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Lumbar spine radiographic features and demographic, clinical, and radiographic knee, hip and hand osteoarthritis: The Johnston County Osteoarthritis Project

Adam P. Goode, DPT, PhD[†] **[Assistant Professor]**,
Department of Community and Family Medicine Duke University

Stephen W. Marshall, PhD [Professor],
Department of Epidemiology University of North Carolina

Jordan B. Renner, MD [Professor],
Department of Radiology University of North Carolina

Timothy S. Carey, MD, MPH [Professor],
Director Cecil G. Sheps Center University of North Carolina

Virginia B. Kraus, MD, PhD [Professor],
Department of Rheumatology Duke University Medical Center

Debra E. Irwin, PhD, MSPH [Research Associate Professor],
Department of Epidemiology University of North Carolina

Til Stürmer, MD, MPH, PhD [Professor], and
Department of Epidemiology University of North Carolina

Joanne M. Jordan, MD, MPH [Professor]
Department of Medicine, Orthopedics, and Epidemiology Division of Rheumatology, Allergy and Immunology University of North Carolina

Abstract

Objective—1) To determine the prevalence of lumbar spine individual radiographic features (IRF) of disc space narrowing (DSN), osteophytes (OST) and facet joint osteoarthritis (FOA). 2) To describe the frequencies of demographic, clinic and radiographic knee, hip and hand osteoarthritis (OA) across lumbar spine IRF. 3) To determine factors associated with lumbar spine IRF.

Methods—A cross-sectional study of 840 participants enrolled in the Johnston County OA Project (2003-4). Sample-based prevalence estimates were generated for each lumbar spine IRF. Associations between lumbar spine IRF and demographic, clinical and peripheral joint OA were determined with logistic regression models.

Results—Sample-based prevalence estimates were similar for DSN (57.6%) and FOA (57.9%) but higher for OST (88.1%) with significant differences across race and gender. Hand and knee OA frequencies increased across IRF whereas the effect was absent for hip OA. African Americans had lower odds of FOA (adjusted odds ratio [aOR]=0.45 (95% CI 0.32, 0.62)) while

Corresponding Author: Adam Goode PT, DPT, PhD DUMC 104002, Durham, NC 27708 Adam.goode@duke.edu 919-357-1039 .
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there was no racial association with DSN and OST. Low back symptoms were associated with DSN (aOR=1.37 (95% CI 1.04, 1.80)) but not OST or FOA. Knee OA was associated with OST (aOR=1.62 (95% CI 1.16, 2.27)) and FOA (aOR=1.69 (95% CI 1.15, 2.49)) but not DSN. Hand OA was associated with FOA (aOR=1.67 (95% CI 1.20, 2.28)) but not with DSN or OST. No associations were found with hip OA.

Conclusion—These findings underscore the importance of analyzing lumbar spine IRF separately as the associations with demographic, clinic and radiographic knee, hip and hand OA differ widely.

Keywords

lumbar spine; knee osteoarthritis; hip osteoarthritis; hand osteoarthritis

Lumbar spine degenerative changes are common and increase in frequency with aging.[1] Degenerative changes in the spine are typically identified as individual radiographic features (IRF) such as disc space narrowing (DSN), vertebral osteophytes (OST) and facet joint osteoarthritis (FOA). The prevalence of lumbar spine degenerative changes varies. Differences in study sample ages and operational definitions in the severity of the condition are the most likely reasons for these variations.[2] The community-based (mean age of >65 years) prevalence of DSN has been estimated to be between 50-64% whereas vertebral OST have prevalence estimates between 75-94%.[3-5] Facet joint osteoarthritis (OA) is a multifactorial process thought to be an indirect result of DSN;[1,6] however, to our knowledge the communitybased prevalence of radiographic FOA has not been reported.

Community-based studies describing differences in gender and race within lumbar spine IRF are limited. Previous studies have identified that men have more prevalent osteophytes than women.[3-5,7] Pye and colleagues[5] found no differences in the prevalence of DSN between men and women while others have found the prevalence to be higher among women[3,4]. No studies have addressed gender differences with plain film radiographic FOA. Racial differences have been found to exist in spine related health services utilization[8] and diagnostic imaging procedures[9-11]. The causes of these disparities are complex and poorly understood.[9] One way to improve this understanding is to determine whether racial differences exist for lumbar spine IRF, but this has not been previously examined or reported.

