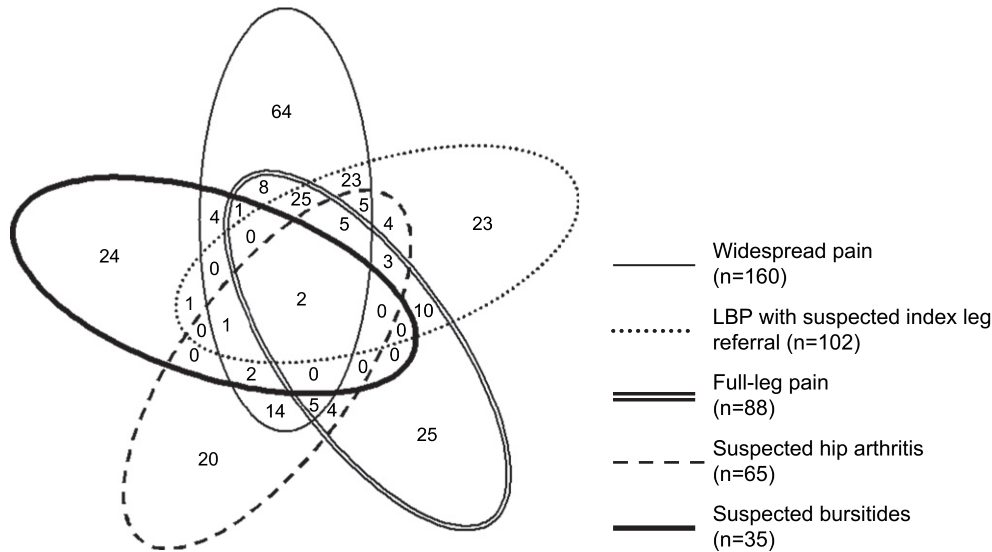

Fig. 1. Venn diagram of the distribution of the non-articular conditions across the five groups.

self-reported pain and disability were systematically higher in those participants with radiographic knee OA than in those without ROA, regardless of whether or not they had one of the NACs. Pain and disability levels were highest of all for the subgroup with concurrent NACs and radiographic knee OA.

A linear regression model, with ROA severity as the independent variable, was able to predict 3% of the variance in WOMAC pain scores ($R^2 = 0.03$), after adjusting for age, gender and BMI. The addition of a single variable to represent the presence or absence of one or more NACs accounted for a further 11% of the adjusted variance in WOMAC pain, but the relative importance of ROA severity to the model remained unaffected (standardised beta coefficients of 0.21 and 0.24, respectively) (Table VII), suggesting that these NACs do not confound or explain the relationship between radiographic severity of OA at the knee and reported pain severity. Similar findings were obtained in modelling to predict WOMAC physical function (Table VIII).

When these analyses were repeated in the subset of individuals without anxiety or depression (HADS anxiety and depression scores both <8), the contributions of ROA to the models remained unaffected but the contributions of the NACs were found to be less (3% of the variance in WOMAC pain scores, compared to 14%; and 4% of the variance in WOMAC-PF scores, compared to 18%), suggesting that the association between these NACs and pain and disability may be partly mediated by psychological distress.

Discussion

OA is thought to be the single greatest cause of regional musculoskeletal pain in older adults[28]. Although the current concept of OA encompasses the whole joint, it is not the only cause of symptoms in and around the knee. Differentiating painful OA from other causes of joint pain is recognised as a common challenge in clinical practice[3]. Yet epidemiological studies of joint pain in the elderly have not generally attempted to differentiate between the various causes. This study suggests that non-knee joint causes of knee pain may be commonplace in community-dwelling older adults with knee pain but that their occurrence is generally unrelated to the presence or severity of underlying radiographic knee OA. NACs appear to make a significant contribution to reported levels of pain and disability although anxiety and depression may act either as a mechanism or a confounder of this association.

