Risk Factors Associated with Rheumatic Complaints: A WHO-ILAR COPCORD Study in Shantou, Southeast China

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ABSTRACT. ***Objective.*** To validate the differences of the prevalence of rheumatic symptoms between the north and south part of China and to investigate the associated risk factors for rheumatic complaints in Shantou, China.

Methods. Four samples together comprising 10,638 people ≥ 16 years of age were surveyed in 1987, 1992, 1995, and 1999. The protocol of the ILAR-China Collaborative Study or the WHO-ILAR COPCORD Core Questionnaire was implemented. Data on rheumatic symptoms that were part of these surveys were collected and analyzed.

Results. The prevalence rate of rheumatic complaints was increasing in the Shantou area during the recent decade (in 1987 11.6%, 1992 12.5%, 1995 16.0%, and 1999 19.8%). However, it was still lower than the rate in Beijing, China, in 1987 (40.0%). Rheumatic symptoms were more prevalent in women than in men, and were more frequently seen in the elderly than in young people. The most frequently involved site was the low back followed by the knee and neck. Lumbar pain was more frequent among rural residents, while neck pain was more prevalent in the urban school-age population group. The prevalence of knee pain was significantly higher in people living in multi-storey buildings without elevators compared with those living in single-storey houses. The peak value of bone mineral density (BMD) in the Shantou population was 0.839 ± 0.085 g/cm^2 in men, and 0.723 ± 0.064 g/cm^2 in women, significantly higher than that reported in 13 other provinces and cities of China including Beijing. The sense of seeking a physician's care was higher in the population with a higher prevalence of rheumatic symptoms than that in the group with a lower prevalence of complaints. However, no significant difference was found in the rate of disability among the different population samples.

Conclusion. The prevalence rate of rheumatic complaints was lower in Shantou than in Beijing. Socioeconomic status, environmental differences (e.g., Shantou in the southern and Beijing in the northern part of China), sex, age, occupation, ergonomics, BMD, and awareness of seeking medical care might all be risk factors associated with the prevalence of rheumatic complaints. (J Rheumatol 2005;32:920–7)

Key Indexing Terms:
RHEUMATIC COMPLAINTS EPIDEMIOLOGY RISK FACTORS CHINA

As reported in the ILAR-China collaborative study[1] carried out in the 1980s, the prevalence rate of rheumatic symptoms was significantly lower in Shantou, located in southern China, than in Beijing, situated in northern China[1]. The prevalence rates of lumbar and knee pain were 5 and 10 times more frequent, respectively, in Beijing than in Shantou. This aroused great interest among domestic and international researchers[2]. To assess the reliability of this result, to determine the different prevalence rates of rheumatic symptoms among different populations, and to

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explore possible associated risk factors, 3 additional surveys were conducted by the Department of Rheumatology, Shantou University Medical College, in cooperation with other centers during the period 1992–99. Data on rheumatic complaints of these 4 surveys were pooled and analyzed.

MATERIALS AND METHODS

Subjects. The 4 surveys involving a total of 10,638 adults (5143 men and 5495 women aged ≥ 16 years) were carried out in February to July 1987, February to May 1992, February to June 1995, and February to May 1999, respectively. Figure 1 shows the locations of these 4 surveys. The age and sex distribution of these 4 samples is shown in Table 1. All persons aged ≥ 16 years in the selected communities were chosen as the target population. The first survey was part of the ILAR-China collaborative study[1]. The size of the sample population and target areas were suggested by the members of the ILAR-China collaborative group and the WHO-ILAR COPCORD international team. A target area with a total population of roughly 5000 (the first survey) or 2000 (second, third, and fourth surveys) adults (age ≥ 16 years) was selected. A village near Chenghai City with a total of 5058 people (2385 men, 2673 women) aged ≥ 16 years was surveyed. The third survey was a WHO-ILAR COPCORD stage 1 study sponsored by the Asia-Pacific League Against Rheumatism (APLAR). According to the decision of the meeting of the WHO-ILAR COPCORD international team held in Vietnam in 1994, a target population of 2040 citizens in total in Chenghai City relating to Neighborhood Committees 1, 2, 3, and 19 were selected for the study. Among the 2040 people, 554 (27.2%) were living in multi-storey buildings and 1486 (72.8%) in single-storey houses. The second and fourth surveys were initiated by Prof. N.Z. Zhang, the former chairman of the Chinese Association of Rheumatology, and Dr. R. Wigley, of the WHO Collaborating Centre for the Epidemiology of Rheumatic Disease, for study in different population samples. In the second survey, 1722 teachers and their relatives from 4 middle schools in Chenghai City were studied. This focused on osteoarthritis (OA), osteoporosis (OP), and gout. The fourth survey comprised 1818 residents in a suburban area of Chenghai City and focused on ankylosing spondylitis (AS) and gout.