The association between plain film radiographs and low back pain is complex.[1] Disc space narrowing has been associated with low back pain[3-5] whereas the association between low back pain and OST is debated.[3-5,7] Facet joint OA continues to be discussed as a source of low back pain, and the utilization of interventions to treat facet joint pain continues to rise.[12] Recent work however has demonstrated no clear relationship between computed tomography (CT) identified-FOA and low back pain.[13] Clinical guidelines indicate that plain film radiographs are a reasonable first imaging technique for patients seeking care for low back pain.[14] In spite of this, the relationship between plain film radiographic FOA and low back pain has yet to be established in a community-based population.

The lumbar spine may not share the same etiologic process of degeneration as the hand, hip and knee,[15] suggesting that the disease process may differ both between and within subtypes of OA. Horvath and colleagues[16] found that Kellgren-Lawrence (K-L)[17] graded hip and knee OA was greater among participants with spinal degeneration than those without. However, their study consisted of a limited sample size of a younger (mean age of 46.1 years) Hungarian population in which many were without lumbar spine, hip and knee degenerative changes.

Previous studies have not examined the relationship between plain film radiograph-identified DSN, OST and FOA and within demographic, clinical and concomitant knee, hip and hand OA groups. Therefore, there are three primary objectives to these analyses: 1) to determine the sample-based prevalence of lumbar spine IRF in a bi-racial community-based population; 2) to describe the frequency of demographic, clinical and radiographic concomitant knee, hip and hand OA factors across severity or presence of the different lumbar spine IRF; 3) to determine which factors are independently associated with lumbar spine IRF. We hypothesized that differences in frequencies and associations within and between lumbar spine IRF would exist and might provide insight into the extent to which the process of degenerative changes differs in the lumbar spine.

Materials and Methods

Participants

Data for these analyses came from participants enrolled in the Johnston County (JoCo) OA Project. Details of the sampling strategy and recruitment methods used for the JoCo OA Project are described elsewhere.[18,19] Briefly, the JoCo OA Project is an ongoing population based cohort study set in 6 rural townships of Johnston County, North Carolina. The primary purpose of the JoCo OA Project is to determine the prevalence, incidence and progression of knee, hip, hand and spine OA. Lumbar spine films were added at the time of cohort enrichment (T1*, 2003-2004), following the first follow-up (T1, 1999-2003) of participants initially recruited from 1991-1998. These particular analyses used crosssectional data from T1* from 1,015 participants who completed 2 interviews and clinical evaluation. The T1* enrollment aimed to enrich the sample of African Americans (AAs) and younger participants. As such, participants at T1* were younger (mean age 59.3 vs. 65.8 years) and had a higher proportion of AAs (40% vs. 28%) than those at T1; the 2 groups did not differ according to gender.[18]

Outcomes

Of the 1,015 participants entering new enrollment, 840 participants had radiographic data for the three outcomes of lumbar spine DSN, OST or FOA. By protocol, women of reproductive age (<50 years of age) were excluded from having lumbar spine radiographs (n=132). Few participants refused lumbar spine radiographs (n=6), but some exceeded the weight limit for the x-ray table (n=23), and some films were missing or unreadable due to congenital defect or surgery (n=16). Lateral lumbar spine films were taken with the participant lying on his/her left side. All lateral lumbar spine radiographs were graded at each lumbar level by a single bone and joint radiologist (JBR) without regard to participants' clinical status. Disc space narrowing and OST were graded based upon the Burnett Atlas[20] in a semi-quantitative fashion as; 0=none, 1=mild, 2=moderate and 3=severe. The grading for OST was done for each superior and inferior face of anterior lumbar vertebra. The outcomes were coded to determine differences across severity, individually for DSN and OST, based upon each subject's most severe feature. For example, a participant was coded as 0 if there was no DSN present, (1) if there was at least mild DSN but no moderate or severe DSN at any level, (2) if there was at least moderate severity at any level but no severe DSN present at any level, or (3) if there was severe DSN at any level. Coding was done in a similar fashion with the most severe anterior superior or inferior vertebral OST. Both DSN and OST were dichotomized into none versus mild or greater for sample-based prevalence estimates. Facet joint OA was graded as present or absent and coded in the same fashion for all analyses.

