Low Prevalence of Knee and Back Pain in Southeast China; the Shantou COPCORD Study

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ABSTRACT. ***Objective.*** To determine whether the previously noted low prevalence of knee pain (KP) and lumbar pain (LP) in rural southern China compared with the high prevalence observed in North China was also true in a southern urban population.

Methods. A population based sample of 2040 adults ≥ 16 years of age was studied in Chenghai City, close to the rural area previously studied on the southeast coast of China. Primary healthcare workers administered the COPCORD Phase I and II questionnaires. Those with rheumatic symptoms were recalled for medical examination, with a response rate at examination (phase III) of 98.4%. Those suspected of having arthritis had radiographs and laboratory tests. Prevalences were age and sex adjusted to the total of populations previously reported.

Results. (1) The prevalence for all rheumatic symptoms at phase III was 18.1%. Of the 7.5% with KP, 55% had osteoarthritic changes on radiograph (KOA) compared with 29% of a sample with no KP ($p < 0.001$). Of the 11.5% with LP, 69% had degenerative changes on lumbar spine radiograph (LOA). (2) Of residents in single-level houses the prevalence was 5.6% for KP and 7.9% for LP, whereas in 4 to 6-level apartment buildings these rates were significantly higher, 9.1% and 16.2%, respectively. All these pain rates were significantly lower than noted in rural North China. The prevalence of pain together with radiographic OA changes in the knee (KOA) was half the rate in single-floor residents (2.7%) compared to apartment residents (5.3%), as was lumbar spine degenerative disease (5.3% vs 11.5%).

Conclusion. The prevalence of knee and lumbar spine pain in this southern urban sample was confirmed to be much lower than in the rural sample in the North, although higher than in the rural sample in the South. Comparing COPCORD studies of Han Chinese in Shanghai and Malaysia there was a decrease in prevalence of knee and back pain with latitude, suggesting an association with climate. Knee and back pain and radiological degenerative changes in the knee and lumbar spine were twice as prevalent in apartment residents than in those living in older single-level houses. Further study is needed to explain these observations. (J Rheumatol 2004;31:2439–43)

Key Indexing Terms:
RHEUMATISM EPIDEMIOLOGY CHINA KNEE
LOW BACK PAIN OSTEOARTHRITIS CLIMATE

The China-ILAR (International League Against Rheumatism) studies of rheumatic diseases in rural Han Chinese populations from 1984 to 1988, in villages near Beijing at 40° latitude and southeastern Guandong at 23° latitude, showed a similar prevalence of rheumatoid arthritis (RA) and ankylosing spondylitis (AS). These rates were about half those found in populations of European origin[1]. In contrast, the prevalence of knee pain (KP), lumbar pain (LP), and general rheumatic pain was higher in the North than in the South, particularly for KP, which was 10 times as prevalent[1]. Intermediate figures were found in urban Shanghai[2], at 32° latitude, and low rates in Chinese living in Malaysia near the equator (Table 1).

In the rural study in the Beijing area[1], 39% of 4192 subjects had KP and in a factory in Beijing City 22% of 2256 had KP[3]. Although the same ILAR protocol was used, in which all subjects were medically examined, in the initial North and South studies[1], and one author (QYZ) took part in both studies, the possibility of differences in methodology was raised, so a second study was undertaken in urban Chenghai City close to the site of the original rural study. This is 300 km east of Hong Kong on the Southeast coast of

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Submitted September 18, 2002; revision accepted July 15, 2004.

Table 1. Prevalence of joint pain ever adjusted for age and sex to the total of the populations in Wigley, *et al* [1], by site of pain in 5 studies of Han Chinese and the ILAR or COPCORD protocol used. Data are percentages.

