New Haven Survey of Joint Diseases XII: Distribution and symptoms of osteoarthritis in the hands with reference to handedness

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It has been known for many years that osteoarthritis can be caused by trauma. More recently however, the concept, first developed by Kellgren and Moore (1952), that osteoarthritis may in some instances involve many joints in the body and have a systemic basis, has gained acceptance. This condition is known as either generalized or primary osteoarthritis, and the degenerative disease of an isolated joint is known as traumatic or secondary osteoarthritis (Kellgren, 1961, 1964).

In this paper a detailed analysis is presented of the patterns and symptoms of osteoarthritis in the hands of a population sample living in a town on the East Coast of the United States. The results indicate that there may be a traumatic element in generalized osteoarthritis.

Materials and methods

THE NEW HAVEN SURVEY OF JOINT DISEASES

This survey was carried out between December, 1963, and March, 1967, and had the following among its general aims:

- (1) The identification in a defined population of the symptomatic and visible stigmata of joint diseases;
- (2) The assessment of the impact of these diseases on the lives of those who suffer from them;
- (3) The evaluation of the resources available in the community for the care of the arthritic.

Several areas of the city were selected for study, each representing a different socio-economic stratum of the community, and the co-operation of the entire population aged 21 and over in each area was sought (Acheson, 1968). The total population enumerated for special study by the survey workers was 2,389. Of these 2,199 completed an interview in which information was obtained concerning symptoms of arthritis and the demographic

characteristics of the respondents (Acheson, Chan, and Payne, 1969a); 1,421 agreed to submit themselves to further examination, including a postero-anterior x ray of both hands (Acheson, Clemett, George, Kolakowski, Payne, and Vicinus, 1965). The present report is concerned with 1,127 of these respondents, who at a subsequent date gave information as to whether they were left or right handed.

ASSESSMENT OF X RAYS

All x-ray assessments considered here were made by one of us (ARC), using the standards of Kellgren and Lawrence (1957). Each joint of each hand was graded individually, classifying disease in the following stages: (1) Doubtful, (2) Minimal, (3) Moderate, (4) Severe; (0) indicated absence of disease. The wrist was classified as a single joint, so that there was information about sixteen joints or joint-complexes in each hand. A detailed study of the variation to which ARC's assessments are liable has been published elsewhere (Wright and Acheson, 1970). This showed that, although his assessments of prevalence were higher than those of two other experienced readers (Dr. John Lawrence and Dr. W. M. O'Brien), his ability to repeat his own assessments was very good. It was found that the rating with the Rogot and Goldberg Index (1966) on his decision whether a joint was diseased or not—that is to say whether it had a grading of 2 or worse—was 90·3 per cent.

Results

Table I (overleaf) compares the severity and frequency of osteoarthritis of the hands in the two sexes in terms of the mean number of joints with disease of more than minimal severity and also the mean score in all the joints. The mean ages of the groups are shown and standard deviations given. Both measures of the disease indicate not only that

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Table 1 *Severity of osteoarthritis by mean score and number of joints affected*

Sex	No. of cases	Score		Number of joints affected		Age (yrs)	
		Mean	s.d.	Mean	s.d.	Mean	s.d.
Male	478	6.663	9.571	4.579	5.486	47.28	13.93
Female	649	7.550	11.908	4.847	6.346	46.10	13.58
Total	1,127	7.174	10.982	4.734	5.995	46.60	13.70

osteoarthritis is more severe in women than in men, but that the variation in women is greater. Further information on sex differences is given in Fig. 1, which shows that in only six joints or joint-complexes are men more frequently affected than women, that is to say the distal interphalangeal joints of the index and fifth fingers, the metacarpophalangeal joints of the thumb, the index, and the middle fingers, and the wrist. Moreover, it is only in the last four that disease is more severe in males.

PATTERN WITHIN THE HANDS

In Fig. 2 (opposite), data for the right and left hands of the two sexes are shown separately. In addition to

the number of joints considered to be diseased, the ranking of the joints within each hand is presented.

Two general patterns are evident. With one exception, every digit in both sexes shows a centrifugal increase in the frequency of disease. The exception is the index finger in men, the knuckle of which on both right and left is much more frequently affected than the proximal interphalangeal joint. The wrist also conforms with this general centrifugal pattern.

