Factors Associated With Pain and Osteoarthritis in the Tecumseh Community Health Study

By Wendy J. Carman

INDEX WORDS: Osteoarthritis; pain; epidemiology.

MUCH OF THE WORK to identify risk factors, develop standards for the measurement of symptoms, or generate diagnostic criteria for osteoarthritis (OA) has come from clinical settings.[1-4] It is well recognized that persons may have radiological evidence of OA without symptoms.[5-7] Conversely, many people suffer from pain without presenting themselves as clinic patients. Population studies of OA that might provide further clues to symptomatology are few.[7-12] Data from such studies have demonstrated discrepancies between symptoms reported and radiological evidence of OA. The Tecumseh Osteoarthritis Study was designed to look at the incidence of OA in hands and to verify, in a community setting, the proposed American College of Rheumatology (formerly the American Rheumatism Association) diagnostic criteria for OA of the knee.[1] It also provided the opportunity to investigate factors associated with pain in hand and knee joints.

METHODS

The Tecumseh Community Health Study is a prospective epidemiologic survey of chronic disease directed toward the entire population of the natural community of Tecumseh, Michigan, and its rural environs.[13,14] In 1985, all Tecumseh residents who had received hand radiographs during the second series of examinations from 1962 to 1965 and who had now reached the ages of 50 to 74 years were targeted for reevaluation. The 1,411 subjects who returned for reexamination represent nearly 80% of the cohort still residing in Tecumseh. This survey included a self-administered questionnaire directed mainly at musculoskeletal symptoms; a physical examination with emphasis on hand and knee joints; and measurement of height and weight, triceps skin-fold, and blood pressures. A body mass index (BMI), weight divided by height squared, was calculated for each subject. Joint pain, stiffness, and swelling were assessed by history; joint tenderness, crepitus, and swelling were assessed on examination by a trained technician. Posteroanterior radiographs of hands and wrists and weight-bearing radiographs of knees were obtained.

Radiographs were graded independently on a joint-by-joint basis by a team of three physicians.[15] Each knee and each of the 32 joints of the hands and wrists were assigned a grade from 0 to 4 for OA, according to the Atlas of Standard Radiographs.[16] A maximum score was derived from the grades assigned to the 32 joints of the hands and wrists (MAX.H). Subjects with a maximum score >1 were designated as having a radiologically defined diagnosis of osteoarthritis of the hand (OAH). A separate maximum score was calculated from the grades coded for the two knees (MAX.K).Subjects with a MAX.K >1 were defined as having osteoarthritis of the knee (OAK).

Questions regarding current hand pain assessed both severity and frequency of pain. Subjects were classified as having current pain (HPAIN) if they described "mild to very severe pain occurring at least sometime during the last month." Questions that might lead to a definition of chronic hand pain were not asked. Subjects were classified as having chronic knee pain (KPAIN) if they reported "knee pain in one or both knees on most days lasting for more than a month." No questions regarding current knee pain were asked.

RESULTS

Nearly 57% of this cohort reported having experienced some hand pain at some time. However, only 36.6% reported hand pain that met our definition of HPAIN. Similarly, 53% of the cohort reported a history of knee pain, while 31.8% reported chronic knee pain.

Of primary interest is the correspondence between reported pain and radiological evidence of OA. The prevalence of HPAIN among those with OAH is 46%, and the prevalence of KPAIN among those with OAK is 69%. Among the 515 subjects who reported HPAIN, only 6% had maximum grades of 0 radiographically. Of the 450 subjects who reported KPAIN, 40% had normal radiographs with a maximum grade of 0. Nearly 40% of subjects with grade 4 OAH did not report HPAIN (Table 1). Correspondence between KPAIN and OAK is more sensitive, with only 9% of those with grade 4 OAK reporting no KPAIN.

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Table 1. Comparison of Prevalence Rates of Joint Pain by Sex and Maximum Radiological Grade of OA

	Maximum Radiological Grade							
	Total (0-4)	None (0)	Doubtful (1)	Mild (2)	Moderate (3)	Severe (4)	NO OA (0-1)	OA (2-4)
Men								
n	635	87	313	164	44	27	400	235
% HPAIN*	28	22	23	34	32	52	23	35†
% No HPAIN	72	78	77	66	68	48	77	65
n	635	363	180	48	31	13	543	92
% KPAIN*	32	23	32	60	71	85	26	76†
% No KPAIN	68	77	68	40	29	15	74	33
Women								
n	756	49	329	232	73	73	378	378
% HPAIN*	45	29	38	50	55	63	36	53†
% No HPAIN	55	71	62	50	45	37	64	47
n	752	453	185	51	42	21	638	114
% KPAIN*	32	21	37	55	76	95	26	70†
% No KPAIN	68	79	63	45	24	5	74	30
Total								
n	1,391	136	642	396	117	100	778	613
% HPAIN*	37	24	31	43	46	60	30	46†
% No HPAIN	63	76	69	57	54	40	70	54
n	1,387	816	365	99	73	34	1,181	206
% KPAIN*	32	22	34	58	74	91	26	69*
% No KPAIN	68	78	66	42	26	9	74	31

*t test for linear trend, grades 0-4, $P < .001$.
†χ^2 test for OA v no OA, $P < .001$.

The prevalence of pain increases significantly with increasing levels of maximum grade of OA (Table 1). The association of pain with maximum OA grade is linear for both knees and hands (test for linear trend, $P < .0001$).[17] After adjustment for sex, the Mantel-Haenzsel measure of relative risk of HPAIN for those with OAH compared with those without OAH is 1.91 with a 95% confidence interval of 1.52 to 2.41.[18] Similarly, the relative risk of KPAIN given OAK is 6.40 with a 95% confidence interval of 4.6 to 8.89.