In addition to the surveys, bone mineral density (BMD) was measured in 1202 of the school-age population in 1992 by single-photon absorptiometry.

Methods. The ILAR-China collaborative study questionnaire[1] was used in the first, second, and fourth surveys. The WHO-ILAR COPCORD Core Questionnaire, phases I and II[3], was used in the third survey. The working team was headed by the first author of this report, and consisted of 6 primary health workers who knew the local inhabitants well, 3 nurses, 3 physicians, and 2 rheumatologists. Standard training of the primary health workers, nurses, and doctors preceded the surveys.

A pilot study was carried out to eradicate bias of the translation of the China-ILAR[1] and COPCORD[4] English Questionnaire to Chinese and blind back-translation to English.

Printed information on the study was distributed to the target population prior to the survey. The primary health workers and nurses interviewed the subjects by house to house visits with the questionnaire, following the experience in Beijing[1] that it would be impossible to contact all subjects just by visiting the local health center. Therefore, house by house visiting

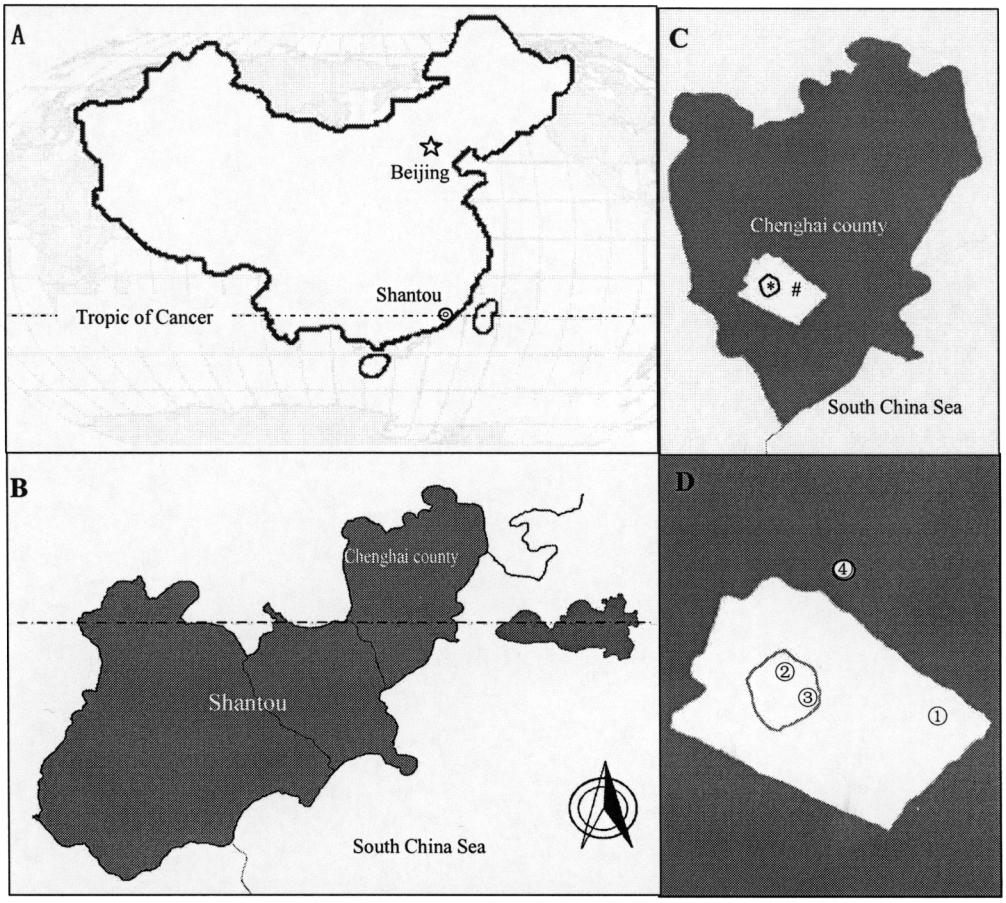

Figure 1. A. Shantou is located in southeast China. B. Chenghai is one county of Shantou. C. Chenghai County. *The original city area, #expanded new city area. D. Location of the 4 survey target areas.