The second overall but less regular tendency is for the disease to increase in severity from the ulnar to the radial side of the hand. But it should be noted that, in both hands and in both sexes, the distal interphalangeal joint of the little finger is more frequently affected than the distal interphalangeal

FIG. 1 *Summary diagram by sex of the two hands combined, showing the distribution of osteoarthritis seen by x ray. Each square represents a joint, the wrist being treated as a single joint. Mean severity score is given above and the percentage in whom a joint was graded as having disease of 'minimal' severity or worse is shown below.*

		LEFT					RIGHT				
		Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP		30.5	21.7	31.4	40.3			44.4	33.2	23.5	34.3
		3	5	2	1			1	3	5	2
PIP		7.8	6.7	8.1	7.2	24.3	24.8	7.4	13.0	8.1	10.2
		11	13	10	12	4	4	13	8	12	10
MCP		1.7	3.3	8.0	8.7	17.6	17.6	16.0	12.2	2.5	2.0
		16	14	9	8	6	6	7	9	15	16
MCC						10.8	8.2				
						7	11				
WRIST				3.0					4.0		
				15					14		

		FEMALES									
		Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP		28.1	24.1	34.4	38.9			45.0	38.3	27.5	31.4
		3	5	2	1			1	2	4	3
PIP		11.1	10.2	12.4	11.9	25.9	24.8	13.8	17.9	13.3	12.3
		10	11	8	9	4	5	7	6	8	9
MCP		2.1	2.8	4.8	7.3	12.8	11.3	9.7	7.3	2.5	1.5
		16	14	13	12	7	10	12	13	14	16
MCC						13.0	10.1				
						6	11				
WRIST				2.5					1.7		
				15					15		

FIG. 2 Comparison by sex of the frequency with which the joints are affected by osteoarthritis of at least minimal severity in the two hands. In each square the upper entry indicates the relative frequency (per cent.) of the disease in that joint, and the lower entry ranks the joint within the hand according to frequency from 1 to 16.

joint of the ring finger. The proximal interphalangeal joints also fail to conform to the generalization of a rising gradient from the ulnar to the radial side.

On the left in both sexes the thumb is, next to the distal interphalangeal joints, the part of the hand most frequently affected. In the right hand, however, disease in the thumb offers less of a clear cut pattern.

Finally, it should be noted that, while the knuckles of the index and middle fingers of the male rank between 7th and 9th in the two hands, they rank 12th and 13th in the female. Thus the differences between the frequency and severity of osteoarthritis in the male and female knuckles are absolute as well as relative (Figs 1 and 2).

LATERAL DIFFERENCES BETWEEN THE HANDS IN ALL SUBJECTS

It is evident from Fig. 2 that there is a general tendency for the right hand in both sexes to be more

frequently and severely affected by osteoarthritis than the left. For many joints taken individually this difference was significant, and it was highly significant when all the joints were taken together (see bottom row of Table II). The patterns already described, when considered together with the literature, seemed consistent with the view that trauma plays an important role in the aetiology of osteoarthritis in the hands.

This conclusion led to the formulation of the null hypothesis that there is no difference between the frequency (or severity) of osteoarthritis in the joints of the right and left hands in right-handed subjects. The alternative hypothesis is that osteoarthritis would be more frequent (or more severe) in the joints of the right hand in right-handed subjects. The corollary of this is that when left-handed subjects are considered alone, osteoarthritis is in excess (or is more severe) in their left than in their right hands.

Table II Average number of joints affected by osteoarthritis in each hand according to handedness of respondent

Dominant hand	No. of cases	Age (yrs)		Number of joints affected				Difference	<i>t</i>	<i>P</i>
				Left hand		Right hand				
				Mean	s.d.	Mean	s.d.			
Left	97	42.2	12.8	1.835	2.687	1.887	2.723	0.052	0.428	>0.6
Right	1,030	47.0	13.7	2.274	3.031	2.555	3.160	0.281	6.87	<0.001
Total	1,127	46.6	13.7	2.236	3.004	2.498	3.130	0.262	6.73	<0.001

HANDEDNESS AND LATERAL DIFFERENCES BETWEEN THE HANDS

Table II summarizes the results concerning laterality of disease and handedness. There were 97 persons (8.6 per cent.) who were left-handed. It can be seen that they have osteoarthritis less frequently and less severely than the right-handed, but this is presumably because they are on average 5 years younger. It can also be seen that, although the alternative hypothesis is satisfied, the corollary is not, because when the two hands of the left-handed population are considered the amount of osteoarthritis in them is almost exactly equal.