A relatively high number of our sample (21%) satisfied the Manchester definition of widespread pain, where chronicity was not taken into account. This requires that pain be reported in at least two sections of two contralateral limbs and in the axial skeleton. This figure may not be inordinately high when one considers the reported prevalences of multiple musculoskeletal regional pains and of back pain in other studies. For instance, 66% of the 4029 responders in the Tameside population-based postal survey reported pain in more than one regional anatomical site, while Wolfe *et al.* found that 55% of patients with OA of the knee suffered from back pain also[29,30]. For the same reason,

Table IV
Cross-tabulation showing likelihood ratios (LR) for the associations (chi-square) between individual non-articular conditions in the 273 participants with at least one non-articular condition (significant associations are in bold type)

Full-leg pain	LR = 0.36 (P = 0.55)	LR = 0.20 (P = 0.55)	**LR = 10.4 (P = 0.001)**	**LR = 12.5 (P < 0.001)**
	Widespread pain	LR = 1.23 (P = 0.27)	**LR = 0.16 (P = 0.69)**	**LR = 14.5 (P < 0.001)**
		Suspected hip arthritis	LR = 1.6 (P = 0.20)	LR = 2.2 (P = 0.14)
			LBP with suspected index leg referral	**LR = 13.5 (P < 0.001)**
				Suspected bursitides

Table V
Summary descriptive statistics for participants with and without non-articular conditions

	No NACs ($n = 472$)	At least one NAC ($n = 273$)	Statistical tests with P values (two-tailed)
Age (years)	65.3 (8.6)	65.1 (8.6)	t (754) = −0.65, NS†
% Female	48.1	59.0	χ^2 (1) = 4.14, $P < 0.05$*
BMI	29.0 (4.7)	30.8 (5.9)	t (466) = 4.32; $P < 0.0005$†
% ROA	69.3	67.0	χ^2 (1) = 0.51, NS*
% ROA severity			
Mild	29.9	28.2	
Moderate/severe	39.4	38.8	
Pain (NRS)	2.9 (2.5)	3.9 (2.9)	$z = -4.57$, $P < 0.0005$‡
WOMAC pain	5.4 (3.8)	8.2 (4.6)	t (476) = 8.4; $P < 0.0005$†
Duration ≥ 90 days	23.3	33.3	χ^2 (1) = 9.46, $P < 0.005$*
WOMAC function	16.8 (13.2)	27.9 (15.8)	t (489) = 9.2; $P < 0.0005$†
% High disability (CPG III/IV)	10.8	34.8	χ^2 (1) = 57.2, $P < 0.0005$*
% Time since onset > 10 years	32.0	35.2	χ^2 (1) = 1.09, NS*
% New problem in last year	13.3	10.6	χ^2 (1) = 1.18, NS*
% Definite anxiety	12.0	24.8	χ^2 (1) = 19.17, $P < 0.0005$*
% Definite depression	2.6	13.4	χ^2 (1) = 31.20, $P < 0.0005$*
% Tenderness count > 2	23.7	40.3	χ^2 (1) = 24.08, $P < 0.0005$*

*Chi-square.
†*t* test (separate variances).
‡Mann−Whitney *U* test.

relatively high prevalences of LBP with index leg referral (14%) − defined as posterior thigh and calf pain in the index leg − and full-leg pain (12%) − defined as pain anywhere in both the thigh and the calf − are not surprising.

Of all the NACs investigated in our study, participants with suspected bursitis showed the highest prevalence of ROA (71%). Eighty percent of these had moderate or severe ROA. This group was also pre-eminent in the extent to which it had the highest prevalence of individuals with a long-standing knee problem (57% reported a problem duration of greater than 10 years) and, inversely, the lowest prevalence of individuals with a new knee problem (3% reported that their knee problem had started in the previous 12 months). This suggests that bursitides are more likely to occur in the more advanced stages of knee OA. We must be cautious in drawing such conclusions for several reasons, however. Not least is the fact that this group contained only 35 individuals and inferences made on the basis of such a small number are hazardous. Further, a high multiple point tenderness count for the majority of these individuals (77% reported tenderness at three or more sites around the knee out of a total of six sites palpated, together with a high prevalence of multi-site periarticular swelling (46% had swelling at two or more of the three bursal sites we identified)) when both of these factors were defining requisites of this group might mean that, rather than consisting mostly of individuals with frank bursitides, this group was largely made up of individuals with diffuse swelling around the knee and a concomitantly low pressure−pain threshold.