Table 1. The age and sex distribution of the respondents of 4 surveys at presentation. Data are n (%).

	Survey											
	1			2			3			4		
Age, yrs	M	F	Total	M	F	Total	M	F	Total	M	F	Total
16–25	598	583	1181	45	30	75	163	165	328	54	54	108
	(25.1)	(21.8)	(23.3)	(4.9)	(3.7)	(4.4)	(16.5)	(15.6)	(16.1)	(6.3)	(5.7)	(5.9)
26–35	663	703	1366	137	124	261	248	278	526	163	175	338
	(27.8)	(26.3)	(27.0)	(15.1)	(15.3)	(15.2)	(25.2)	(26.4)	(25.8)	(18.9)	(18.3)	(18.6)
36–45	374	428	802	209	196	405	219	237	456	188	207	395
	(15.7)	(16.0)	(15.9)	(23.0)	(24.1)	(23.5)	(22.2)	(22.5)	(22.3)	(21.8)	(21.7)	(21.8)
46–55	329	363	692	250	272	522	133	139	272	178	204	382
	(13.8)	(13.6)	(13.7)	(27.5)	(33.5)	(30.3)	(13.5)	(13.2)	(13.3)	(20.6)	(21.4)	(21.0)
56–65	242	272	514	202	146	348	105	119	224	117	127	244
	(10.1)	(10.2)	(10.2)	(22.2)	(18.0)	(20.2)	(10.7)	(11.3)	(11.0)	(13.5)	(13.3)	(13.4)
> 65	179	324	503	67	44	111	117	117	234	163	188	351
	(7.5)	(12.1)	(9.9)	(7.4)	(5.4)	(6.4)	(11.9)	(11.1)	(11.5)	(18.9)	(19.6)	(19.3)
Total	2385	2673	5058	910	812	1722	985	1055	2040	863	955	1818

was arranged at noon and in the evening. The positive respondents were examined simultaneously (ILAR-China protocol) or recalled to a community health center (COPCORD protocol) within not more than 3 days by doctors under the supervision of rheumatologists. The elderly and those unable to go out were visited and examined at their own home. Suspected cases of rheumatoid arthritis (RA), AS, OA, gout, and systemic lupus erythematosus (SLE) were recalled after completion of the survey and examined by a rheumatologist to ensure international comparability of results. Rheumatoid factor (RF), antinuclear antibody (ANA), uric acid, and HLA-B27 tests, and radiographs of hands, feet, or lumbar spine and pelvis, and the relevant joint, were arranged when required. Radiographs were read by 2 radiologists blindly and independently. Leading members of the Chinese Rheumatology Association and APLAR and Drs. N.Z. Zhang, S.L. Chen, J. Darmawan, and R. Wigley visited the survey sites, examined some of the subjects, and read the radiographs.

BMD was measured at the nondominant radial site, at the junction of the middle-distal thirds, with a single photon absorptiometry machine, model SPA-IIc, made by the factory affiliated with the Chinese Detection Technique Institute, Sichuan, China.

Diagnostic criteria. RA was diagnosed according to the American Rheumatology Association (ARA) criteria (1987)[5]. The modified New York criteria recommended by van der Linden in 1984[6] were used for AS. The ARA criteria for SLE (1982)[7], gout[8], and knee (1986)[9], hand (1990)[10] and hip (1991)[11] OA were used. OA of axial joints was diagnosed in cases with suggestive symptoms and radiographic OA change greater than grade 1 according to the Kellgren-Lawrence grading[12]. OP was diagnosed according to the WHO recommended criteria for osteoporosis based on bony density[13].