Knee, hip and hand radiographs

Posterior-anterior knee radiography of both knees in weight-bearing posture with a Synaflexer™ (CCBR-Synarc, San Francisco, CA) positioning device were available for 979 participants. The primary reason for missing knee radiographs was knee arthroplasty. Anterior-posterior bilateral pelvis radiographs were available for 830 participants. The primary reasons for not having hip radiographs were women of reproductive age (<50 year of age) (n=132) and hip arthroplasty. Hand radiographs were available for 1,012 participants. A single bone and joint radiologist (JBR) read all hip, knee and hand radiographs. Inter-rater and intra-rater reliability have been previously reported with a weighted kappa of 0.86 and 0.89, respectively for both the hip and knee.[21] Hip and knee OA, for these analyses, was individually defined as a K-L score of 2-4 in at least one extremity. Hand OA was defined, similar to a previous definition, as having at least one extremity with a K-L grade of 2-4 in one distal interphalangeal joint and 2 other interphalangeal joints or carpometacarpal joint. [22]

Participant demographic and clinical factors

Demographic and clinical data were collected including age and body mass index (BMI), measured at time of clinical examination (calculated from height measured without shoes and weight measured with a balance beam scale), race (Caucasian / AA), and gender. Low back symptoms were obtained at interview by asking participants to answer “yes” or “no” to “On most days, do you have pain, aching or stiffness in your low back?”

Statistical Analysis

Descriptive statistics were generated in the form of means and standard deviations for continuous covariates and counts and percentages for categorical covariates. Student’s t-tests (continuous covariates) and chi square tests (categorical covariates) were used for analysis of differences.

Unconditional binary, proportional odds and partial proportional odds logistic regression models were used, as appropriate, to determine independent associations between demographic and clinical factors and concomitant radiographic knee, hip and hand OA with each outcome. Associations were adjusted for all demographic and clinical covariates (i.e., age, race, gender, BMI and low back symptoms) and the other radiographic variables (i.e., knee, hip and hand OA). Collinearity was analyzed for all variables using variance inflation factors and tolerance values.

Odds ratios and their 95% confidence intervals (CI) were the measures of association. However, it is important to note that since the outcomes in these analyses are common (>10%) the odds ratios from these analyses will likely overestimate the relative risk.[23] The degree of overestimation is dependent on the prevalence of disease and strength of association.[24] Therefore, the associations reported should be viewed relative to lumbar spine IRF across demographic, clinical and concomitant knee, hip and hand OA rather than interpreted as the relative risk of the outcome of interest. All analyses were conducted in Stata 10 (Stata Corp, College Station, TX). All participants in the JoCo OA Project have provided informed consent for participation. The JoCo OA Project has been continuously approved by the Institutional Review Boards of the University of North Carolina and of the Centers for Disease Control and Prevention in Atlanta, GA.

Results

A description of the demographic, clinical and concomitant radiographic knee, hip and hand OA is provided in Table 1. After exclusion of women less than 50 years of age and missing

data there were 840 lumbar spine radiographs with complete data for DSN, OST or FOA. The demographics of this sample were 37.6% AA and 62.3% female, BMI of 30.4 (SD 6.3), and a mean age of 60.1 years (SD 10.3) for men and 62.7 years (SD 9.8) for women.

Prevalence

Table 2 describes the sample-based prevalence of lumbar spine IRF stratified by age, gender and race. The sample-based prevalence of DSN at a mild or greater severity was 57.6% for all participants. Similarly, the sample-based prevalence of FOA was 57.9% for all participants while the sample-based prevalence of OST was higher (88.1% of all participants had at least mild OST**).** Facet joint OA was significantly greater among women (p=0.004) whereas no significant difference with gender was observed with DSN (p=0.068) or OST (p=0.912). Caucasians had a significantly higher frequency of DSN (p=0.014), OST (p=0.012) and FOA (p<0.001) than AAs. The frequency of lumbar spine IRF consistently increased across categories of increasing age. The majority of participants had at least mild or greater DSN and OST (54.5%) and OST and FOA (53.8%). In addition, participants with concomitant DSN and FOA (38.9%) and participants with all three lumbar spine IRFs (37.3%) were also common.