The summary comparison which is made in Table II is further analysed and presented in much greater detail in Figs 3 to 8. When a difference in either score or frequency exists between two hands, an entry has been made in the appropriate square for the hand in which the excess disease exists. If there is no difference a zero is entered in the square on both sides. An asterisk indicates cases in which the difference found reaches the 5 per cent. level of significance. The test statistics used depend on the circumstances; details of these are given in the legends of the relevant Figures.

Among the right-handed (Fig. 3) a significant excess of disease on the right is present in nearly all joints, and the patterns for severity and frequency are very similar. This is also true when the sexes are considered separately, with the exception of right-handed females in whom the metacarpophalangeal joint of the index finger on the right is more severely but not more frequently diseased than that on the left.

Joints which do not show a significant excess of disease on the right fall into two classes. The first of these are joints such as the knuckles of the ring and little fingers and the wrist, which are rarely diseased anyway; these rank 14th, 15th, and 16th (see Fig. 2).

The second exception is the thumb, the interphalangeal joint of which, though it ranks 4th or 5th in Fig. 2, shows no suggestion of laterality at all. However, in contrast to all the other joints, it seems

that there is substantially more frequent and severe disease in the *left* than in the right metacarpophalangeal joint of the thumb in right-handed subjects. The metacarpophalangeal joint of the thumb also seems to follow the same general pattern, in that there tends to be an excess of disease on the left.

The pattern in left-handed subjects is highly irregular (Fig. 6) and suggests that in them disease tends to be equally distributed on both sides. Only three joints show any excess:

(1) Disease tends to be more severe in the metacarpophalangeal joint of the left little finger when the sexes are considered together, but not when they are considered separately (Fig. 6).

(2) The distal interphalangeal joint of the left little finger shows more frequent disease in males (Fig. 7) but this is not the case in females (Fig. 8).

(3) The interphalangeal joint of the left thumb is more severely affected in left-handed persons, both when the sexes are taken together (Fig. 6) and when females are considered separately (Fig. 8).

SYMPTOMS OF OSTEOARTHRITIS IN THE HANDS

Table III (overleaf) shows by sex how far the symptoms in the hands of morning stiffness, nocturnal pain, and swelling are associated with radiological evidence of osteoarthritis.

In males nocturnal joint pain and morning stiffness are rare, and no association whatsoever exists between them and disease shown by x ray. Joint swelling is a little more common, but the association between it and osteoarthritis does not quite reach the 5 per cent. level of significance.

In contrast, among women all three symptoms are much more frequent. Swelling and morning stiffness are, moreover, significantly associated with osteoarthritis.

In conclusion it would seem that minor repeated trauma plays an important role in the genesis of osteoarthritis of the hands, but that both in the hands and elsewhere in the body the disease is of complex multifactorial origin.

	LEFT SEVERITY					RIGHT SEVERITY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP							0.081* 1167	0.028* 1158	0.036* 1163	0.073* 1107
PIP				0.001 1165		0.014 1160		0.063* 1167	0.033* 1163	0.013 1128
MCP	0.002 1166	0.005 1176			0.010 1172		0.054* 1176	0.048* 1178		
MCC					0.060 1179					
WRIST			0.004 1156							

	LEFT FREQUENCY					RIGHT FREQUENCY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP							61* 165	34* 178	28* 162	51* 161
PIP					4 154		9 103	66* 128	30* 82	16 76
MCP	1 29	6 38			12 140		52* 142	43* 141		
MCC					33 89					
WRIST			3 29							

FIG. 3 Comparison of frequency and severity of osteoarthritis in the two hands of right-handed persons, both sexes together. An entry was made in a square if there was an excess of disease on the side concerned, or if no difference between the two sides was detected. A blank square indicates that the joint concerned was less frequently (or severely) diseased than its opposite number.

The upper portion is concerned with the severity of the disease in the two hands. The upper entry in each square denotes the excess score for the joint concerned, and the lower the number of pairs considered. A one-tailed *t* test is used for paired observations, and joints in which the difference exceeds zero at a probability of less than 5 per cent. are marked with an asterisk.

