

Brief report

Joint-specific prevalence of osteoarthritis of the hand

F. V. Wilder Ph.D.^{†*}, J. P. Barrett M.D.[‡] and E. J. Farina Ph.D., P.T.[§]

[†] *The Arthritis Research Institute of America, Inc., Clearwater, FL, USA*

[‡] *Florida Knee and Orthopedic Center, FL, USA*

[§] *Sarasota Therapy Centers, USA*

Summary

Purpose: To quantify the prevalence of radiographic hand osteoarthritis (OA) among a group of community-dwelling individuals. Joint-specific prevalence rates/100 of radiographic OA of the hand were quantified and reported by age, gender, and dominant hand.

Methods: Data from a community-based, longitudinal study designed to follow the natural history of OA were used. Participants were ambulatory men and women, ages 40 years and older, with and without radiographic hand OA ($N=3327$). Bilateral hand OA was examined at three joints: second distal interphalangeal joints (DIP), third proximal interphalangeal joints (PIP), and first carpometacarpal joint of the thumb (CMC). The ordinal scale of Kellgren and Lawrence (0–4) was used to determine OA status (grades 2+).

Results: Radiographic hand OA status was determined for all persons in the study group comprised of 2302 women (69%) and 1025 men (31%). The sample sizes for the age groups (years) were 532 (40–49), 905 (50–59), 998 (60–69), 749 (70–79), and 143 (80+). Overall, the DIP joint demonstrated the highest OA prevalence, while the PIP joint showed the lowest prevalence. Joint-specific hand OA prevalence rates for second DIP, third PIP, and first CMC were 35%, 18%, and 21%, respectively. Expectedly, hand OA prevalence for all joints increased with age. With exceptions, women demonstrated higher hand OA prevalence rates for the three sites examined. However, among men aged 40–49, the second DIP joint OA rate was higher (13%) compared with women (8%). Additionally, men in that age group demonstrated an elevated first CMC joint OA rate (9%) compared with women (5%). Gender-specific hand dominance analyses demonstrated that the majority of individuals with unilateral second DIP or third PIP OA presented in their dominant hand. However, among those with unilateral first CMC OA, both genders displayed a tendency to present in their nondominant hand.

Conclusion: These findings suggest the need for further investigation of the role gender can play in the development of hand OA in populations under 60 years of age. Additional epidemiological studies addressing hand OA will serve to bridge the gap between the current levels of knowledge about the knee and the hand. The disease burden of hand OA affects a large percentage of the population. Research efforts that more exhaustively characterize the prevalence of hand OA may contribute toward interventions that, ultimately, impact a rapidly growing segment of our population.

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Key words: Osteoarthritis, Epidemiology, Hand, Prevalence.

Osteoarthritis (OA) is the most common joint disease and it most frequently involves joints of the hands¹. As a consequence of hand OA, the ability to perform tasks of everyday life may become impaired or lost altogether. Hand OA commonly affects the distal interphalangeal joints (DIP), proximal interphalangeal joints (PIP), and the carpometacarpal joint of the thumb (CMC)². Autopsy studies reveal almost universal evidence of cartilage damage in people over age 65 years³. It is estimated that 70–90% of people older than age 75 are affected by some type of OA⁴. A 2005 study reported the presence of radiographic OA in at least one hand joint in 67% of the women and 54.8% of the men, among persons 55 years and older⁵. Because one of the most important social phenomena of the 20th century was the increased longevity of the population, and today almost 80% of the population can expect to live through most of

their seventh decade of life, the socioeconomic impact of OA is likely to increase even further in the future³.

While knee OA has received a large share of OA-related research, additional data about hand OA will contribute information about the etiology of this common disease. The purpose of our study was to quantify the prevalence of radiographic hand OA among a group of community-dwelling individuals. Radiographic OA prevalence rates were examined by individual joints, stratified by age, gender, and dominant hand. Data from a longitudinal study designed to describe the natural history of OA were used. Epidemiologic studies emerging from this cohort have contributed to, and complemented, the existing body of OA literature. Using this observational, prospective study, researchers have been able to track the natural progression of this disease. Since its inception in 1988, published studies from this cohort have characterized OA risk (and protective) factors such as knee trauma⁶, cigarette smoking⁷, exercise^{8,9}, as well as comorbid conditions¹⁰.