Disc Space Narrowing

Table 3 provides the frequencies of demographic, clinical and radiographic knee, hip and hand OA across severity of DSN. Knee and hand OA increased substantially as severity of DSN increased, whereas hip OA had a weaker relationship to DSN severity. Increasing age, gender, low back symptoms, knee and hand OA, and race were associated with DSN in crude analyses. After adjustment, increasing age, gender and low back symptoms remained independently associated with DSN (Table 6).

Osteophytes

Table 4 provides the frequencies of demographic, clinical and radiographic knee, hip and hand OA across severity of OST. Women had higher proportions of mild OST whereas men demonstrated higher proportions of moderate and severe OST. Knee, hip and hand OA increased in frequency with increasing severity of OST. This effect was most pronounced with knee OA. The proportional odds assumption was violated with gender effects demonstrating significant changes across levels of OST severity. As such, after adjustment, men demonstrated monotonically increasing odds ratios from 1.39 (95% CI 0.88, 2.22) 3.18 (95% CI 2.25, 4.50) and 5.74 (95% CI 3.20, 10.28) with increasing severity, respectfully. Increasing age, gender, low back symptoms, knee, hip and hand OA were associated with OST in crude analyses. After adjustment, increasing age, BMI, gender, and knee OA demonstrated independent associations with OST (Table 6).

Facet joint osteoarthritis

Table 5 provides the frequencies of demographic, clinical and radiographic knee, hip and hand OA with presence or absence of FOA. Knee and hand OA frequencies were greater among those with FOA whereas low back symptoms and hip OA were nearly equal in frequency between those with and without FOA. Increasing age, BMI, race, gender, knee, hip and hand OA were associated with FOA in crude analyses. After adjustment, increasing age, BMI, race, knee and hand OA were independently associated with FOA (Table 6).

Discussion

Ours is the first study to describe the sample-based prevalence of plain film radiographic DSN, OST and FOA across gender and race sub-groups from the same sample. The

differences in lumbar spine coding schemes and sample ages have been reported to compromise comparisons across studies.[2] However, our sample-based prevalence estimates fall in the middle range of previously reported communitybased studies for DSN and OST. Any differences are likely due to the younger mean age in our study when compared to others. Our group has reported racial differences in IRF of the knee and hip.[25,26] This was also the case in the current study, as AAs had a lower sample-based prevalence of all three lumbar spine IRF. These findings may help improve our understanding of racial differences observed in spine related imaging utilization. The similarities in gender stratified sample-based prevalence estimates for OST are not consistent with previous studies reporting that men have significantly more prevalent OST.[4,5] The inconsistency is most likely due to differences in coding schemes, as some have combined severity categories of OST prior to dichotomizing for prevalence analyses. However, differences in study mean ages and locations between our study and others may also contribute to this difference.

To our knowledge this is the only study to have determined the sample-based prevalence of plain film radiographic FOA in a community-based population. The similarities in frequency estimates and overlap for DSN and FOA support previous work suggesting that FOA is related to DSN.[1,6] Our sample-based prevalence estimates, for all participants and stratified by gender, are similar to those found by Kalichman and colleagues[13] of CT identified FOA. This is interesting since lateral plain film radiographs are admittedly not optimal for identifying FOA due to the orientation of the facet joint.[27] This suggests that, on a population level, plain film radiography may be useful for the study of FOA etiology, its association with low back symptoms, relationship to other lumbar spine IRF and the study of generalized OA.

Differences in associations were observed between demographic of age, gender and race and lumbar spine IRF. Consistent with previous work, increasing age demonstrated similar associations across severity and presence of lumbar spine IRF.[4,5,13] Also in agreement, we found a moderate to strong adjusted association with BMI and both OST and FOA and a nearly null association with DSN.[4,13] Pye and colleagues reported that men have greater osteophyte severity.[5] Similarly, we found that the associations increase in strength across severity of osteophytes for men. This is the first study to report on racial differences across lumbar spine IRF. The difference in associations across race indicates the degenerative process for FOA differs when compared to DSN and OST. Human cadaver studies have found no statistical difference in the prevalence of FOA [28] or facet joint orientation[29] between Caucasians and AAs. Our findings indicate that there may be physical activity or occupational exposures that lead to the decreased association of FOA among AAs that are beyond the scope of these analyses.