The lower portion concerns the frequency of the disease. The upper entry in a square is the excess number of joints graded 'minimal' or worse on the side concerned; beneath is the sum of those who have the disease in the left joint but not the right (A) and those who have the disease in the right joint but not the left (B). The McNemar test (Siegel, 1956), which is based on the following formula:

$$\chi^2_{(1)} = \frac{(|A - B| - 1)^2}{A + B}, \text{ is used when } A + B > 10.$$

Again differences exceeding zero at a probability of less than 5 per cent. are marked with an asterisk. This method of presentation of data is used again in Figs 4 and 5.

Discussion

The literature on osteoarthritis contains differing usage and definitions for almost every important term—including the name for the condition itself. Thus, Kellgren and Lawrence, whose approach comes nearest to giving the detail presented in this paper, consider in all their population studies, both hands in combination when they report their x-ray readings, and give only the highest reading for each row: 'The grading for groups of joints, as for example the distal interphalangeal joints of the hands, indicated the severity in the most affected

joint' (Kellgren and Lawrence, 1957). They do not state how they classify the two more distal joints in the thumb. As we shall see, the patterns they find on a row by row basis have much in common with those reported here, but their data do not permit comparisons to be made between the hands or within each hand. Comparison of the distribution and patterns shown here with the U.S. National Health Survey is even less feasible, because the technique used in it was as follows: 'The degree of disease assigned to the hands corresponded to the grade of the most severely affected joint of the hands (but excluding any single isolated joint where involvement

Table III *Persons with radiological osteoarthritis according to whether they had symptoms in their hands, by sex*

Symptoms		Sex									
		Male					Female				
		Total no.	Mean no. of joints affected	No. with at least one joint affected	χ^2	P	Total no.	Mean no. of joints affected	No. with at least one joint affected	χ^2	P
Morning stiffness	Present	17	4.82	12	}0.03	>0.8	72	7.11	57	}10.21	<0.01
	Absent	461	4.57	330			577	4.56	340		
Nocturnal joint pain	Present	5	7.00	3	}0.01	>0.9	32	8.37	25	}3.36	>0.05
	Absent	473	4.55	339			617	4.66	372		
Joint swelling	Present	27	8.81	24	}3.37	>0.05	117	9.10	100	}34.24	<0.005
	Absent	451	4.32	318			532	3.91	297

FIG. 4 *Comparison of frequency and severity of osteoarthritis in right-handed males (for full details see legend to Fig. 3).*

was rated at least two grades more severe than the other joints in the hand' (Roberts and Burch, 1966). There are also differences in the definition of trauma. Whereas Lawrence, Bremner, and Bier (1966) tend to look upon this as overt trauma or an injury which is of sufficient severity to be remembered and reported at a single interview, Engel and Burch (1966) again reporting in the U.S. National Health Survey, write of 'repetitive household

tasks involving minor trauma'. It would seem this latter sense of the wear and tear of frequent minor knocks and bruises is the most appropriate for the present purpose. Stecher and Karnosh (1947) observed that neither radiological osteoarthritis nor Heberden's nodes form in paralysed hands; thus, although many feel that the aetiology of these lesions has a systemic basis, there is reason to believe that their development also requires the wear and tear

	LEFT					RIGHT				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP							0.107* 662	0.041* 662	0.035* 659	0.058* 638
PIP						0.001 657	0.011 660	0.072* 665	0.038* 664	0.005 646
MCP	0.004 664	0.006 666			0.030 660		0.033* 664	0.038* 665		
MCC					0.078 665					
WRIST			0.012 661							
FREQUENCY										
DIP							39* 83	26* 86	20* 88	24* 94
PIP					6 88		13 61	38* 78	22* 48	7 39
MCP	2 14	1 19			12 62		16 64	19* 57		
MCC					20 48					
WRIST			6 10							

FIG. 5 Comparison in right-handed females.

which goes with the regular use of a joint. Examples of such cases are to be found in the classic studies of Bauer and Bennett (1936).

The data presented here are wholly compatible with the view that there is also a relationship between the development of osteoarthritis of the finger joints and trauma, whether or not Heberden's nodes* are present. It has already been stated above that detailed comparison with the surveys of Kellgren and Lawrence is difficult because of the different techniques in assessment; however, the results obtained in the general populations in Leigh, Wensleydale, and Jamaica (Kellgren and Lawrence, 1958; Bremner, Lawrence, and Miall, 1968), as well as the special occupational groups of cotton operatives and foundry workers (Lawrence, 1961; Lawrence, Molyneux, and Dingwall-Fordyce, 1966) have certain features in common with the New Haven data.

