



Prevalence of low back pain in three occupational groups in Shanghai, People's Republic of China

Kezhi Jin^{a,b,c}, Gary S. Sorock^{b,d}, Theodore K. Courtney^{b,c,*}

^aSchool of Public Health, Fudan University, Shanghai, China

^bLiberty Mutual Research Institute for Safety, Hopkinton, MA, USA

^cHarvard University, School of Public Health, Boston, MA, USA

^dJohns Hopkins University, School of Public Health, Baltimore, MD, USA

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Abstract

Problem: Low back pain (LBP) is one of the most prevalent work-related conditions affecting employed populations in developed countries, yet little is known about this condition among the world's largest, single-nation labor force: The People's Republic of China. **Method:** This is a cross-sectional study of the prevalence of low back pain (LBP) among garment workers, battery/kiln workers, and teachers in Shanghai, People's Republic of China. Data were collected by personal interview and physical examination at six work sites. The overall response rate was 78%. **Results:** The overall (N = 383) self-reported annual prevalence of LBP symptoms lasting 24 hours or more was 50%. Garment workers had a higher annual prevalence of LBP (74%) than teachers (40%), prevalence ratio (PR = 1.9, 95% CI = 1.4–2.4). **Discussion:** The overall annual prevalence of self-reported LBP (50%) was higher than that reported among 50 other Chinese employed study populations (30%). Healthy worker effects may have limited the conclusions from this cross-sectional study. **Summary:** These results suggest that LBP is a prevalent condition in Chinese workers and that more work should be done to estimate its impact on the Chinese workforce. The findings for garment workers were consistent with increased risk of LBP among persons doing work in fixed, sedentary postures.

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1. Introduction

Low back pain (LBP) is among the most common work-related health problems in economically developed countries (Waddell, 1994). The lifetime incidence of LBP has been estimated to be as high as 85% of the adult population (Von Korff, Dworkin, LeResche, & Kruger, 1988) with an estimated 18% annual prevalence of back pain lasting at least one week in American adults (Guo et al., 1995). There is considerably less information about the magnitude and impact of LBP among adult, employed

populations in developing nations. This situation has been argued to be the result of an overbalance of research on populations in the most economically developed (or highest income) countries. This lack of research leaves a profound gap in the knowledge of "LBP in the rest of the world," where the bulk of the world's working population resides (Volinn, 1997).

The People's Republic of China (PRC) is the world's largest economically developing country. Its estimated 600 million workers compose the largest, single-nation labor force (Leigh, Macaskill, Kuosma, & Mandryk, 1999; Takala, 1999). Despite this economic and labor pre-eminence among developing countries, there have been relatively few studies of occupational LBP in the PRC. A recent review of existing literature on LBP in PRC workers, published in both English and Chinese, concluded that many studies were substantially limited by methodological or reporting flaws (Jin et al., 2000). Specific limitations

* Corresponding author. Liberty Mutual Research Institute for Safety, 71 Frankland Road, Hopkinton, MA 01748, USA. Tel.: +1-508-497-0207; fax: +1-508-435-3456.

E-mail address: theodore.courtney@libertymutual.com (T.K. Courtney).

included the lack of a clear and potentially generalizable definition of LBP, the absence of a systematic approach to documenting manual materials handling, and the often incomplete reporting of study methods including population characteristics, inclusion/exclusion criteria, participation rates, and other design details that would permit replication of the investigation.

To begin to address these limitations, a cross-sectional study of LBP prevalence was conducted in three Chinese occupational groups representing a diversity of workplace exposures: garment workers, battery and kiln factory workers, and teachers. The objectives of the study were to describe the prevalence of low back pain among employees in a variety of Chinese work environments and to identify work-related and personal factors potentially associated with LBP.

2. Method

2.1. Participants

Six work environments in the Shanghai municipality were recruited for the study: an apparel manufacturer; the mold department of a battery factory; the brick kiln department of a fire retardant materials factory; and three primary schools. To be eligible for the study, subjects had to meet the following criteria: (a) at least 12 months employment at the work site; and (b) absence of a physician's current diagnosis of cancer, infection, neurological diseases, or traumatic injury (Bigos et al., 1994).