Statistics. All data were entered in an IBM-PC for statistical analysis by SPSS for Windows, v. 10.0 (SPSS, Chicago, IL, USA). The Mantel-Haenszel test was used for comparisons of age/sex adjusted rates, and correlation analysis was performed by Spearman rank correlation analysis[14].

RESULTS

Age and sex distributions of the populations. The age and sex distributions of the 4 target populations are given in Table 1. Questionnaires were completed for all the subjects of every survey.

Disease distribution. As shown in Table 2, the prevalence rate of RA was 0.32% and 0.2% in the first and third surveys, respectively. Among the first, third, and fourth surveys, the prevalence of AS was 0.26%, 0.2%, and 0.3%, respectively. OA was 8.3% in the second survey, and 10.8% in third. Gout was 0.17%, 0.15%, and 0.26% in the second, third, and fourth surveys, respectively. OP was 7.1% in men and 15.8% in women in the second survey.

Rheumatic symptoms. Prevalence. As shown in Table 3, the prevalence rate of rheumatic complaints after age and sex standardization in the first to fourth surveys was 11.6%, 12.5%, 16.0%, and 19.8%, respectively. This indicated an increasing trend in the past 12 years. Nevertheless, prevalence remained much lower than the 40% recorded in Beijing in 1987; the prevalence of knee pain was only one-fifth and lumbar pain one-third of that in Beijing (Table 4).

Sex and age distributions of the populations. In each sample population, rheumatic symptoms were more common in women than in men, regardless of which joint was affected (Table 4). As shown in Table 3, there was age gradient of the prevalence rate of rheumatic symptoms in the third and fourth surveys, yet there was no such age gradient in the age group of > 65 years in the first and second surveys (the gradient still existed among people < 65 years old).

Joint distribution. As shown in Table 4, the most frequently involved site was the low back in both sexes, followed by knee and neck. However, the prevalence of neck pain (8.9%) was higher than that of knee pain (7.5%) in the school-age population and also higher than in the other sample populations (2.5%, 4.6%, and 7.1% in the first, third, and fourth surveys, respectively). The prevalence rate of low back pain was highest in the rural populations of the first survey (13.2% vs 11.2%, 11.5%, and 10.8%, respectively), but showed no statistical significance in comparison with other population surveys. In the third survey, as shown in Table 5, the prevalence rates of knee pain in people living in multistorey buildings without elevators and those living in single-storey houses were 10.1% and 6.5%, respectively ($p < 0.05$). In the former group, it is obvious that men were more affect-

Table 2. Prevalence rates of some diseases in the 4 population samples.

	Survey			
	1	2	3	4
RA, % (95% CI)	0.32 (0.16–0.48)	NS	0.20 (0.01–0.39)	NS
AS, % (95% CI)	0.26 (0.12–0.40)	NS	0.20 (0.01–0.39)	0.30 (0.05–0.55)
OA, % (95% CI)	NS	8.30 (7.00–9.60)	10.80 (9.45–12.15)	NS
Gout, % (95% CI)	NS	0.17 (0.02–0.36)	0.15 (0.00–0.32)	0.26 (0.03–0.49)
SLE, % (95% CI)	0.02 (0.02–0.06)	NS	NS	NS
OP (male), % (95% CI)	NS	7.10 (5.43–8.77)	NS	NS
OP (female), % (95% CI)	—	15.80 (13.29–18.31)	—	—

NS: not studied, RA: rheumatoid arthritis, AS: ankylosing spondylitis, OA: osteoarthritis, SLE: systemic lupus erythematosus, OP: osteoporosis, CI: confidence interval.

Table 3. Prevalence rates (%) of rheumatic complaints of 4 surveys after age standardization.