In each of these six populations, the distal interphalangeal joints of both sexes are, by a considerable margin, the most frequently affected, though it should be noted that some of the cotton workers and most of the controls for the foundry workers are in-

cluded in the Leigh sample. It is also true of the distribution of Heberden's nodes reported by Stecher (1955). With the exception of the men from Wensleydale and the women from Jamaica, the wrist is the least commonly involved joint in both sexes—the foundry workers and their controls (Lawrence and others, 1966) are excluded from the comparison for the wrist because in that study the prevalence of disease in the intracarpal joints was presented together with that for the carpometacarpal joints. To the knowledge of the present authors no data are available on the frequency of movement of the joints of the hand, but it seems likely that if a system were devised which took this together with frequency of minor knocks and bruises into account the distal interphalangeal joints would be shown to suffer much more frequently than the wrists. Moreover, on this same basis, it seems quite reasonable that the distal interphalangeal joint of the index finger should be most frequently and most severely affected in both hands of both sexes, as it is that the metacarpophalangeal joints of the index and middle fingers—the knuckles—of the male should have more frequent and severe disease than those of the female, and that they should also rank

* Although information on prevalence of Heberden's nodes is available for a subsample of the New Haven population, yet to be analysed, it is not available for all the respondents considered in this report.

	LEFT SEVERITY					RIGHT SEVERITY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP							0.000 107	0.009 108	0.074 108	0.050 100
PIP		0.009 108			0.085* 106		0.047 106	0.018 108		0.086 104
MCP	0.047* 107	0.018 108	0.009 108				0.009 108			
MCC					0.028 108					
WRIST									0.009 107	

	LEFT FREQUENCY					RIGHT FREQUENCY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP	7 15					6 18	4 18	3 11		
PIP		2 2/6			3 3/9		5 1/7	1 4/9		6 1/8
MCP	4 0/4	1 1/3	1 11		0 16	0 16	4 12			
MCC					2 10					
WRIST									1 0/1	

FIG. 6 Comparison (similar to that shown in Fig. 3) for left-handed males and females. The method is the same as that used in Figs 3 to 5. In comparisons of frequency, in instances where $(A + B)/2 < 5$ the binomial test is used (for definitions of A and B see legend to Fig. 3). The use of the binomial test can be identified by squares containing three entries; in them the upper digit is, as before, the excess number of diseased joints on the side concerned, i.e. $(A-B)$, and the lower fraction $X/(A+B)$ where $X = \text{minimum}(A,B)$, i.e. A or B whichever is the smaller. If no fraction is shown the McNemar test is again used.

higher within the male hand (see Figs 1 and 2). Perhaps the most convincing evidence in favour of the role of minor trauma playing a causal role, however, is the fact that almost every joint in the right hand of right-handed persons of both sexes has disease which is more frequent and more severe than that in their left hands. While the absence of laterality in the disease of left-handed people does not provide positive support for the hypothesis, for three reasons it is not contradictory to it:

- (i) The left-handed subjects are on average 5 years younger than the right-handed, and therefore have a lower overall prevalence of disease;
- (ii) There are relatively few of them, and therefore patterns are less likely to be clearly evident;
- (iii) In general, left-handed persons are more likely to use their right hands than are right-handed persons to use their left hands.

Worthy of comment is the finding that in right-handed persons of both sexes the left thumb is more likely to develop osteoarthritis than the right. A

possible explanation is that, in twisting and gripping actions involving both hands, the left thumb tends to act against the right hand. A less likely explanation is that, in movements which involve tapping or hammering objects, such as a nail into wood, the left thumb is the part of the left hand most likely inadvertently to be knocked.

Differences in methods of analysing and collecting data make comparison between our findings with regard to sex and age with those in the other studies difficult. In the surveys of Lawrence and Kellgren and in the U.S. National Health Survey, osteoarthritis is found to be commoner in the male before the age of 44, but much commoner in the female from that age onwards. Since all these sources, together with our own data (Acheson, Collart, Greenberg, and Clemett, 1969b) indicate that osteoarthrotic changes are both mild and unusual in people under 45 years of age, and since the analysis reported here is already extensive, no attempt was made to consider this younger group separately.