	Beijing Rural, ILAR[1]	Shanghai Urban, COPCORD[2]	Shantou 1 Rural, ILAR[1]	Present, Shantou 2 Urban, COPCORD	Malaysia Rural, COPCORD[13]
Latitude°	40	32	23	23	5
N	4213	2010	5058	2040	474
Knee	30	11	2.6	6.5	5.7
Lumbar	35	15.8	13	10.2	8.8
Shoulder	5	4.8	2	4.9	2.2
Neck	5	3.5	2	4.1	3.1
Elbow	4.4	0.5	1.4	2.4	1.5
Dorsal	1.5	—	2	0.5	2.6

China in the Shantou special economic zone. In the ILAR study physicians examined all subjects, but only those with symptoms were examined by physicians in the COPCORD (Community Oriented Program for the Control of Rheumatic Disease) protocol used in this study[4]. In a preliminary report of the present urban study[5] the prevalence of KP was confirmed to be lower than in the North although higher than in the initial rural study, which was immediately east of Chenghai City in eastern Guandong province.

MATERIALS AND METHODS

This was a study of an urban population aged 16 years and over. All the 2040 residents in areas of the neighborhood committees 1, 2, 3, and 19 of the East Administration of Chenghai City were interviewed by primary healthcare workers going house to house from February to June 1995 (Table 2). Those confirmed to have musculoskeletal symptoms were recalled for physical examination (phase III) by physicians who had access to the initial questionnaires.

The COPCORD questionnaires had been translated into Chinese script and backtranslated into English in 1992 with no change in meaning[2]. Printed information on the study was distributed in advance. Six primary healthcare workers, 2 nurses, 2 resident physicians from the Chenghai Hospital, and 3 rheumatologists were given standard instruction before the survey. The phase I and II questionnaires were administered simultaneously.

Examinations were done in a health center by the physicians with daily supervision by rheumatologists. Subjects unable to walk to the center were examined at home. Radiographs and laboratory tests (rheumatoid factor, antinuclear antibodies, and urate level) were requested where indicated clinically. Radiographs were taken of those with rheumatic symptoms at the Chenghai Hospital. Authors JD, RDW, and SLC visited the site while the survey was in progress to assess the procedure.

To ensure comparability with the previous studies[1], lateral and anteroposterior non-weight-bearing radiographs were taken of the knees for those with KP. Posteroanterior and lateral views of the lumbar spine were taken in those with back pain and/or leg or buttock numbness. Osteoarthritis (OA) was diagnosed when there was pain together with Kellgren-Lawrence grade II to IV osteoarthritic changes[6]. Two Chinese radiologists (denoted CR here) at the Shantou Medical College read all radiographs separately without knowledge of clinical details, and arrived at a consensus opinion. The highest grade in either radiographic view was recorded. These were later compared with independent readings by author RDW of 291 knee radiographs, giving a kappa value of 0.42. These included knee radiographs taken later of 110 volunteer subjects who did not have KP. One-quarter of the latter were not in the original sample but were added to make the age and sex distribution similar to those with KP. Of these readings, 29% (CR) and 34% (RDW) had grade II to III changes. Of 234 subjects with back pain having lumbar spine radiographs, 69% (CR) and 62% (RDW) of the readings (kappa 0.33) were found to have grade II to IV OA changes (lumbar OA, LOA). These differences were considered small so the initial consensus readings of the local radiologists were used in the analysis (Table 3). Radiographs of other joints were graded similarly. Heberden's nodes were diagnosed as indicating OA when identified clinically.

The criteria used for diagnosis are given in the following references: ankylosing spondylitis (AS)[7] and gout[8]; and systemic lupus erythematosus (SLE)[9] and rheumatoid arthritis (RA)[10].

Standard methods were used for the general analysis. As in the initial studies[1], age/sex standardization to the combined North and South populations[1] was made by the direct method[11] and the kappa test for comparability of radiograph readings, the Mantel-Haenszel test for comparisons of age/sex adjusted rates, and the chi-square test as described[11]. The Cochran-

Table 2. Data for all responders in the present study and age and sex-specific rates for pain at any site from the phase I and II interviews by primary healthcare workers.