Differences in associations were also observed between clinical factors of low back symptoms and lumbar spine IRF. Although, the association between lumbar spine degenerative changes and low back symptoms continues to be debated in the literature,[1] in general, our results are consistent with previous studies regarding a modest association between DSN and low back symptoms.[4,5] Clinical guidelines recommend plain film radiographs as a reasonable first option in imaging for patients seeking care for low back symptoms who either have ‘red flag’ concerns on initial presentation or who do not improve after 4-6 weeks of conservative care.[30] Only modest associations have been consistently reported between DSN and low back symptoms.[3-5] Our findings do not change the current clinical guidance regarding the use of plain film radiographs and low back pain but are useful in understanding if the associations differ between lumbar spine IRF and low back symptoms. With OST, after adjustment, no association was observed with low back symptoms; this is consistent with a previous study[5] but in contrast to others[3,4]. The differences between our study results and some others could likely be due to operational

definitions of low back symptom questions, grading scales or coding schemes. The lack of association between FOA and low back symptoms is consistent with another US community-based study with CT identified FOA.[13] This lack of association is concerning given that utilization of interventions to treat facet joint pain have increased dramatically from 1997 to 2006, with an annual growth rate of 60% among Medicare beneficiaries.[12]

The associations between lumbar spine IRF and concomitant knee, hip and hand OA differ. There was some consistency observed in associations between lumbar spine IRF and knee and hand OA. After adjustment, both knee and hand OA remained significantly associated with lumbar spine OST and FOA. We have reported in previous work that a high proportion of participants with both hand or knee OA also have spine OA from both a family study of generalized OA in Caucasians[22], and the Johnston County OA Project cohort[31]. Hand OA was independently associated with lumbar spine FOA indicating the process of degenerative process may be different than that of DSN or OST. Hip OA demonstrated no independent association with DSN, OST or FOA. Previous work in the JoCo OA Project and others have questioned whether the process of hip OA is a separate entity and not considered as part of generalized OA.[32-34] Our findings here indicate that hip degeneration may occur through a different etiologic process when compared to that of the lumbar spine. This is not surprising given the prevalence of morphometric abnormalities cited as common etiologies for hip OA.[35-38]

These results underscore the importance of analyzing lumbar spine IRF separately since the degenerative process may differ by demographic, clinical and concomitant radiographic knee, hip and hand OA. Subsequently, these findings may have important implications for future research regarding generalized OA. The modest associations between low back symptoms and lumbar spine radiographic features observed in this study may not aid clinicians in the diagnosis or treatment referral for mechanical low back pain related to degeneration in the lumbar spine. Improvements in low back pain sub-group classification and consistent use of standardized symptom ascertainment across studies may improve the understanding of the associations between plain film radiographs and low back symptoms. Our study has some limitations and several strengths. The primary limitation is that these analyses are cross-sectional and cannot determine causality, and longitudinal analyses may differ. Not inherent to this study are the differences in coding schemes that may limit comparisons of the outcomes across studies. We coded the outcomes to preserve the grading scale used for this study and provide a descriptive analysis for future studies. Another limitation is that our study was conducted among a community-based sample of Caucasian and African American rural participants over age of 45 years in which African Americans were deliberately targeted, which may limit the generalizability of findings. However, this is a large well-balanced sample of both men and women and is the only study to characterize lumbar spine IRF across race. Lastly, this is the first community-based study to recognize that there are differences in associations between lumbar spine IRF with radiographic knee, hip and hand OA.

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Significance and Innovations

- The lumbar spine individual radiographic features (IRF) of disc space narrowing, vertebral osteophytes and facet joint osteoarthritis are common and differ significantly across race and gender.
- The frequency of hand and knee OA consistently increased across presence or severity of lumbar spine IRF whereas this effect was weak or absent for hip OA.
- Adjusted associations between lumbar spine IRF and demographic, clinical and concomitant knee, hip and hand OA varied widely with no associations found with hip OA.
- These findings underscore the importance of analyzing lumbar spine IRF as separate outcomes for OA studies as they likely reflect different processes ongoing in the joint during the course of this disease.