Methods

Participants were ambulatory men and women, ages 40 years and older, with and without radiographic hand OA

*Address correspondence and reprint requests to: Dr Frances V. Wilder, Ph.D., The Arthritis Research Institute of America, Inc., Research, 300 South Duncan Avenue, Suite # 188, Clearwater, FL 33755, USA. Tel: 1-727-461-4054; Fax: 1-727-449-9227; E-mail: fwilder@preventarthritis.org

Received 16 December 2005; revision accepted 10 April 2006.

($N = 3327$). In 1988, The Arthritis Research Institute of America [ARIA] located in Clearwater, Florida, initiated The Clearwater Osteoarthritis Study [COS]. The COS is an ongoing community-based prospective cohort study designed to identify the major risk factors for the development of OA, to differentiate risk factors for localized and generalized primary OA, as well as to identify risk factors for the progression of OA. Currently, in its 18th year, the 25 year longitudinal study follows individuals while collecting demographic, historical, clinical, and radiological data. Funded solely on private donations since its inception, this study has received ongoing institutional review board approval.

ARIA is located in Pinellas County, FL drawing upon a population with a large percentage of residents 65 years and older [22.5%]¹¹. In 1990, Pinellas County ranked first of all U.S. counties in total population 65 years of age and older. Furthermore, Pinellas County ranked first in those 85 years of age and older¹². The study sample of this older community is comprised of volunteer participants who are recruited by various methods. These include invitational letters, television and radio announcements, newspaper articles publicizing the COS study, articles posted in community organizations' bulletins, as well as seminars held at community clubs and organizations. In efforts to include younger subjects who are more likely to be free of OA, concerted recruitment efforts are used to encourage participation by employees of the Pinellas County School System, the City of Clearwater, and Pinellas County. During the initial contact with participants, a description of study procedures is given, followed by a screening questionnaire, detailing inclusion and exclusion criteria. After eligibility is determined and the informed consent is obtained, participants are asked to complete a self-administered, mostly precoded COS History Questionnaire¹³. This collects detailed information pertaining to demographics, family history, childhood history, adult habits and behavior, adult diet and work history, leisure/sports activities, ailments, injury history, self-functional assessment, and joint symptoms. With an emphasis on clinical and functional joint evaluation, the COS Physical Exam¹⁴ is conducted by the clinicians at enrollment. The following study subjects were excluded from enrollment: individuals with self-reported rheumatoid arthritis (lupus erythematosus, and ankylosing spondylitis); gout; disabling neuralgic disease; those confined to a wheelchair; and lastly, those mentally incompetent to give informed consent.

Prevalence rates of radiographic hand OA were calculated for six joints: bilateral second DIP, third PIP and first CMC. Our study's financial considerations restricted the numbers of hand joints interpreted. We interpreted and reported six of the 10 joints adopted by the American College of Rheumatology in 1990 for hand OA classification criteria². A licensed x-ray technician using standard exposure techniques takes radiographs of multiple sites, including the hands. X-rays are interpreted by the study's board-certified radiologist. Each radiograph was graded 0–4 for OA by the ordinal criteria of Kellgren and Lawrence¹⁵: 0, absent; 1, questionable osteophytes and no joint space narrowing; 2, definite osteophytes with possible joint space narrowing; 3, definite joint space narrowing with moderate multiple osteophytes and some sclerosis; 4, severe joint space narrowing with cysts, osteophytes and sclerosis present. Subjects whose x-rays were interpreted as grade 0 or 1 were considered disease-free for joint-specific hand OA. Subjects whose hand radiographs were interpreted as grade 2, 3, or 4 were classified as cases. We evaluated the relationship between self-reported injury history and

hand OA. Our study's history questionnaire has an injury module of items. The questions states, "Have you ever been told by a doctor or medical professional that you have a cracked, fractured, broken, or dislocated bone?" One of the response choices is the "Hand (including fingers)" site.

For each joint scored, grade-specific photos served as a guide for interpreting the films. Every 10th subject's assembled films are independently interpreted by a nonaffiliated radiologist blinded to the results of the first reading. In case of discrepancy in classification, the study radiologist's reading is selected for OA. The study radiologist is blinded to information about the individual study participants. Interreader reliability by a second radiologist reflected 93% agreement between the two readers ($\kappa = 0.85$).

The purpose of our current investigation was to describe joint-specific hand OA prevalence. Thus basic descriptive statistics, rather than analytical tests, were employed. Prevalence rates were calculated per 100 persons (i.e., percent). The age distribution of our study sample was not the same as our source population. Thus, we reported crude, as well as age-standardized prevalence rates. Statistical Analysis Software (SAS), Version 8.12¹⁶ was used for the analysis of these data.