The prevalence of HPAIN is higher for women than men; this is true for all OA grades of hand radiographs. After adjustment for maximum grade, women with OAH have a relative risk of HPAIN compared with men of 1.94 with a 95% confidence interval of 1.53 to 2.45.[18] This relative risk does not vary over the range of MAXH. Sex differences in reporting of KPAIN are not significant when grade of radiological OA is considered.

Mean BMI is higher among patients with OA with HPAIN than those without pain (29 v 27; analysis of variance [ANOVA], $P < .01$). This relationship is also significant for KPAIN (32 v 30: ANOVA, $P < .01$). In multiple logistic analysis of subjects with OAH adjusting for age, sex, and maximum radiological grade, the relative odds of reporting HPAIN compared with no current hand pain, given a five-point higher BMI, are 1.19 with a 95% confidence interval of 1.02 to 1.40. Among all subjects, the relative odds of KPAIN after adjustment for MAXK are 1.50 with a 95% confidence interval of 1.31 to 1.71. However, when analyses are restricted to those with OAK, BMI is no longer significantly related to KPAIN.

Among those with radiologically defined OA of the hands, those who report pain have a significantly higher sum of grades for the 32 joints, prevalence of swelling of hand joints, and morning stiffness lasting <30 minutes (Table 2). Among those with radiologically defined OAK, subjects with pain are more likely to report knee stiffness, knee swelling, crepitus, knee buckling, or knee locking episodes and knee injury histories than those without pain (Table 2). Only 14% of subjects with OAK and KPAIN report neither swelling of the knees nor morning stiffness of knee joints, and only 4% of subjects with OAH and HPAIN report neither swelling of finger joints nor morning stiffness (Table 3).

Education and income are both significant

Table 2. Prevalence of Selected Joint Symptoms by Presence of Joint Pain Among Subjects With Radiologically Defined OA of the Knee (n = 206) and Hand (n = 615)

Symptom	Pain	No Pain
Osteoarthritis of the knee (OAK)		
% Knee swelling	65	17
% Knee AM stiffness	38	23
% Knee crepitus	50	20
% Knee locking	23	2
% Knee dislocations	17	0
% Knee buckling	60	23
% Knee injury history	43	17
Osteoarthritis of the hand (OAH)		
% Hand swelling	76	24
% General AM stiffness	53	30

predictors of the presence of hand or knee pain. Among those with OA, these measures of socioeconomic status are significantly associated only with HPAIN. The proportion of subjects with OA with no high school diploma is significantly higher among those reporting HPAIN than those not reporting pain (28% *v* 20%; χ^2, $P < .01$). Income levels are significantly lower among those with HPAIN than those without ($21,179 *v* $24,571; ANOVA, $P < .01$). Even after adjustment for sex, the relative odds of a $5,000 lower income are 1.08, with a 95% confidence interval of 1.01 to 1.16. Measures of health habits such as current smoking status and participation in active leisure time activities show no relationship with pain among patients with OA in this cohort.

The prevalence of both hand and knee pain increases significantly with age. However, after adjustment for radiological grade there is no significant relationship between age and pain in this cohort of subjects aged 50 to 74 years; therefore, no adjustments for age have been made in these analyses.

DISCUSSION

Tecumseh Study data confirm the findings of others who have found discrepancies between radiological evidence of OA and pain in the associated joint. Chronic knee pain is a more sensitive and more specific predictor of OA status than reports of hand pain within the last month. This might be a function of the definition of HPAIN as current rather than chronic pain. Our data complement earlier studies finding hand symptoms associated with OAH.[7,19,20]

This analysis does not resolve the question of the role of obesity in joint pain.[7,21,22] In our data, BMI is clearly associated with joint pain among those with OAH, but may be confounded by severity of disease in OAK. The excess risk of joint pain among subjects with lower socioeconomic status is corroborated for subjects with OAH, although this may be confounded by obesity. No excess risk of KPAIN among a similar group with OAK is demonstrated. This indicates a need for further investigation of trauma and job activity.[23] Our findings regarding sex and knee symptoms among OAK subjects are contrary to those of Davis.[24] Sex differences need further evaluation for the effects of duration of disease, obesity, and possible role of treatment.

Subjects with no OA and no swelling or morning stiffness are unlikely to report joint pain.[5] This may indicate an inability of the cohort to differentiate between types of discomfort. However, if these differentiations are accurate, then the clustering of symptoms may be indicative of more pervasive disease. Data regarding the clustering of other joint symptoms suggest that subjects who report pain may have more serious disease, possibly generalized OA rather than localized to hand or knee, than those who do not report pain. In fact, even prevalence of knee symptoms is correlated with HPAIN. Multivariate analyses considering clinically observed signs as well as joint symptoms need to be undertaken. Such analyses may also provide better clues regarding the role of obesity and sex. Further data analyses would help establish the clinical significance of these findings.

Table 3. Proportion of Subjects by Symptom Status for Individuals With and Without Joint Pain Among Those With Radiologically Defined OA of the Knee (n = 206) and Hand (n = 615)

Symptom	KPAIN (n = 141)	No KPAIN (n = 64)	HPAIN (n = 284)	No HPAIN (n = 329)
% No stiffness* and no swelling	14	56	4	53
% With stiffness* or swelling	35	36	29	32
% With stiffness* and swelling	52	8	67	16

*χ^2 test for KPAIN *v* no KPAIN and for HPAIN *v* no HPAIN, $P < .001$.

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