	LEFT SEVERITY					RIGHT SEVERITY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP	0.125 56			0.085 59				0.000 60	0.067 60	
PIP		0.050 60				0.017 60	0.102 59	0.033 60		0.053 57
MCP	0.033 60					0.017 60	0.100 60	0.017 60	0.000 60	
MCC					0.033 60					
WRIST										
									0.017 59	
FREQUENCY										
DIP	6* 1/8	0 3/6					1 13	2 12	0 3/6	
PIP		2 1/4	0 3/6		0 3/6	0 3/6	5 0/5	0 3/6		3 1/5
MCP	2 0/2	0 1/2	0 4/8		0 10	0 10	5 7	0 4/8	0 1/2	
MCC					2 2/6					
WRIST										
									1 0/1	

FIG. 7 Comparison in left-handed males (full details in legend to Fig. 6).

	LEFT SEVERITY					RIGHT SEVERITY				
	Little	Ring	Middle	Index	Thumb	Thumb	Index	Middle	Ring	Little
DIP							0.104 48	0.021 48	0.083 48	0.045 44
PIP				0.021 47	0.217* 46			0.000 48	0.042 48	0.128 47
MCP	0.064 47	0.042 48	0.042 48	0.021 48		0.000 48				
MCC					0.021 48					
WRIST										
									0.000 48	
FREQUENCY										
DIP	1 3/7						5 0/5	2 2/6	3 1/5	
PIP		0 1/2		0 1/2	3 0/3		0 1/2	1 1/3	0 1/2	3 0/3
MCP	2 0/2		1 1/3	1 2/5	0 3/6	0 3/6			1 0/1	
MCC					0 2/4	0 2/4				
WRIST										
					0 0/0				0 0/0	

FIG. 8 Comparison in left-handed females.

However, the present finding that osteoarthritis of the hands is rather more frequent and more severe in females when all age groups are combined is wholly consistent with the other studies.

Most previous studies which have analysed the relationship between osteoarthritis and symptoms have treated the disease as the independent and the symptoms as the dependent variable. This requires that a case of osteoarthritis be defined and this definition presents certain problems; in Table III therefore the opposite approach was made. In an earlier report, Acheson and others (1969a) showed that women in New Haven have symptoms of joint disease more frequently than men; they are more likely than men to have any symptom in more than one area of the body, and if they have one of the three symptoms they are more likely to have one or both of the other two. Table III shows that if women have any of the symptoms they are also more likely than men to have severe osteoarthritis—the 7.1 per cent. of the women with morning stiffness had an average of 7.11 arthrotic joints compared to 4.82 in the 3.6 per cent. of the men; the differences for the other two symptoms are in the same direction but are not so great. These results are complementary to those of Lawrence and others (1966), who studied the prevalence of pain according to the severity of osteoarthritis of the distal interphalangeal joints, taking into account whether or not rheumatoid arthritis was present. For those with radiological osteoarthritis graded moderate or severe, pain was always commoner in women, regardless of whether or not rheumatoid arthritis was observed. The sex differences they reported for pain with osteoarthritis of the interphalangeal joints were not, however so clear-cut.

While the present data support the view that there is a traumatic component in osteoarthritis of the fingers, this is not to say that they are not wholly consistent with findings in other studies, which indicate that osteoarthritis involving many fingers is a systemic disorder or that it has a strong familial basis (Kellgren, Lawrence, and Bier, 1963). Table III, and another analysis (Acheson and others 1969b), indicate that swelling of the fingers is the *local* symptom most closely associated with osteoarthritis of the hands. In an earlier paper, however, it was shown that morning stiffness was the *generalized* symptom most closely associated with osteoarthritis in the hands (O'Brien, Clemett, and Acheson, 1968). Whereas only 12.2 per cent. of those who had no osteoarthrotic joints in their hands complained of morning stiffness, 42 per cent. of the 142 persons with more than eleven joints shown by x ray to be affected reported this symptom, as did all the three persons with more than sixteen joints involved. This finding was statistically highly significant, and taken

together with the results in Table III points strongly to osteoarthritis having a systemic basis; coincidentally, it supports the statement of Cobb, Merchant, and Rubin (1957) that morning stiffness tends to be a generalized symptom. Indeed, further preliminary unpublished analyses of these data lend support to the findings of Kellgren and Lawrence (1958) and of Engel (1968) that obesity or body weight are associated with osteoarthritis of the hands in men, and to a lesser extent in women. This, together with the association of osteoarthritis with raised serum cholesterol shown by Kellgren (1961), and the more generalized and severe form that the disease takes in women, all suggest that osteoarthritis is nearly always a disease with a systemic basis. Clearly, those cases of osteoarthritis which involve one joint, and one joint only, with a strong history of unusually damaging trauma must be treated as exceptions, but the present data, and those collected in the many surveys undertaken by Kellgren and Lawrence, imply that, either an absolute or on a relative basis, such cases are rare.