	Survey											
	1			2			3			4		
Age, yrs	M	F	Total	M	F	Total	M	F	Total	M	F	Total
16–25	0.8	1.6	1.2	0	3.3	1.3	0	1.4	0.7	3.7	1.8	2.8
26–35	2.9	4.2	3.6	8.0	7.2	7.7	3.0	6.0	4.6	5.5	5.7	5.6
36–45	11.2	14.9	13.2	16.3	15.8	16.0	5.5	13.4	9.9	6.4	10.1	8.3
46–55	13.4	25.9	20.2	17.6	20.9	19.3	16.4	29.6	22.9	19.7	30.4	25.4
56–65	15.2	25.5	20.2	17.8	19.8	18.7	22.5	46.8	35.4	34.2	58.3	46.7
> 65	16.1	18.1	17.2	14.3	16.0	15.0	30.8	47.5	39.9	48.5	57.5	54.1
Total	8.9	14.0	11.6	11.8	13.3	12.5	10.7	21.0	16.0	15.9	23.1	19.8

Table 4. Prevalence rates (%) of rheumatic complaints from the 4 survey samples and Beijing, when standardized for sex and age.

	Male					Female					Total				
	1	2	3	4	Beijing	1	2	3	4	Beijing	1	2	3	4	Beijing
Peripheral	8.9	11.8	10.7	15.9	33.4	14.0	13.3	21.6	23.1	47.1	11.6	12.5	16.0	19.8	40.0
Knee	1.8	7.5	5.1	9.3	24.1	3.4	7.6	9.7	15.5	35.8	2.6	7.5	7.5	12.5	29.0
Neck	1.9	6.9	3.7	6.5	4.6	3.0	11.4	5.5	7.6	8.2	2.5	8.9	4.6	7.1	6.0
Lumbar	12.1	9.7	7.4	8.3	27.8	14.5	12.5	15.3	12.8	42.5	13.2	11.2	11.5	10.8	35.0

ed (8.3% in multi-storey buildings vs 3.4% in single-storey houses; $p < 0.001$) than women (11.9% in multi-storey buildings vs 9.4% in single-storey houses; $p < 0.05$). As shown in Table 6, prevalence of both knee pain and low back pain was increased with the floor levels (both $R = 0.99$ and $p < 0.05$). However, no significant difference was noted in terms of residing on the ground floor to the fifth floor ($R = –0.23$ for knee pain and 0.26 for low back pain; both $p > 0.05$).

Bone mineral density. BMD was determined in 1202 subjects in the second survey. The peak value was 0.839 ± 0.085 g/cm^2 in men and 0.723 ± 0.064 g/cm^2 in women, respectively. These figures were higher than those for 13 other provinces and cities in China (included Beijing: for men 0.759 ± 0.156 g/cm^2 and for women 0.706 ± 0.156 g/cm^2) reported at the same time as our survey[15].

Disability. The prevalence of disability caused by rheumatic symptoms was less than 1% in both rural (the first survey) and urban (third survey) populations, and there was no statistically significant difference between these 2 groups (Table 7).

Medical care. The percentage of people seeking medical care was higher in an urban (third survey) than in a rural area (first survey) (13.3% vs 9.0%; Table 7). Nonprescription drugs were more commonly used in the rural than in the urban area (8.2% vs 7.0%). The frequency of taking nonsteroidal antiinflammatory drugs was slightly higher in the urban populations. More than half the patients took Chinese traditional medicine, more commonly seen in the rural patients (72.4% vs 56.9%).

DISCUSSION

The ILAR-China collaborative study showed that while there were no regional differences in the north-south prevalence of RA, SLE, and AS, there was a truly remarkable difference in the prevalence of low back pain and knee pain[1].

Table 5. Prevalence rates of knee pain in multi-storey compared with single-storey residents.

	Multi-storey			Single-storey			
	Subjects	Positive	%	Subjects	Positive	%	p
Male	276	23	8.3	709	24	3.4	< 0.001
Female	278	33	11.9	777	73	9.4	> 0.05
Total	554	56	10.1	1486	97	6.5	< 0.05

Table 6. A comparison of the prevalence of knee pain (KP) and low back pain (LBP) in subjects living in single-storey houses and on different floors of multi-storey buildings.