A further note of caution should be sounded regarding inferences drawn on the basis of the descriptive profiles of the

Table VI
Summary descriptive statistics for the non-articular conditions (NACs) group and the no-identifiable NACs (NACs-absent) group by the presence or absence of ROA

	NACs-absent		At least one NAC	
	ROA ($n = 327$)	No ROA ($n = 145$)	ROA ($n = 183$)	No ROA ($n = 90$)
Age (years)	66.7 (8.5)	62.2 (8.0)	66.6 (8.8)	61.9 (7.1)
% Female	46.8	63.4	53.0	28.9
BMI	29.6 (4.6)	27.7 (4.6)	31.5 (6.1)	29.3 (5.1)
ROA severity				
Mild	43.1	−	42.1	−
Moderate/severe	56.9	−	57.9	−
Pain (NRS)	3.3 (2.6)	2.1 (2.1)	4.2 (3.0)	3.4 (2.7)
WOMAC pain	5.9 (3.9)	4.1 (3.3)	8.9 (4.7)	6.8 (4.0)
Pain duration ≥ 90 days (last 6/12)	27.2	14.5	37.7	24.4
WOMAC function	19.3 (13.4)	10.9 (10.9)	29.9 (15.9)	23.8 (14.8)
% High disability (CPG III/IV)	12.8	6.2	38.8	26.7
% Time since onset > 10 years	35.8	23.4	40.4	24.4
% New problem in last year	9.8	21.4	8.2	15.6
% Definite anxiety	10.8	14.8	25.7	23.0
% Definite depression	2.8	2.1	13.1	13.8
% Tenderness count > 2/6	26.6	17.2	39.3	42.2

Table VII
Standardised beta coefficients for each of the models to predict WOMAC pain scores, after adjusting for age, gender and BMI ($n = 689$)

	Model 1 ($R^2 = 0.03$)	Model 2 ($R^2 = 0.14$)
ROA severity	0.20	0.24
Non-articular conditions	–	0.54

Model 1, ROA severity; model 2, ROA severity and NACs.

individual NACs. There is a considerable overlap between the five groups, as Fig. 1 demonstrates, with 43% of the NACs group satisfying the definitions of more than one of the five NACs that we identified. Furthermore, the results of the analyses of associations between the individual NAC groups revealed that there are high levels of dependence between some of the groups, demonstrating that many of the individuals satisfying the criteria for more than one group were unlikely to have done so merely by chance (Table III). The results of these analyses suggest that the group identified according to our criteria as having suspected bursitides are unlikely to contain many individuals with a discrete diagnosis: likelihood ratios (LRs) for also fulfilling the criteria for other non-articular definitions ranged from 12.4 to 14.6, with only the suspected hip arthritis group showing a non-significant association with the suspected bursitides group. Of the remaining six potential pairings, only full-leg pain/LBP with suspected index leg referral demonstrated a significant association ($LR = 10.4$, $P = 0.001$), with 44% of those with LBP with suspected index leg referral having full-leg pain also (i.e., pain in both the thigh and lower leg). This overlap is, of course, a function of these broad definitions, whose diagnostic accuracy has not been established, and serves to highlight their limitations as tools for diagnostic subgrouping.

Where all the NACs were considered together as one group, and the summary descriptive statistics for this group were compared with those of the NACs-absent group, certain trends could be identified. Measures of pain severity/persistence and physical functional limitation/disability were found to be higher for the NACs group than for the NACs-absent group. This suggests that NACs might make a significant contribution to the severity of pain and associated disability experienced by older adults with knee pain. Indeed, the finding that the existence of NACs was a far stronger predictor of pain and functional self-reports than radiographic disease severity implies that the presence of NACs should be considered in epidemiological studies of joint pain and OA alongside traditional interest in radiographic characteristics.