Results

Of the 3542 persons who enrolled, 3327 were included in the current analyses. Figure 1 summarizes the reasons for participant exclusion. The average age of our participants was 62 years, 11 (standard deviation), spanning from 40–94 years. The percentage of our study sample that was right and left handed was 94% and 6%, respectively. Radiographic hand OA status was determined for all persons in the study group comprised of 2302 women (69%) and 1025 men (31%). Among the 3327 study participants, 1380 (41%) were prevalent for hand OA at any of the six joints examined (data not shown).

Overall, the second DIP joint demonstrated the highest OA prevalence, while the third PIP joint showed the lowest prevalence (Table 1; Figs. 2–4). Joint-specific hand OA prevalence rates for second DIP, third PIP, and first CMC were 35%, 18%, and 21%, respectively. Standardized age-adjusted prevalence rates for men and women, respectively, were 31.2 and 35.8 (second DIP), 15.2 and 20.2 (third PIP), and 17.7 and 21.0 (first CMC). Expectedly, hand OA prevalence for all joints increased with age. With few exceptions, women demonstrated higher hand OA prevalence rates for the three sites examined. However, among men aged 40–49, the second DIP joint OA rate was higher (13%) compared to women (8%). Additionally, men aged 40–49 demonstrated a modestly elevated first CMC joint OA rate (9%) compared to women (6%).

Gender-specific hand dominance analyses demonstrated that the majority of those individuals with unilateral hand OA

Enrolled →	3542
Excluded – ambidextrous (133) →	3409
Excluded due to missing dominant hand data (9) →	3400
Excluded due to missing radiographic data (69) →	3331
Excluded due to other missing data (2) →	3329
Excluded due to surgery (2) →	3327

Fig. 1. Sample selection for hand OA prevalence analyses.

Table I
Joint-specific prevalence/100 of radiographic OA of the hand, by age group

	N	Second DIP			Third PIP			First CMC		
		Total (%)	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)
Total	3327	35.3	35.1	35.4	18.2	17.6	18.5	20.5	19.7	20.9
<i>Age group</i>										
40–49	532	9.6	13.2	8.3	2.6	2.1	2.8	6.6	9.0	5.7
50–59	905	21.6	22.0	21.4	7.6	8.1	7.5	14.2	13.1	14.6
60–69	998	42.6	39.7	44.0	21.7	18.1	23.4	23.5	22.9	23.7
70–79	749	53.8	49.2	56.3	31.0	29.8	31.6	31.1	26.0	33.9
80+	143	69.9	63.0	74.2	51.1	42.6	56.2	36.4	31.5	39.3

presented with OA in their dominant hand (Table II). This is a rather expected finding held true for the second DIP and the third PIP joints. However, among those with unilateral hand OA, both genders displayed a tendency to have first CMC OA in their nondominant hand. Hand dominance analyses by age group demonstrated prevalence rates increasing with age (Table II). Of the six hand joints scored, men and women tended to have a similar percentage of total number of joints affected by radiographic OA (Table III). Table IV shows the prevalence rates for hand OA, by body mass index (BMI) category. Among women, our findings show that increasing BMI is positively associated with hand OA. Our data did not demonstrate this relationship among men. Our data note that 9.8% responded yes to the “Hand (including fingers)” site. Analyses found this self-reported injury history to not be a risk factor for having hand OA (odds ratio 0.93; P value 0.55).

Discussion

OA is one of the most common joint disorders in the elderly, yet compared to knee OA research, relatively few studies have targeted radiographic hand OA. Although previous studies have investigated prevalence rates of hand OA, direct comparison of rates can be problematic due to study population differences in age, gender composition, case definition, total number of joints scores, etc.