Table 1

Distribution of selected demographic, clinical and radiographic variables for the 1,015 new enrollment participants in the Johnston County Osteoarthritis Project (2003 – 2004).

		n	%
Age, mean (SD)	59.7 (10.4)	1,015	100
Age, yrs	45-54	390	38.4
	55-64	295	29.1
	65-74	212	20.9
	75+	118	11.6
Race	African American	408	40.2
	Caucasian	607	59.8
Gender	Men	336	33.1
	Women	679	66.9
BMI, mean (SD)	31.3 (7.4)	1,015	100
BMI	<30	511	50.3
	≥30	504	49.7
Low Back	Present	524	51.8
Symptoms	Absent	488	48.2
	Missing	3	<1
Knee OA	K-L Score 2-4	285	29.1
	K-L Score 0-1	694	70.9
	Missing	36	3.6
Hip OA	K-L Score 2-4	196	23.6
	K-L Score 0-1	634	76.4
	Missing	185	18.2
Hand OA	K-L Score 2-4	225	22.2
	K-L Score 0-1	787	77.8
	Missing	3	<1

BMI=body mass index measured in kg/m^2. K-L= Kellgren-Lawrence. Knee radiographs missing primarily for unilateral and bilateral arthroplasty, hip radiographs missing due to women <50 years of age as a result of study protocol and hip arthroplasty. Low back symptoms defined as pain aching or stiffness on most days.

Table 2

Sample-based prevalence of disc space narrowing (DSN), vertebral osteophytes (OST) and facet joint osteoarthritis (FOA) stratified by gender, race and age.

	DSN		OST		FOA	
	n (%)		n (%)		n (%)	
All participants n=840	484 (57.6)		740 (88.1)		486 (57.9)	
Age Category						
45-54	86 (36.1)		188 (79.3)		92 (38.5)	
55-64	153 (54.8)		247 (88.5)		146 (52.3)	
65-74	151 (73.3)		193 (93.2)		149 (72.3)	
75+	94 (80.3)		112 (95.7)		99 (85.3)	
Cross Tabulation						
DSN	N/A		458 (54.5)		327 (38.9)	
OST	N/A		N/A		452 (53.8)	
DSN & OST	N/A		N/A		313 (37.3)	
Women n=523	314 (60.4)	0.068 *	462 (88.0)	0.912 *	323 (61.6)	0.004 *
Age Category						
45-54 †	48 (38.4)		104 (83.2)		59 (46.8)	
55-64	101 (54.0)		163 (86.7)		101 (53.7)	
65-74	97 (75.8)		117 (90.7)		92 (71.9)	
75+	68 (81.9)		78 (94.0)		71 (86.6)	
Men n=317	170 (53.6)		278 (88.3)		163 (51.6)	
Age Category						
45-54	38 (33.6)		84 (75.0)		33 (29.2)	
55-64	52 (56.5)		84 (92.3)		45 (49.5)	
65-74	54 (69.2)		76 (97.4)		57 (73.1)	
75+	26 (76.5)		34 (100.0)		28 (82.4)	
AAs n=316	165 (52.2)	0.014 *	267 (84.5)	0.012 *	142 (44.7)	<0.001 *
Age Category						
45-54	33 (30.6)		80 (74.1)		26 (23.9)	
55-64	61 (52.6)		102 (87.9)		51 (43.6)	

	DSN	OST	FOA
	n (%)	n (%)	n (%)
65-74	44 (68.8)	59 (92.1)	44 (68.8)
75+	27 (96.4)	26 (92.9)	21 (75.0)
Caucasians n=524	319 (60.9)	473 (90.3)	344 (65.9)
Age Category			
45-54	53 (40.8)	108 (83.7)	66 (50.8)
55-64	92 (56.4)	145 (89.0)	95 (58.6)
65-74	107 (75.4)	134 (93.7)	105 (73.9)
75+	67 (75.3)	86 (96.6)	78 (88.6)

Disc space narrowing and vertebral osteophytes coded as mild or greater and facet joint osteoarthritis coded as absent or present.

*p-value for difference in gender or race for each outcome.

†Women <50 years old excluded (n=132). N/A= not applicable

Table 3

Disc space narrowing severity by demographic, clinical and radiographic factors.