Similar levels of radiographic severity across the two groups suggested that the NACs are not alternatives to OA at the knee. This was confirmed by the regression analyses, which demonstrated that however weak the correlation between radiographic disease severity and self-reports of pain severity and functional limitations may be, the existence of NACs does not confound it or explain it away. So the contribution of structural changes seen on plain X-rays to the pain and disability experiences of older adults with knee pain is independent of whether or not people have NACs, and people with potential non-articular causes of their knee pain would seem to be just as likely to have OA changes as those with an absence of NACs. It is, therefore, likely that the NACs are additional, rather than alternative, causes of knee pain and disability. Highest levels of pain and disability in the subgroup of individuals with NACs and ROA would tend to support this conclusion.

Table VIII
Standardised beta coefficients for each of the models to predict WOMAC physical function scores, after adjusting for age, gender and BMI ($n = 692$)

	Model 1 ($R^2 = 0.03$)	Model 2 ($R^2 = 0.18$)
ROA severity	0.21	0.26
Non-articular conditions	–	0.60

Model 1, ROA severity; model 2, ROA severity and NACs.

There are two linked limitations to the conclusions we have drawn here. Firstly, is the fact that the criteria we have used here to define the NACs are heavily dependent on self-reports of pain location. Secondly, is the fact that cross-sectional studies such as this cannot establish cause and effect; all they can do is to describe associations. These two factors mean that any conclusions regarding the differential pain- or self-reported function-levels of the NACs and NACs-absent groups could be confounded by psychological affect. So, although the NACs group was associated with higher mean scores for pain and functional limitation, and higher percentages of individuals with persistent symptoms and definite disability, higher levels of anxiety and depression in this group may have mediated these effects. In such a scenario, higher levels of psychological distress would result in both more widespread pain reporting (with a concomitantly greater likelihood of satisfying the inclusion criteria for one of the NACs) and higher levels of pain and physical functional limitation. A repetition of the regression analyses in the subset of individuals without anxiety or depression confirmed the involvement of anxiety and depression in the relation between NAC group membership and pain and physical functional limitation. The conclusion that much of the apparent pain and disability associated with the non-articular causes of knee pain is due to psychological affect does not necessarily follow, however. It is well recognised that pain and functional limitation may occasion anxiety and depression, and that measures of psychological distress tend to be higher in knee OA patients with other non-knee causes of pain, such as LBP[30]. A plausible alternative conclusion, therefore, is that it is the impact of non-articular causes of knee pain that results in both increased levels of pain and disability and an associated increase in psychological distress.

The extent to which knee pain in older adults in the community may be caused by referral from other anatomical sites is an important question[31]. This study demonstrates that potentially non-articular causes of knee pain are commonplace amongst adults of 50 years of age and above, both with and without radiographic evidence of OA. They seem to make a significant contribution to the knee pain and associated disability experienced by these people, above and beyond that which can be explained by radiographic disease severity alone. It is, therefore, likely that, in many cases, these potential non-articular causes represent additional, rather than alternative, causes of knee pain and disability to OA. For epidemiological research this highlights the drawback of treating joint pain in older adults as a proxy for OA. In fact, such joint pain may reflect a mixture of conditions that independently contribute to self-reported pain severity and functional limitation. Although based at the epidemiological level, these findings also reinforce the clinical message that all joint symptoms in older adults should not be automatically attributed to OA or intra-articular pathology.

Conflict of interest

None of the authors of this paper have any financial and personal relationships with other people or organisations that could inappropriately influence (bias) their work.

Acknowledgements

The authors would like to acknowledge the contributions of Dr Krysia Dziedzic, June Handy, Charlotte Clements, Jonathan Hill, Helen Myers, Dr Ross Wilkie, Dr Jacqueline Saklatvala, Carole Jackson, Julia Myatt, Janet Wisher, Sue Stoker, Sandra Yates and Kath Hickson to aspects of the conception and design of the study and to the acquisition of data. We gratefully acknowledge Professor Chris Buckland-Wright for advice and training on the radiographic techniques. The authors would also like to thank the administrative and health informatics staff at Keele University's Primary Care Musculoskeletal Research Centre, and the staff and patients of the participating general practices.

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