	All Responders, n			Positive Responders, n		Men + Women, n
Age, yrs	Men	Women	Total	Men (%)	Women (%)	Total (%)
16–20	68	71	139	0 (0)	1 (1.4)	1 (0.7)
21–30	200	217	417	6 (3.0)	13 (6.0)	19 (4.6)
31–40	271	299	570	15 (5.5)	40 (13.4)	55 (9.6)
41–50	171	169	340	28 (16.4)	50 (29.6)	78 (22.9)
51–60	111	126	237	25 (22.5)	59 (46.8)	84 (35.4)
61–70	115	110	225	29 (25.2)	49 (44.5)	78 (34.7)
71–80	44	42	86	18 (40.9)	27 (64.3)	45 (52.3)
> 81	5	21	26	0 (0)	9 (42.9)	9 (34.6)
Total	985	1055	2040	121(12.3)	248 (23.5)	369 (18.1)

Table 3. Subjects with positive musculoskeletal pain ever and the numbers of those with pain and radiographic diagnosis of OA (N), and percentage of the whole population sample and percentage of OA in those with pain (not adjusted for age/sex).

	Pain, n (%)	Pain + OA, n	Percentage of Whole Sample	Percentage with OA of Those with Pain
Lower back	234 (11.5)	161*	7.9	69
Knee	153 (7.5)	84	4.1	55
Shoulder	108 (5.3)	1	0.05	1
Neck	94 (4.6)	38	1.9	40
Elbow	54 (2.6)	8	0.4	15
Ankle	47 (2.3)	6	0.3	13
Hand**	42 (2.1)	—	—	—
Wrist	30 (1.5)	8†	0.4	27
Hip	36 (1.8)	3	0.2	8
Feet	23 (1.1)	2	—	9
Upper back	12 (0.5)	3	0.2	25

* Includes lumbar back pain and/or sensory symptoms. ** Includes Heberden's nodes. † Wrist and hand OA combined.

Armitage trend analysis[12] was used in comparing the prevalence in different floor levels in the apartment buildings.

RESULTS

Questionnaires were completed for all 2040 subjects (Table 2). Of these, 18.1% (248 women, 121 men) had ever had rheumatic complaints. At the examination (phase III) one person had died, 2 families had moved out of the area; 3 families refused and the remainder were not traced, so the response rate at phase III was 98.4%. A total of 1486 (72.8%) people lived in single-level older homes and 554 (27.2%) in 4 to 6-level apartments built 18 to 20 years before the study. The occupants were predominantly government employees with administrative occupations, which were considered similar for the different types of housing.

Table 3 shows the population prevalence of complaints of pain-ever and diagnosis of OA that was recorded if there were both pain and OA (degenerative) changes of grades II to IV[6]. We observed 7.9% of the whole population had knee pain. Of these, 55% had knee OA (KOA) of grade II or III. None reached grade IV. Of the volunteer sample with no KP the prevalence of OA grade II to III was 29%. This was significantly lower than the prevalence of knee OA in those with KP ($p < 0.001$). There was an increase in prevalence with age for pain and radiographic changes for both the knee (KOA) and lumbar spine OA (LOA). Joint pain and/or abnormality on examination were more prevalent in women than men in all joints except for the hip.

Of the 234 with lumbar pain and/or leg paresthesia, 161 (69%) had degenerative changes in the lumbar spine radiographs (LOA). All were grade II or III, except for one at grade IV. Thus 7.9% of the whole population was classed as having degenerative disease of the lumbar spine (LOA); 17 women and 10 men had lumbar disk narrowing.

Four of the 72 shoulder radiographs showed minor degenerative changes. Shoulder pain with no OA on radiographs in 35 cases (1.7%) was assumed to be due to rotator cuff strain. The prevalences of KP, LP, and OA changes in knee and lumbar radiographs were found to be roughly double for residents in multilevel apartment buildings compared to those in single-level residences for each sex (Table 4). The sex predominance in women was greater in single-level than multilevel residences for KOA and LOA.