	1-storey	Multi-storey Buildings (N = 554)						Correlation	
	Houses, N = 1486	Ground, N = 102	1st Floor, N = 147	2nd Floor, N = 106	3rd Floor, N = 112	4th Floor, N = 60	5th Floor, N = 27	R	p
KP, %	6.6	6.9	8.8	12.3	13.4	6.7	7.4	0.99*	< 0.05
(95% CI)	(5.3–7.9)	(2.0–11.8)	(4.2–13.4)	(6.0–18.6)	(7.1–19.7)	(0.4–13.0)	(0.0–17.3)	–0.23†	> 0.05
LBP, %	9.0	13.7	15.6	18.9	20.5	18.3	14.8	0.99*	< 0.05
(95% CI)	(7.5–10.5)	(7.0–20.4)	(9.7–21.5)	(11.4–26.4)	(7.5–28.0)	(8.5–28.1)	(1.4–28.2)	0.26†	> 0.05

95% CI: confidence interval for the prevalence rate. * Spearman correlation coefficient between different floor from the ground to 3rd floor and the rates. † Spearman correlation coefficient between different floors and the rates. There was an increase trend between different floors from the ground to 3rd floor and the prevalence rates for KP and for LBP.

Table 7. A comparison of the prevalence rates of disability and medical care in 3 different surveys.

	Shantou-Rural, %	Shantou-Urban, %	Beijing, %
Saw a doctor	9.0	13.3	21.0
Had to stop work	5.0	6.0	3.0
Cannot walk	0.4	0.5	0.4
Cannot lift	0.4	0.5	0.5
Cannot dress self	0.4	0.3	0.3
Cannot carry	0.6	0.8	0.5

Several questions were raised[1,2]. First, the methodological problems were emphasized, and thereafter potential risk factors for rheumatic symptoms were considered. The population of the first survey, which was carried out at the same time as the survey in Beijing, could not be surveyed again because the original village has been urbanized and incorporated into Chenghai City. As a result of economic reform, many villagers moved to the city to seek jobs there, while many people living in the city went to the countryside for development projects (i.e., to set up factories, etc.). These factors offered an opportunity for us to study associated risk factors of rheumatic symptoms by surveying different populations at different periods. The aim of this study was to determine whether the prevalence of rheumatic symptoms was indeed lower in the South (Shantou) than in the North (Beijing) of China, and to investigate the associated risk factors for rheumatic complaints.

As shown in Figure 1, Shantou is situated in the southeast coastal area of China, near the Tropic of Cancer. Chenghai County is one district of Shantou, covering an area of about 500 km^2. It is situated on the delta of the Hangjiang River and has a yearly average temperature of 21°C. The county population of one million people are all of the Han ethnic group and their living habits are essentially the same. Thus the biases of genetics, environment, geography, and cultural background could be excluded.

As for the survey methodology, the ILAR-China Questionnaire and the WHO-ILAR COPCORD Questionnaires have been validated[1,16]. The questionnaires of these 2 protocols were identical. The only difference between the 2 protocols was that every subject was examined directly after the interview in the former, while in the latter only the positive respondents were examined, within no more than 3 days (in our study) after being interviewed. Thus the bias between these 2 methods was minor. Further, the personnel participating in the working team remained the same, and the leading members of the Chinese Rheumatology Association and APLAR and ILAR who supervised the surveys also remained unchanged. This methodology ensured the uniformity of the 4 surveys.

This study indicated that (1) as shown in Table 3, although the prevalences of rheumatic symptoms of the last 3 surveys were higher than that of the first survey (12.5%, 16.0%, and 19.8% vs 11.6%), and pooling these data together showed an increasing trend, the results in total confirmed the previous impression that the prevalence rate of rheumatic symptoms was lower in Shantou than that in Beijing (40.3%). (2) The increasing trend of the prevalence of rheumatic symptoms in the Shantou area in recent years might be related to the following factors:

(a) Socioeconomic status. Owing to the opening economic policy of the state development program in China, great change has occurred in Shantou, which is one of the Special Economic Zones of China. The Shantou urban area has expanded more than 10 times. Many farmers have changed

their occupations to blue-collar workers, white-collar workers, business people, entrepreneurs, etc., and have also changed their educational standards, dietary habits, housing conditions, and lifestyle. The increased prevalence of rheumatic symptoms in the Shantou area might be related to all these changes. A report[17] from Britain that compared 2 prevalence surveys at an interval of 10 years (1987-88 and 1997-98) showed that the one-year prevalence of back pain (directly standardized to the age and sex distribution of the combined samples) rose from 36.4% to 49.1%. The authors presumed that it was due to cultural changes, which had led to a greater awareness of more minor back symptoms and willingness to report them, and this cultural shift may also have rendered back pain more acceptable as a reason for work absence attributed to sickness. However, another COPCORD study, in Brazil[18], revealed that among their study population almost 70% of patients with rheumatic disorders belonged to the lower socioeconomic levels. We believe that changes in socioeconomic status have exerted a multifactorial influence.