2.2. Outcome assessment

Outcomes were assessed by questionnaire and physical examination. The questionnaire was adapted from the standardized Nordic questionnaire for the analysis of musculoskeletal symptoms (Kuorinka et al., 1987). The back pain questions were modified to include a minimum duration of continuous pain lasting more than 24 hours, and substituted the word "discomfort" for "trouble." The minimal duration definition of back pain was used to facilitate recall of episodes of back pain. The descriptive term "trouble" lacked cultural relevance in Chinese, and was changed to "discomfort." "Discomfort" was explained to subjects as being any discomfort or unpleasant subjective sensation including pain, numbness, soreness, and/or any limitation of physical activity. Physical examinations were conducted by two physicians specializing in orthopedics prior to the in-person administration of the study questionnaire by a trained interviewer. Subjects were not informed of the results of their physical examinations until they had completed the study questionnaire.

A positive response to any of the three questions below was used to define LBP occurrence in this study. However, consistent with the international literature (Burdorf & Sor-

ock, 1997), only the second question was used in the evaluation of the associations between individual characteristics, occupational group membership (garment workers, battery and kiln product workers and teachers), and LBP prevalence.

1. "Have you *ever* had discomfort in the lower back lasting more than 24 hours in the past?"
2. "Have you had discomfort in the lower back lasting more than 24 hours in the *previous 12 months*?"
3. "Have you had discomfort in the lower back lasting more than 24 hours in the *seven days* prior to the interview?"

Back-related symptoms were defined by a diagram showing a location between T7–S1 and the buttocks with or without radiation to the legs. Each subject was also examined clinically for signs of LBP, including range of motion intolerance, pain on palpation, sensory limitation, or positive pathologic reflexes (Bigos et al., 1994). The physical examination data were used only as an indicator of LBP severity.

2.3. Exposure and demographic assessment

Three occupational groups were chosen to represent categorically different physical workloads. Differences in workloads were evaluated by observation during facility walkthroughs. Workers were also asked to subjectively rate the percent of time they spent in manual materials handling. Time spent doing manual materials handling on the job was assessed by asking the subject, "What is the total percent of your day normally spent manually handling materials (pushing, pulling, carrying, lifting or lowering)?" The responses were categorical: (0%, 1–10%, 11–25%, 26–50%, 51–75%, >75%). Demographic data were collected by questionnaire including gender, age, height, weight, body mass index (weight/height²), living with children under 5 years of age, education, job experience, alcohol and tobacco use, and job satisfaction.

2.4. Statistical analysis

Descriptive statistics of the demographic, occupational, and health characteristics of the study population are presented first using counts, percentages, and means (standard deviations). The percent distributions of self-assessed physical demand scores and percent of time doing manual materials handling (MMH) were calculated for each occupational group. Then the prevalence of LBP for each work group was calculated using the three different period prevalence estimates: (a) lifetime, (b) previous year, and (c) the week before the interview. Prevalence ratios and 95% confidence intervals were used to compare the between-group differences in LBP prevalence. The PR was estimated in a manner similar to a cumulative incidence ratio in a cohort study (Kleinbaum, Kupper, & Morgenstern, 1982). The 95% confidence interval was

Table 1
Study group characteristics of 383 subjects, by occupational group, Shanghai, PRC, 1998

Occupational group	Garment factory workers	Battery and kiln product workers	Primary school teachers	Total
Sample size/total	81/102	181/195	121/195	383/492
Participation (%)	79%	93%	62%	78%
Male (%)	6%	80%	18%	45%
Age (yrs.) ^a	33.2 ± 5.3	38.7 ± 6.0	35.7 ± 9.8	36.6 ± 7.6
Education (yrs.) ^a	8.3 ± 0.6	8.2 ± 2.4	12.4 ± 1.5	9.5 ± 3.1
Work hours ^a	9.8 ± 1.1	4.4 ± 1.4	8.0 ± 1.1	6.7 ± 2.6
Employment (yrs.) ^b	9.9, (1–18)	11.5, (2–31)	10.0, (1–35)	10.3, (1–35)
Current smoker	6%	64%	12%	35%
Current drinker	5%	44%	12%	26%
Child at home <5	9%	9%	17%	11%
Weight (Kg)	54.0 ± 6.4	63.7 ± 7.8	55.6 ± 11.5	59.1 ± 9.9
Height (cm)	160.0 ± 5.3	167.5 ± 6.9	161.7 ± 5.9	164.1 ± 7.1
BMI (wt/ht ²)	21.1 ± 2.2	22.7 ± 2.3	21.2 ± 3.9	21.9 ± 3.0
Job satisfaction ^c	2.09 ± 0.7	2.09 ± 0.7	2.64 ± 0.5	2.26 ± 0.7

^a Mean ± s.d.