In conclusion, therefore, we are of the opinion that osteoarthritis, like most if not all of the common chronic diseases, is of complex multifactorial origin. Although it may take nodal or non-nodal forms, or may on occasion be a sequel to other arthritides, repeated petty traumata have an important role to play in the genesis of osteoarthritis in the hands as well as in other parts of the body.

Summary

An analysis is presented, on a joint-by-joint basis, of the distribution of osteoarthritis detected in the radiographs of the two hands of 1,127 persons aged 21 and over in the general population of New Haven, Connecticut. Disease was more severe and more frequent in women than in men. Within each hand in each sex the disease tended to have a centrifugal distribution; there was also a less consistent tendency for it to be more severe on the radial than on the ulnar side of the hand. The observation that in both sexes disease was more frequent in the right hand than in the left led to the hypothesis that this difference was due to handedness. The hypothesis was substantiated in those whose right hand was dominant, but not among those who were left-handed. The thumb was exceptional in that the left thumb tended to be more severely affected in right-handed people of both sexes. The symptoms in the hands of morning stiffness, joint swelling, and nocturnal joint pain were commoner in women than in men. In women swelling and morning stiffness were significantly associated with radiological evidence of osteoarthritis in the hands, but there were no such associations in men.

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Le relevé des maladies articulaires à New Haven: La distribution et les symptômes de l'ostéoartrite des mains en se référant à l'usage des mains

RÉSUMÉ

Une analyse est présentée au sujet de la distribution de l'ostéoartrite découverte dans les radiographies des deux mains de 1,127 personnes âgées de 21 ans et au-dessus dans la population générale de New Haven, Connecticut. La maladie était plus grave et plus fréquente chez les femmes que chez les hommes. Dans chaque main de chaque sexe la maladie avait tendance à avoir une distribution centrifuge; il y avait aussi une tendance

El estudio de enfermedades de las articulaciones en New Haven: Distribución y síntomas de osteoartritis en las manos, con referencia a su uso

SUMARIO

Se presenta un análisis, sobre la base de articulación por articulación, de la distribución de la osteoartritis detectada en las radiografías de las dos manos de 1.127 personas de 21 o más años de edad en la población general de New Haven, Connecticut. La enfermedad era más severa y más frecuente en las mujeres que en los hombres. En cada mano en cada uno de los sexos, la enfermedad tendía a presentar una distribución centrífuga; también se

moins uniforme de la maladie à être plus grave du côté radial plutôt que du côté cubital de la main. L'observation que chez les deux sexes la maladie était plus fréquente dans la main droite que dans la main gauche a conduit à l'hypothèse que cette différence était due à l'usage d'une main plutôt que de l'autre. Cette hypothèse était justifiée chez ceux où la main droite dominait mais pas chez ceux qui étaient gauchers. Le pouce était exceptionnel en ce que le pouce gauche avait tendance à être plus gravement affecté chez les droitiers des deux sexes. Les symptômes des mains: raideur matinale, enflure des articulations et douleurs articulaires nocturnes, étaient plus communs chez les femmes que les hommes. Chez les femmes, l'enflure et la raideur matinale étaient associées d'une manière significative avec la présence radiologique de l'ostéoartrrose des mains, mais cette association n'était pas observée chez les hommes.

notó una tendencia menos consistente a ser más severa en el lado radial que en el ulnar de la mano. La observación de que en ambos sexos la enfermedad era más frecuente en la mano derecha que en la izquierda, condujo a la hipótesis de que esta diferencia era debida al uso de la mano. La hipótesis fue substanciada en aquellos cuya mano derecha era dominante, pero no en los zurdos. El pulgar resultó ser excepcional en el sentido de que el izquierdo tendía a ser más severamente afectado en personas diestras, en ambos sexos. Los síntomas de rigidez matutina, hinchazón de las articulaciones y dolores articulares nocturnos eran más comunes en mujeres que en hombres. En las mujeres, la hinchazón y la rigidez matutina estaban más significativamente asociadas con pruebas radiológicas de osteoartritis en las manos, pero no se descubrió tales asociaciones en los hombres