In a 2005 study, Dahaghin *et al.*⁵ investigated the prevalence of radiographic DIP, PIP, and CMC OA among a group of subjects 55+ years (N = 3906). Like our findings, their results also reflected the highest prevalence rates in

the DIP joint, followed by the CMC and PIP joint. A 2004 population-based study investigated the prevalence of radiographic OA in the CMC joint of the thumb in adults 30 years of age or older in Finland (N = 3595)¹⁷. Among men and women aged 75 years and older, their reported CMC OA prevalence rates were similar to ours at 27% and 38%, respectively. In 2003, Zhang *et al.*¹⁸ compared radiographic hand OA prevalence rates between Chinese and white subjects in the United States (ages 60+). DIP and PIP prevalence rates among women (78% and 48%) and men (64% and 32%) were lower compared to our findings. In 2002, Sowers *et al.*¹⁹ conducted a cross-sectional study examining radiographic OA in the dominant hand in a population of women (N = 1053). DIP prevalence rates for the 40–44 (8.3%) and the 45–49 (16.8%) age groups compared higher to our findings of 7.2% for all women combined. Likewise, our rates for the PIP and CMC joints were lower than their findings. A 1997 publication reported findings on the Framingham Study volunteers who had a right hand radiograph taken during 1967–1969²⁰. Fifteen hand joints were scored. The Framingham latter age category (55–76) may be most comparable to our study sample. In 41% of our participants aged 55–76, hand OA was prevalent (data not shown). This is in comparison to 54% of the Framingham volunteers, aged 55–76 whom hand OA was prevalent. Although the second DIP and third PIP joints are two of the most commonly diagnosed hand OA joints, the Framingham Study’s reporting of 15 total joints (vs our six) could very well have contributed to this rate difference. In the late 1980’s, a paper reported hand OA prevalence rates among individuals in the Tecumseh Community Health Study. Participants were examined for radiographic

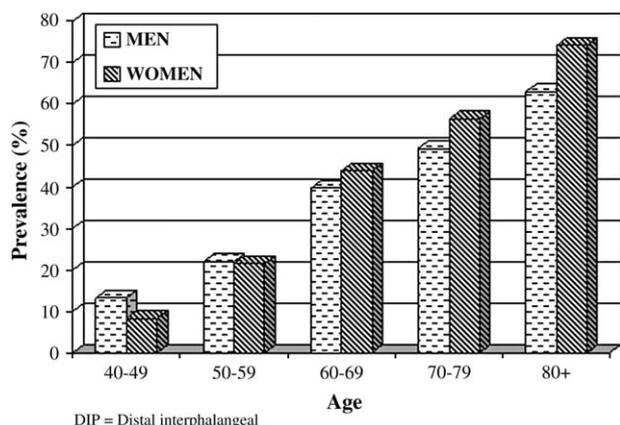


Fig. 2. Prevalence of second DIP, by age, by gender.

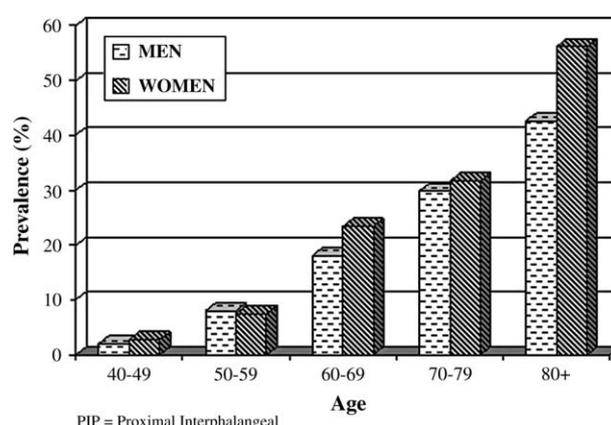


Fig. 3. Prevalence of third PIP, by age, by gender.

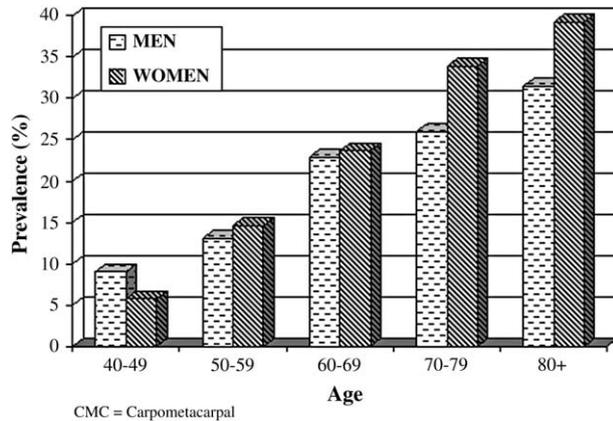


Fig. 4. Prevalence of first CMC, by age, by gender.

OA for 32 joints of the fingers and wrists²¹. Similar to our findings, the DIP joint was the most frequently affected joint in all age categories for both sexes.