^b Median, range.

^c Scale 1–3, with 3 is most, 1 is least.

calculated using standard methods for risk ratios (Gardner & Altman, 2000). Logistic regression analysis was used to adjust for differences in potential confounders between garment workers, teachers, and reported LBP (SAS Institute, Inc, 1997).

3. Results

The demographic characteristics of the garment factory workers, battery and kiln product workers, and primary school teachers are summarized in Table 1. A total of 383 of 492 subjects (78%) agreed to be examined and interviewed. Three subjects from the group of garment workers were excluded because of pelvic inflammatory diseases; no other subjects were excluded because of diseases or injury. Study participation was 62% for teachers, 79% for garment workers, and 93% for battery and kiln product workers. The gender distribution of the participants differed by work group. The battery and kiln workers were mostly males

(80%) and the garment workers and teachers were mostly females, 94% and 82%, respectively. The garment workers were the youngest group and the battery and kiln workers were the oldest group. The teachers, as expected, had more years of education than either of the other two groups. The garment workers had a longer workday than either of the other two groups. Employment years were roughly equivalent for each group at about a mean of 10 years. The battery and kiln workers smoked cigarettes and drank alcohol more often than the other groups. The height, weight and body mass index differences between groups reflected the underlying gender differences. Teachers were more satisfied with their jobs than the other two groups. The teachers were more likely than the garment workers and the battery/kiln workers to have a child at home under age five.

The three prevalence estimates of LBP all indicated the highest reported occurrence of LBP among garment workers (Table 2). The prevalence dropped considerably as the period of recall shortened from 61% (lifetime) to 20% in the past week. Using teachers as a comparison group, the garment workers had between 60% and 90% increased prevalence rates of LBP. The prevalence ratio for reported annual occurrence of LBP was 1.9 (95% CI, 1.4–2.4). When adjusting for age, gender, employment years, and job satisfaction as potential confounders between these two groups, the adjusted odds ratio was 4.0 (95% CI, 2.1–6.3). The crude odds ratio for this comparison was 4.4 (95% CI, 2.4–8.1). The physical examination data indicated that 43% of the garment workers had one or more physical signs of LBP, compared with 23% of the battery and kiln workers and 32% of the teachers. The battery and kiln workers were closer in prevalence to the teachers (prevalence ratio ranged from 0.6–1.2); because of the inherent demographic differences with the teachers, no statistical adjustment was made between these two groups.

There were large differences in the distributions of manual materials handling (MMH) between the three groups (Table 3). The battery/kiln workers did more MMH than did the garment workers or the teachers. Assuming the measurement interpretation is similar between groups, when the prevalence data are stratified by level of reported MMH, the higher two categories of MMH each had 30% higher prevalence of LBP than those workers reporting < 10% of their time doing MMH (Table 3).

Table 2
Low back pain prevalence estimates by occupational group, Shanghai, PRC, 1998

Group	LBP Prevalence												
	Total, N	Week				Annual				Lifetime			
		n	(%)	PR ^a	CI ^b	n	(%)	PR	CI	n	(%)	PR	CI
Teachers	121	26	(22)	–	48	(40)	–	–	60	(50)	–	–	
Battery/kiln	181	24	(13)	0.6	84	(46)	1.2	0.9–1.5	109	(60)	1.2	1.0–1.5	
Garment	81	27	(33)	1.6	60	(74)	1.9	1.4–2.4	64	(79)	1.6	1.3–2.0	

^a PR = Prevalence Ratio.

^b CI = 95% Confidence Interval.

Table 3

Percent of work time spent manual materials handling by occupational group and combined annual prevalence of LBP

Work time (%)	Garment workers N (%)	Battery/kiln workers N (%)	Teachers ^a N (%)	All workers total N	Annual LBP prevalence ^b N (%)	PR ^c	(95% CI) ^d
< 10	22 (27)	0 (0)	84 (70)	107	45 (42)	–	
10–75	10 (12)	21 (12)	21 (18)	52	29 (56)	1.3	(1.0–1.8)
>75	49 (61)	160 (88)	15 (12)	224	118 (53)	1.3	(1.0–1.6)
Total	81 (100)	181 (100)	120 (100)	382	192 (50)		

^a Data on percent time spent in MMH were missing for one teacher.

^b Annual prevalence of LBP across all worker groups (e.g., the annual prevalence of LBP in workers who spent more than 75% of their time in MMH is 118/224 or 53%).

^c PR = Prevalence Ratio.