Our study confirmed the previous conclusion from the ILAR-China collaborative study that there was a remarkable difference in the prevalence of rheumatic symptoms between Shantou (in the south) and Beijing (in the north), and also indicated that changes in social and economic status had influenced the prevalence of rheumatic complaints (Beijing certainly was more developed than Shantou in the past, as well as at the present time).

(b) Age and sex. In the 4 surveys, rheumatic complaints were more prevalent among women than in men, except in the age group < 25 years in the fourth survey (3.7% in men and 1.8% in women, Table 3), for reasons that are unknown. This indicates that sex is one of the associated risk factors for rheumatic complaints.

It is known that the prevalence of rheumatic symptoms is generally increased with aging. In our study, as shown in Table 1, the proportion of young people (age ≤ 25 yrs) in the first survey was significantly higher ($p < 0.05$) than in the other 3 surveys (23.3% vs 4.4%, 16.1%, and 5.9%, respectively). The proportion of middle-aged people (ages 46~55 and 56~65 yrs) was significantly higher ($p < 0.05$) in the second survey (50.5% vs 23.9%, 24.3%, and 34.4%, respectively); and the proportion of elderly (age > 65 yrs) was significantly lower in the first and second survey (9.9% and 6.4% vs 11.5% and 19.3%). This might explain why the prevalence of rheumatic symptoms among the elderly was not as high as expected in the first and second surveys.

(c) Occupation. Prevalence rates of low back pain were highest in rural populations in the first survey (13.2% vs 11.2%, 11.5%, and 10.8%), and prevalence of neck pain was highest in the school-age population compared with the others (8.9% vs 2.5%, 4.6%, and 7.1%). An association between farm work and low back pain has been suggested[19]. The authors considered that the former finding might be related to the fact that farmers often work bending forward (for example in rice-growing) and also endure greater low back burdens while carrying heavy weights on poles on their shoulders. A significantly higher prevalence rate of neck pain in the school-age population has been reported[20], and this was thought to be associated with a wide variety of risk factors. Another representative population sample of 8000 in Finland[21] showed that chronic neck pain syndrome was diagnosed in 9.5% of the men and 13.5% of the women. When adjusted for age and sex, the prevalence of neck pain syndrome was associated with a history of injury to the back, neck, or shoulder, and with mental and physical stress at work. We believe that in our study, the high prevalence rate of neck pain among the school-age population might be due to their special occupation with longterm bending over a desk. Apparently, occupation has much influence as a relative risk factor for rheumatic symptoms.

(d) Ergonomic factors. The finding that the prevalence rate for knee pain was higher in residents of multi-storey buildings without elevators than in those living in single-storey houses supported the idea that ergonomic factors may play a role[1]. As for the finding of a significant difference of the prevalence rate of knee pain and low back pain that was only observed in the ground floor to third floor residents of multi-storey buildings, but no significant difference was noted among residents from the ground to fifth floors, this might be due to the small number of residents in the fourth and fifth floors (only 60 and 27 residents on the fourth and fifth floors, respectively, compared with more than 100 in each floor from the ground to third floors; Table 6). It might also be due to a tendency to place the elderly and the disabled on the lower floors. This factor would have to be controlled in any future study. Thus a similar study on a larger scale should be carried out in the future. It has been said that a force of 6 to 9 times body weight is exerted across the knee during a single step while going up or down stairs; the magnitude of the force exerted on the knee depends on the speed of climbing/descending and the slope of the staircase[22]. All these ergonomic factors await further study.