We reported that the DIP and PIP joints of the dominant hand demonstrated higher OA prevalence than the non-dominant hand. Conversely, data for the first CMC joint did not support this dominant hand finding. In contrast to the DIP and PIP joints, we report that the nondominant hand demonstrated higher OA prevalence rates for the first CMC joint. While perhaps seemingly counterintuitive, the findings are reflected in earlier published studies²²⁻²⁷. Authors have reported that in right handed persons of both sexes the left thumb was more likely to develop OA than the right thumb²⁷. Acheson and colleagues suggested a possible explanation for such a phenomenon is that, in twisting and gripping actions involving both hands, the left thumb tends to act against the right hand. As a less likely explanation of their findings, the authors commented that

Table II
Joint-specific prevalence/100 of radiographic OA of the hand by dominant hand status, by gender and age group

	Dominant hand only	Nondominant hand only
Second DIP	(%)	(%)
Total	7.2	3.0
<55	5.0	2.0
55-69	7.7	3.4
70+	9.0	3.6
Men	7.1	2.3
Women	7.2	3.2
Third PIP	(%)	(%)
Total	4.6	2.4
<55	1.0	1.3
55-69	5.4	2.4
70+	7.6	3.6
Men	4.9	2.1
Women	4.5	2.5
First CMC	(%)	(%)
Total	2.8	4.8
<55	1.4	3.4
55-69	3.1	5.6
70+	4.0	5.2
Men	3.4	4.6
Women	2.5	4.9

Table III
Prevalence/100 of radiographic OA of the hand Percentage by number of joints affected, bilateral second DIP, third PIP, and first CMC

	Number of joints affected					
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)
Total	9.2	11.7	5.2	7.1	2.8	5.3
Men	9.1	13.4	5.3	6.4	2.8	4.8
Women	9.3	10.9	5.2	7.4	2.8	5.5

in movements which involve tapping or hammering objects, the left thumb is the part of the left hand most likely to be inadvertently knocked.

A 1999 study assessed the association between body weight, BMI, and incident symptomatic OA in 134 matched case-control pairs of women aged 20-89 years²⁸. Their similar findings suggested that obesity is associated with the development of incident hand OA. Other investigators examined the influence of body weight throughout the life course on the development of clinical hand OA²⁹. In contrast to our findings, there was no significant relationship between weight and hand OA in women. However, in men, hand OA was significantly associated with increased weight at ages 26 years, 43 years, and 53 years and with decreased weight at birth.

Our data do not suggest a ceiling effect with regard to age and the prevalence of hand OA. With increasing age, our findings demonstrate a positive relationship between age and hand OA prevalence rates. For all of the five age categories analyzed, each of the three hand joints (DIP, PIP, and CMC) consistently showed an increasing hand OA prevalence rate, even when stratified by gender. Our findings are consistent with a 2004 study by Kalichman *et al.*³⁰ who investigated the pattern distribution of OA in the hands and the influence of age (*N* = 1245). This study indicated that age was the most powerful factor in determining both the frequency and severity of hand OA. In contrast to our results suggesting a positive relationship between age and radiographic hand OA, Bagge *et al.*²⁵ reported opposing findings. Age-related differences in the prevalence of OA were not found.

Limitations

Although the sample for this community-based study was not selected using a randomized design, the study participants are similar to the population from which the cases arose. However, if study subjects chose to volunteer for a reason related to hand OA (e.g., a family member had OA), then our data may overestimate hand OA prevalence rates. Based on demographic factors, we characterized our sample arising from a white, middle- to upper-socioeconomic class subset of Pinellas County and the surrounding area population.

Prevalence studies are helpful to assess the specific impact of any given condition. They assist planners to project and allocate necessary health care resources. They also provide a backdrop of information as future trends in the disease are noted. Additional epidemiological studies addressing hand OA will serve to bridge the gap between the current levels of knowledge about the knee vs the hand. The disease burden of hand OA affects a large percentage of the population. Research efforts that more exhaustively characterize the prevalence of hand OA may contribute

Table IV
Joint-specific prevalence/100 of radiographic OA of the hand, by BMI

BMI* category	N	Second DIP			Third PIP			First CMC		
		Total (%)	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)
<25	1395	31.8	35.4	31.0	15.8	18.1	15.3	18.9	19.8	18.8
25-<30	1242	37.0	35.9	37.7	19.7	17.6	21.0	21.2	20.0	22.0
30+	688	39.2	33.1	42.6	20.4	17.0	22.2	22.5	18.6	24.5

*BMI = weight/height².

toward interventions that, ultimately, impact a rapidly growing segment of our population.

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