The KP prevalence in the initial rural study in the South[1]

Table 4. Prevalences expressed as percentages of knee pain and lumbar pain and positive radiographs, showing a significantly higher prevalence in multilevel apartments than in single-level residences. Age-adjusted prevalences are shown in parentheses.

	Apartments			Single-Level			Total
	Men	Women	Total	Men	Women	Total	
Number	276	278	554	709	777	1486	2040
Knee pain	8.3	11.9	10.1 (9.1)	3.4	9.4	6.5 (5.6)*	7.5 (6.5)
Knee radiograph	4.7	7.2	6.0 (5.3)	1.8	4.9	3.4 (2.7)*	4.1 (3.4)
Lumbar pain	13.8	20.5	17.1 (16.2)	4.9	13.4	9.4 (7.9)**	11.5 (10.2)
Lumbar radiograph	10.9	14.0	12.5 (11.5)	3.2	8.9	6.2 (5.3)**	7.9 (7.0)

Significance of differences between single-floor and multilevel apartment residences (Mantel-Haenszel test): * $p < 0.01$, ** $p < 0.001$.

(Table 1), 2.6% (age adjusted), was significantly lower (Mantel-Haenszel, $p < 0.001$) than in those living in similar single-level residences in the present study, 6.5%. The LP prevalence was 16.2% for multilevel and 7.9% for single-level residents compared to 13% for the initial study (Shantou 1) and 35% for the North. The differences between single-level and multilevel residents for KP, KOA, LP, and LOA are all significant. Analysis of the data for the multilevel apartment buildings for floor-level did not show a significant difference between floor levels for KP, KOA, LP, or LOA on a chi-square analysis to 4 degrees of freedom or on trend analysis[12].

All 15 subjects suspected of having RA had radiographs. All were tested for rheumatoid factor and 5 were found to be positive. Four of these satisfied the American College of Rheumatology (ACR) criteria for RA, giving a prevalence of 0.2%. None of the seronegative cases satisfied the ACR criteria. No case of SLE was found. Of 10 subjects with gout-like attacks tested for blood urate, 3 with elevated levels were diagnosed as having gout. Four cases of AS were identified (0.2%).

DISCUSSION

Table 1 compares the studies of rheumatic pain in 5 samples of Han Chinese living in latitudes extending from Beijing at 40°, through Shanghai and Chenghai, to Malaysia near the equator (5°)[13]. The Chinese in rural Malaysia had migrated from Fujian province, immediately north of the present study location, 2 centuries ago. They still speak the same dialect. Although there were variations in modes of data collection, the differences in prevalence are substantial, indicating a decreasing prevalence of KP and LP with latitude in Han Chinese[14]. All these populations were living at low altitude.

Among the Indonesians in Central Java[15] at 9° south, urban rates for current LP at sea level at 22.8% were higher than rural rates 15.1% at 750 to 950 meters elevation[15] with a cooler climate. Peripheral joint pain rates were urban 27.8% and rural 17.8%. At similar altitude at 20° north, in Pune, India[17], 13.2% had KP and 11.4% had LP. Other populations studied did not show a definite trend in pain prevalence with latitude, but there are considerable differences of genetics, ethnicity, altitude, and domestic heating practices between the populations studied. Lawrence[17] found a higher prevalence of incapacitating pain in the back and knee and other rheumatic symptoms in subjects in rural Wensleydale, UK, than in Jamaicans. He noted that Burch had found a higher prevalence of hip, shoulder, and segmental pain in Blackfeet Indians in Montana in the north than in the Pima Indians in Arizona in southern USA. Back pain was 27% in Montana and 14% in Arizona. Recent migration of populations would throw more light on this question. Hameed and Gibson[18] compared Pakistanis who had migrated to England with those still living in Pakistan. They found that low back pain was significantly more prevalent in England, but found no difference in nonspecific musculoskeletal pain. Of Caucasians in the Australian COPCORD study[17], crude rates were 15% for KP and 22% for LP. In a Dutch study[20], 12% had KP and 43% had LP. The latter figure is higher than the North China rate.