(e) Effect of latitude. As shown in Table 8, the prevalence rates of rheumatic complaints in Hong Kong[23], Shantou, Shanghai[4,24], Beijing[1], and Harbin[25] at latitudes 22°, 23°, 32°, 40°, and 46° were 13.1%, 11.6–19.8%, 13.3–24.3%, 40.9%, and 46.6%, respectively. The prevalence rate of rheumatic complaints was increased with increasing latitude (Spearman correlation between latitudes and the prevalence rates shows significant correlation, $R = 0.99$, $p < 0.01$). It is interesting that a report[26] from Canada (situated north of 45° latitude) claimed that the prevalence of rheumatic symptoms was up to 60%; a COPCORD study in a suburban community (with better education about healthcare) of Mexico City situated at about 19° north latitude[27] reported a prevalence rate of 17%; and another COPCORD study (a population with 37.8% white, 62.2% nonwhite) in Montes Claros City,

Table 8. Prevalence of rheumatic complaints at different latitudes.

	Hong Kong (1993)	Shantou 1 (1987)	Shantou 2 (1992)	Shantou 3 (1995)	Shantou 4 (1999)	Shanghai 1[4] (1992)	Shanghai 2[24] (2003)	Beijing[1] (1987)	Harbin[25] (1992)	Malaysia[29] (1992)*	Canada[26] (1985)
Latitude, degrees	22	23	23	23	23	32	32	40	46	5	45
Prevalence of rheumatic complaints, %	13.1	11.6	12.5	16.0	19.8	24.3	13.3	40.9	46.6	13	60

* Malaysian Chinese ethnicity.

Brazil, at about 16° south latitude was 30.9%[18]; the rate in Malaysian Chinese living at 5° south latitude was only 13%[28]. These findings indicate latitude, climate, and temperature are possibly important risk factors. A COPCORD study recently reported from Shanghai, China, that the prevalence of rheumatic complaints was only 13.3%[24]. However, it was speculated that only those with pain in the last week or lasting more than a week were included, so a lower prevalence would be expected than if pain-ever had been used, as in the other studies[29].

(f) Bone mineral density. BMD was measured in 1992 by single-photon absorptiometry, which is out of date now. Nevertheless, our data were comparable to studies from 13 other provinces and cities of China, included Beijing,[15] which were done using the same technique. The results of a radial bone BMD survey in a Shantou population were higher in both men and women. A study of 90 knee pain patients in Beijing showed that knee pain was related to genu varum[30]. The Shantou COPCORD study noted the same phenomenon, and found that knee pain in patients of this type had started in childhood[31]. Apparently, BMD might contribute at least partly to the differences of the prevalence of rheumatic symptoms among different populations. For children, special attention should be paid to the prevention and treatment of rickets.

(g) Nutrition. Nutrition may be indirectly associated with rheumatic complaints of osteopenia and osteoporosis. The main diet staple in the coastal areas of Shantou is rice, but seafood, eaten daily, contains a significantly higher concentration of calcium and other minerals than food in other regions of China. This could be one of the reasons for the higher BMD in Shantou and the lower prevalence of rheumatic symptoms compared with other regions of China. Nutrition may be an indirect risk factor for rheumatic complaints.

(h) Awareness of seeking medical care. As shown in Table 7, Beijing, with a significantly higher prevalence rate of rheumatic symptoms compared with Shantou (40% vs 9.9%), showed a significantly higher rate of persons seeking medical care (21% vs 9%). In Shantou area the first survey (rural) revealed a lower prevalence rate of rheumatic complaints compared with the third (urban) survey and showed a lower rate of persons seeking medical care (9.0% vs 13.3%), but the disability rate in these 2 areas was essentially the same[1], yet the prevalence of disability was also similar between the urban and rural populations. Further, a report[32] of a comparison of patients with ankylosing spondylitis between south and north China showed that the frequency of peripheral joint symptoms was higher in Beijing (38.7%) than in Shantou (9.9%), but there were no significant differences in radiographic changes. All these data might also suggest that rheumatic pain was not necessarily related to the presence of organic pathologic changes of joints.

In summary, the significantly lower prevalence rates of rheumatic complaints in Shantou compared with Beijing has been validated. Socioeconomic status, environmental differences (e.g., Shantou in the south, Beijing in the northern part of China), age, sex, occupation, ergonomic factors, geographic location (latitude), nutrition, BMD, and awareness of seeking medical care might all be the associated risk factors for rheumatic complaints.

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