^d CI = Confidence Interval.

Associations between potential confounders and LBP prevalence in the past year were examined by inspection of prevalence ratios and confidence intervals for the three groups combined (Table 4). Worker tenure in the form of

years of employment was significantly associated with LBP prevalence.

4. Discussion

The results indicate that the overall annual prevalence of LBP lasting more than one day among all three work groups is considerable: 50%. This prevalence figure (50%) is higher than the median prevalence (30%) reported among 50 other Chinese employed populations (Jin et al., 2000). Caution is urged however when comparing these studies due to the differences in LBP definitions and study methods.

The LBP prevalence for garment workers in the past seven days (45%) and past year (74%) was higher than that reported by Schibye, Skov, Ekner, Christiansen, and Sjøgaard (1995) for Danish sewing machine operators (25% and 45%, respectively) using the Nordic questionnaire. These rates remained stable among the 25% of sewing machine operators who stayed another 6 years on the job (25% and 47%, respectively). Of the 75% of Danish workers who left the job during the 6-year period, LBP prevalence at follow-up was slightly higher. Masset and Malchaire (1994) reported LBP prevalence among Belgian steel manufacturing workers similar to that reported here for battery and kiln workers. LBP prevalence in the past 7 days was 25% (versus 13%) and in the past year 53% (versus 46%). The 7-day LBP prevalence for teachers in the present study (22%) agreed with that reported by Tsuboi, Takeuchi, Watanabe, Hori, and Kobayashi (2002) for self-reported LBP among Japanese teachers (between 20% and 23%). The comparisons for battery and kiln workers and teachers are made with caution due to differences between studies in case definition and questionnaire design.

These results also suggest that relatively fixed, sedentary posture among garment workers is associated with an increase prevalence of LBP as compared with teachers. Both the self-reported prevalence of LBP and the higher prevalence of physical findings among garment workers support this conclusion. This finding is generally consistent with the LBP literature from China, which supported a positive association between sedentary posture and LBP prevalence (Jin et al., 2000). Teachers may have more

Table 4

Annual low back pain prevalence ratios for selected study variables for total group

Variable	No. with LBP	Total	Prevalence per 100	Prev. Ratio	(95% CI)
<i>Age</i>					
20–29	42	99	42.4	ref. category	
30–39	85	152	55.9	1.3	(1.0–1.7)
40–49	58	120	48.3	1.1	(0.8–2.3)
=>50	7	12	58.3	1.4	(0.8–2.3)
<i>Gender</i>					
Male	76	169	45.0	ref.	
Female	116	214	54.2	1.2	(1.0–1.5)
<i>Cig. Smoker</i>					
No	134	248	54.0	ref.	
Yes	58	135	42.9	0.8	(0.6–1.0)
<i>Alcohol Use</i>					
No	142	284	50.0	ref.	
Yes	50	99	50.5	1.0	(0.8–1.3)
<i>Education</i>					
< 10 years	136	253	53.7	ref.	
=>10 years	56	130	43.1	0.8	(0.6–1.0)
<i>Body Mass Index</i>					
< 23	128	256	50.0	ref.	
=>23	64	127	50.3	1.0	(0.8–1.3)
<i>Employment Years</i>					
< 8	39	113	34.5	ref.	
8–11	59	97	60.8	1.8	(1.3–2.4)
>11	94	173	54.3	1.6	(1.2–2.1)
<i>Job Satisfaction</i>					
low	89	149	59.7	ref.	
medium	55	128	42.9	0.7	(0.6–0.9)
high	48	106	45.3	0.8	(0.6–1.0)
<i>With child under age 5</i>					
No	178	340	52.3	ref.	
Yes	14	43	32.5	0.6	(0.4–1.0)

opportunity to change postures and walk at work than do garment workers, which may explain this difference in part. Both these groups had similar age and gender distributions.

The lower than expected prevalence of LBP among battery and kiln workers may be explained in part by a healthy worker effect (survivor bias; Sorock & Courtney, 1996). These workers faced the highest physical demands of the three groups. It could not be determined whether battery and kiln workers with chronic or severe back pain left the job resulting in a remaining worker or survivor population with “healthier” backs. The workload for these workers was estimated at greater than 10 tons per shift, and their workday was limited by law to 4.5 hours. Many of these workers also came to the factory from the surrounding villages and had previously performed physically demanding farm work. This earlier work experience may have impacted their pain reporting, if not their self-selection for hard physical labor.