Lawrence[21] determined the prevalence of radiological OA by personally reading the radiographs from studies in 10 populations. He did not find an association with climate, but the study populations were from diverse ethnic, genetic, and environmental backgrounds. This suggests that the prevalence of knee and back pain and OA changes on radiographs are determined by different sets of factors. Lawrence did not report data on KP and LP in that study. We have complete radiological data only for the present study, as asymptomatic subjects were not radiographed in the other studies included in Table 1. Compared with clinic samples, population samples would include a higher proportion of minor changes, which would be less likely to produce symptoms. Creamer and Hochberg[22] concluded that there were a number of determinants of KP other than radiographic changes.

In Beijing the prevalence of lumbar back pain is similar to that in The Netherlands[20], but much higher than in South China. Prevalence of KP in the initial rural sample in South China[1] was much lower, and lower than in the present southern urban sample. Very few subjects with signs but no symptoms of KOA would have been included in the initial ILAR study, in which all were examined by physicians, but it is not felt that these would explain the large differences observed. Both LP and KP showed the rise in prevalence with age and the predominance in women that was expected from findings in other studies.

Felson, *et al*[23] compared knee radiographs in samples of elderly subjects from Beijing and Framingham, Massachusetts, USA, and found that in women both lateral and medial KOA was more common in Beijing Chinese than in subjects from Framingham. In men, lateral KOA was more common in Beijing, but medial KOA was more prevalent in Framingham. This latter unexpected finding was possibly explained by abnormalities in knee alignment. Varus deformity of the knees was significantly related to KP in a pilot case-control study in North China[24]. This deformity could be genetic in origin, but could also reflect vitamin D deficiency in childhood. There would be less exposure to sunlight in the northern winters, as heavy clothing is worn and more time is spent inside with coal heating in rural areas. On the South China coast the high fish intake would provide more vitamin D. Cold may increase sensitivity to pain without affecting the disease process, but in contrast to this other pain sites in the neck, shoulder, and elbow did not show the same trend. Climate also affects the diet, which in the North is based on wheat flour, meat, and some freshwater fish. In the South near the coast, sea fish predominates over meat, and rice is the main source of carbohydrate.

Ergonomic differences do not explain the higher urban compared to rural rates observed in the Chenghai area in South China, or the higher rates in apartment buildings than in single-level homes. The suggestion that repeated stair-climbing carrying loads caused back and knee problems was not supported, as the differences in prevalence by floor-level did not reach significance. Larger samples would be needed to reach a definite conclusion. There would be a tendency to place the elderly on the lower floors and to move the disabled to a lower floor. This would have to be controlled for in future studies.

RA and AS were marginally less prevalent than in European populations, as in the previous surveys[1], and are too infrequent to explain the observed differences in prevalence of KP and LP in this study.

Although all subjects were of Han Chinese origin there may have been some genetic drift, so genetic factors cannot be excluded with certainty.

The factors suggested above could be assessed in future studies to enable multivariate analysis to provide more specific guides to causation. Although the COPCORD protocol was adhered to and the studies were supervised by the same personnel, there was a possibility of interobserver differences between physician examiners at different sites, but this was judged to be too small to affect the overall conclusions. Studies of migrant populations would be informative.

This study confirms that the prevalences of both knee and lumbar pain are substantially lower in South China than in the North, where rates are closer to those in Western populations. Including COPCORD studies of Han Chinese in Shanghai and Malaysia, a gradient in pain with latitude in these ethnically and genetically similar populations suggests an effect of climate. The hypothesis that knee and lumbar pain result from a heavier workload is not supported by these observations. Further study is indicated to explain the unexpected observation of lower prevalences of knee and lumbar pain and degenerative changes on radiographs in persons living in single-floor houses than in those living in apartment buildings. As causation is most likely due to combinations of risk factors, multivariate analyses of all the variables indicated above, in future studies, should answer some of the questions raised by this study.

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