Disc Space Narrowing	None n=356	Mild n=284	Moderate n=161	Severe n=39	p-value
Age, mean (SD)	58.0 (8.7)	62.4 (9.8)	66.9 (9.9)	68.9 (9.4)	<0.001
BMI, mean (SD)	30.4 (6.3)	30.4 (6.4)	30.5 (6.4)	29.7 (5.5)	0.921
Race, n (%)					
AA	151 (47.8)	106 (33.5)	45 (14.2)	14 (4.4)	0.019
Caucasian	205 (39.1)	178 (34.0)	116 (22.1)	25 (4.8)	
Gender, n (%)					
Men	147 (46.4)	106 (33.4)	48 (15.1)	16 (5.1)	0.093
Women	209 (40.0)	178 (34.0)	113 (22.6)	23 (4.4)	
Low Back Symptoms, n (%) n=839	163 (45.9)	141 (49.5)	97 (60.3)	22 (56.4)	0.020
Knee OA, n (%) n=807	78 (22.5)	79 (28.6)	63 (42.0)	15 (44.1)	<0.001
Hip OA, n (%) n=818	79 (22.6)	59 (21.0)	44 (28.8)	10 (27.8)	0.286
Hand OA, n (%) n=838	62 (17.4)	71 (25.2)	66 (41.0)	21 (53.9)	<0.001

Low back symptoms defined as pain aching or stiffness on most days. BMI=body mass index. OA=osteoarthritis. SD=standard deviation. Proportions for symptoms, knee, hip and hand OA differ from column due to missing data. Disc space narrowing coded based upon subjects most severe level. Knee and hip OA defined as Kellgren-Lawrence (KL) score of 2-4. Hand OA defined as the presence of KL grade 2-4 in at least one distal interphalangeal joint and 2 other interphalangeal joints or carpometacarpal joints.

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Table 4

Anterior vertebral osteophytes by demographic, clinical and radiographic factors.

Osteophytes					
	None	**Mild**	**Moderate**	**Severe**	
	n=100	**n=484**	**n=185**	**n=71**	**p-value**
Age, mean (SD)	56.9 (8.6)	60.5 (9.6)	65.6 (9.9)	66.7 (9.9)	<0.001
BMI, mean (SD)	29.1 (5.8)	30.3 (6.4)	30.4 (6.3)	32.5 (5.8)	0.006
Race, n (%)					
AA	49 (15.5)	174 (55.1)	63 (19.9)	30 (9.5)	0.052
Caucasian	51 (9.7)	310 (59.2)	122 (23.3)	41 (7.8)	
Gender, n (%)					
Men	37 (11.8)	148 (47.0)	83 (26.4)	47 (14.9)	<0.001
Women	63 (12.0)	336 (64.0)	102 (19.4)	24 (4.6)	
Low Back Symptoms, n (%) n=839	44 (44.0)	240 (49.5)	100 (54.1)	39 (54.9)	0.338
Knee OA, n (%) n=807	13 (13.3)	121 (25.9)	68 (38.6)	33 (50.0)	<0.001
Hip OA, n (%) n=818	14 (14.3)	117 (24.7)	41 (22.8)	21 (31.3)	0.068
Hand OA, n (%) n=838	17 (17.0)	110 (22.8)	65 (35.1)	28 (39.4)	<0.001

Low back symptoms defined as pain aching or stiffness on most days. BMI= body mass index. OA=osteoarthritis. SD=standard deviation. Proportions for symptoms, knee, hip and hand OA differ from column due to missing data. Anterior vertebral osteophytes coded based upon a subjects most severe superior or inferior lumbar level. Knee and hip OA defined as Kellgren-Lawrence (KL) score of 2-4. Hand OA defined as the presence of KL grade 2-4 in at least one distal interphalangeal joint and 2 other interphalangeal joints or carpometacarpal joints.

Table 5

Facet joint osteoarthritis by demographic, clinical and radiographic factors.

Facet Joint Osteoarthritis			
	Present n=486	**Absent n=354**	**p-value**
Age, mean (SD)	64.7 (10.2)	57.5 (8.2)	<0.001
BMI, mean (SD)	30.8 (6.6)	29.9 (6.0)	0.039
Race, n (%)			
AA	142 (44.7)	176 (55.4)	<0.001
Caucasian	344 (65.9)	178 (34.1)	
Gender, n (%)			
Men	163 (51.6)	153 (48.4)	0.004
Women	323 (61.6)	201 (38.4)	
Low Back Symptoms, n (%) n=839	247 (50.8)	175 (49.6)	0.721
Knee OA, n (%) n=807	174 (37.8)	64 (18.4)	<0.001
Hip OA, n (%) n=818	118 (25.1)	74 (21.3)	0.214
Hand OA, n (%) n=838	179 (36.8)	40 (11.3)	<0.001

Low back symptoms defined as pain aching or stiffness on most days. BMI=body mass index. OA=osteoarthritis. SD=standard deviation. Proportions for symptoms, knee, hip and hand OA differ from column due to missing data. Facet joint OA coded as absent or present. Knee and hip OA defined as KL score of 2-4. Hand OA defined as the presence of KL grade 2-4 in at least one distal interphalangeal joint and 2 other interphalangeal joints or carpometacarpal joints.