The reference group, teachers, were less likely (62%) than the other two groups to volunteer for the study (79% and 93%). The primary reason for the variability in participation was the difference in organization of the three groups. A greater recruiting efficacy was noted in the factory settings where recruiting was conducted by the occupational medicine department compared to the school settings where the administration solicited participation. In addition, the survey was conducted just after the teachers’ annual physical exams that may have made some teachers, perhaps the healthier ones, less interested in participating. One impact of this potential selection bias might be to artificially raise the LBP prevalence of the teacher group that contributed to the unexpectedly small difference between teachers and battery and kiln workers. Primary school teachers in China teach students age 7 through 12 years. A small proportion of teachers (12%) reported doing manual materials handling more than 75% of their work time. Whether this is misinterpretation of the question or reflects the frequent lifting of children or objects is unknown.

Gender differences between groups could not be completely controlled in this study. It is interesting to note that in another cross-sectional study of LBP prevalence among 800 workers (400 men, 400 women) in a machine building factory in Russia, the annual prevalence of LBP lasting more than 24 hours was 31.5% (Toroptsova, Benevolenskaya, Karyakin, Sergev, & Erdesz, 1995), which was lower than the annual prevalence among all three groups in this study, including the teachers. No difference in LBP prevalence was found in that study between men and women, further supporting the notion that gender differences were seen initially in uni-variable analysis are diminished when controlling for work-related physical factors (Burdorf & Sorock, 1997). Furthermore, in a study of LBP prevalence on the day of the examination in a manufacturing company in Japan (2,517 men and 525 women), no difference was found between male and female workers (Matsui, Maeda,

Tsuji, & Naruse, 1997). The gender differences seen between the battery and kiln workers and teachers in the present study could still confound the results if women were more likely to report LBP than men, or the male workers were less likely to report pain for various reasons, including selection bias and/or denial of “minor” health complaints.

Besides potential selection bias operating among all three groups, as in any cross-sectional study, the relative timing of the onset of LBP and the exposure is uncertain (Bombardier, Kerr, Shannon, & Frank, 1994). We attempted to address this caveat by restricting the study to people who had been on the job for at least a year and used the reported annual prevalence of LBP in the main analysis. The cases in this study may reflect a mixture of incident (new cases) and prevalent cases (including recurrent cases whose first episode occurred on an earlier job).

Exposure assessment in this study was limited to self-reported percent of time doing manual materials handling. Self-reported questionnaire-based assessments have been found to overestimate physical load on the back from lifting and bending and twisting compared with hourly self-reported logs of the same activities (Burdorf & Laan, 1991). In this regard, this study is also limited by the absence of more quantitative measurements of manual material handling task parameters. Moreover, the relative contribution of non-occupational factors to the reported LBP prevalence among these worker populations was not determined. Given the limitations in sampling and potential selection biases in the present study, however, it still met 8 of 10 quality methodological criteria for acceptable LBP prevalence studies (Leboeuf-Yde & Lauritsen, 1995).

4.1. Impact on industry

In summary, the annual prevalence of LBP among these three Chinese working groups was high (50%). Although the impact on worker health and productivity from LBP in the PRC is unknown, this research suggests that studies be done to test ergonomic interventions to lower the prevalence of LBP, especially among garment workers. Job rotation, adjustable workstations, exercise, or walking breaks may help reduce the frequency of LBP among sedentary garment workers.

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Kezhi Jin Ph.D. is Lecturer in the Department of Occupational Health, School of Public Health, Fudan University, Shanghai, China. He is currently a post-doctoral fellow at the Harvard School of Public Health in Boston and the Liberty Mutual Research Institute for Safety in Hopkinton, MA. He has published work on occupational disease and injury including low back pain.

Gary S. Sorock Ph.D. is Associate Professor of Injury Epidemiology, Liberty Mutual Research Institute for Safety, Hopkinton, Massachusetts. He specializes in the epidemiology of occupational injuries.

Theodore K. Courtney M.S., CSP is Director of the Quantitative Analysis Unit at the Liberty Mutual Research Institute for Safety, Hopkinton, Massachusetts and Instructor on Injury, Safety and Ergonomics at the Harvard University School of Public Health, Boston, Massachusetts. He received the 2003 William Floyd Medal from the Ergonomics Society for significant contributions to ergonomics research. His recently published work includes: examining US occupational morbidity in large surveillance data systems; comparative studies on fall-related injuries in the US, UK, and Sweden; research on disabling injuries in construction workers; and studies of occupational fatalities in the People's Republic of China.