Table 6

Crude and adjusted associations between disc space narrowing, osteophytes and facet joint osteoarthritis (OA) with demographic, clinical and radiographic factors.

	Disc Space Narrowing		Osteophytes		Facet Joint OA	
	Crude OR (95% CI)	**Adjusted OR* (95% CI)**	**Crude OR (95% CI)**	**Adjusted OR* (95% CI)**	**Crude OR (95% CI)**	**Adjusted OR* (95% CI)**
Age 45-54	Ref	**Ref**	Ref	**Ref**	Ref	**Ref**
55-64	2.14 (1.52, 3.01)	**1.60 (1.11, 2.30)**	1.89 (1.33, 2.70)	**1.64 (1.12, 2.38)**	1.75 (1.24, 2.49)	**1.23 (0.83, 1.83)**
65-74	4.96 (3.43, 7.16)	**2.84 (1.88, 4.30)**	4.53 (3.09, 6.66)	**2.82 (1.82, 4.38)**	4.18 (2.80, 6.24)	**2.25 (1.39, 3.62)**
75+	7.55 (4.88, 11.65)	**3.07 (1.80, 5.24)**	5.14 (3.29, 8.03)	**3.14 (1.78, 5.54)**	9.30 (5.23, 16.56)	**2.98 (1.51, 5.88)**
BMI <30	Ref	**Ref**	Ref	**Ref**	Ref	**Ref**
≥30	1.00 (0.98, 1.02)	**0.86 (0.64, 1.15)**	1.46 (1.12, 1.90)	**1.55 (1.14, 2.09)**	1.33 (1.01, 1.75)	**1.56 (1.11, 2.19)**
Race Caucasian	Ref	**Ref**	Ref	**Ref**	Ref	**Ref**
AA	0.68 (0.53, 0.89)	**1.00 (0.74, 1.35)**	0.83 (0.63, 1.09)	**0.98 (0.72, 1.33)**	0.42 (0.31, 0.56)	0.45 **(0.32, 0.62)**
Sex Female	Ref	**Ref**	Ref	**Ref**	Ref	**Ref**
Male	0.76 (0.59, 0.99)	**0.68 (0.51, 0.92)**	1.94 (1.47, 2.56)	**2.68 (1.97, 3.63)**	0.66 (0.50, 0.88)	**0.75 (0.53, 1.05)**
Low Back Symptoms	1.44 (1.12, 1.85)	**1.37 (1.04, 1.80)**	1.28 (0.98, 1.66)	**1.11 (0.84, 1.48)**	1.05 (0.80, 1.38)	**0.84 (0.61, 1.15)**
Knee OA	1.94 (1.46, 2.58)	**1.16 (0.84, 1.59)**	2.45 (1.82, 3.30)	**1.62 (1.16, 2.27)**	2.69 (1.93, 3.74)	**1.69 (1.15, 2.49)**
Hip OA	1.20 (0.89, 1.62)	**0.99 (0.71, 1.38)**	1.31 (0.96, 1.79)	**1.01 (0.72, 1.43)**	1.23 (0.89, 1.72)	**0.89 (0.60, 1.31)**
Hand OA	2.63 (1.97, 3.52)	**1.14 (0.79, 1.63)**	2.00 (1.48, 2.69)	**0.81 (0.55, 1.18)**	4.55 (3.12, 6.63)	**1.67 (1.20, 2.28)**

*Adjusted for all demographic, clinical, and the other radiographic variables in this table. Disc space narrowing and osteophyte estimates from proportional odds model and facet joint osteoarthritis from binary logistic model. Low back symptoms defined as pain aching or stiffness on most days. BMI=body mass index. OA=osteoarthritis. OR=odds ratio. CI= confidence interval. Ref=referent group. Knee and hip OA defined as Kellgren-Lawrence (K-L) score of 2-4. Hand OA defined as the presence of K-L grade 2-4 in at least one distal interphalangeal joint and 2 other interphalangeal joints or carpometacarpal joints.