

Occupational Safety and Health Status of Sanitation Workers in Urban Areas: A Pilot Study From Wuhan, China

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Sanitation workers' workload increases quickly with rapid urbanization, but there is almost no evidence or policy recommendations for their management in developing countries. This study describes the health status and occupational protection of sanitation workers; it also explores risk factors related to their health status in Wuhan City, China. Three hundred and eighty-five sanitation workers from 54 streets of Wuhan were surveyed. Their prevalence of 2-week illness and arthritis was relatively higher than in the general population in China. Findings related to occupational protection showed that both sanitation workers (users) and their managers (providers) neglected the role of low-cost protection measures, especially masks, soap/hand sanitizer and prejob training (use rate of 7.27%, 26.75% and 43.64%, respectively). High-intensity workload was an important risk factor for 2-week illness, and prejob training was an important protective factor against arthritis.

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1. INTRODUCTION

In recent decades, with rapid economic development, urbanization has become an important trend in developing countries. As a result of urbanization, the large population concentrated in cities has brought many environmental and sanitation problems, including a lot of garbage, dirty streets, blocked drains and walls plastered with illegal advertising [1]. Since enacting its reform and opening-up policy, China has significantly accelerated the urbanization process. In 1978–2007, the level of China's urbanization increased from 17.9% to 44.9%, an average annual increase of 0.86%. China's urbanization rate is about twice as quick as the world average [2, 3]. In China, urban garbage has increased rapidly in the

past 20 years from 31.3 million tonnes in 1980 to 113.0 million tonnes in 1998, at an annual rate of 3%–10%. In 2004, China has surpassed the USA to become the world's largest garbage generator [4, 5]. In China, like in other developing countries [6, 7, 8], garbage is primarily cleaned up by people, not machines. This means that city sanitation workers' workload will increase quickly and proportionally to urbanization.

City sanitation workers, including street sweepers, also referred to as garbage/refuse collectors, are a very special occupational group [6, 7, 8, 9]. They normally work an 8-h shift that often begins at 4:00–5:00, regardless of the weather. Their work is physically exerting, but essential to public health and safety. In developing countries, sanitation workers face particular stigmatization

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for having a job perceived as unclean or lowly. Sanitation workers are often exposed to dust, fumes and odors, harmful materials and chemicals, and dangerous machinery. Their safety and health are often threatened when they handle hazardous materials. For protection, they need to be equipped with safety and health equipment, e.g., fluorescent clothes, gloves, soap/hand sanitizer and masks [6, 7, 8, 9].

Sanitation workers have little influence over policy formulation and resource allocation at the national and local levels, which makes it difficult for them to improve their access to occupational safety and health. In developing countries, such as China, studies on urban garbage mainly focus on disposal methods [10]. There is little research on sanitation workers' health status, occupational safety or protection [11, 12]. Therefore, the purposes of this study are the following: (a) to describe demographic characteristics, health status and occupational protection of sanitation workers in Wuhan City, China; (b) to analyze risk factors related to their health status and (c) to provide evidence and policy recommendations for managing sanitation workers during the process of urbanization in developing countries.

2. METHODS

2.1. Study Population

The study was a pilot survey executed with face-to-face interviews on the streets in July and August 2009. In six districts of congested areas in Wuhan City (Wu-chang district 15, Hong-shan district 7, Han-yang district 4, Qiao-kou district 8, Jiang-an district 12 and Jiang-han district 8), 54 streets were chosen using purposive sampling according to the size and population distribution. The survey targeted all sanitation workers on those streets. Out of the 550 targeted workers, 165 (30%) declined to take part in the survey. A total of 385 questionnaires were completed in six districts (122 in Wu-chang, 50 in Hong-shan, 18 in Han-yang, 57 in Qiao-kou, 86 in Jiang-an and 52 in Jiang-han). All sanitation workers provided written informed consent prior to the survey.

2.2. Measures

The first part of the questionnaire collected socio-demographic information, including age, gender, marital status, years of education, resident characteristics (urban resident or rural migrant resident), job type (formal or informal, off-the-books), years in sanitation work, workload (self-reported as *average/a little light*, *a little heavy* or *very heavy*), individual monthly income (self-reported as *low*, *average* or *high*).

The second part of the questionnaire evaluated health status. Two-week illness (perceived health status in the past 2 weeks) and self-reported doctor-diagnosed arthritis were recorded, which represented short- and long-term health effects, respectively. Two-week illness was surveyed by asking "Have you had any physical and mental discomfort during the past 2 weeks?" [13], whereas doctor-diagnosed arthritis was defined as a response of *yes* to "Have you ever been told by a doctor or other health professional that you have some form of arthritis?" [14].

The third part of the questionnaire requested responses on occupational protection measures: prejob training and provision of fluorescent clothes, gloves, soap/hand sanitizer and masks. Regarding access to fluorescent clothes, gloves, soap/hand sanitizer and masks, a *yes* or *no* answer was requested for two questions: "Have you been provided this protection measure?" and "Do you now use this protection measure?"

2.3. Statistical Analysis

Study data were tabulated and quality control was carried out. The results were analyzed with SAS release 8.2. We constructed multivariate logistic regression models to describe association between risk factors as the independent variables, and 2-week illness and self-reported doctor-diagnosed arthritis as the dependent variable. Adjusted odds ratios (*ORs*) and 95% confidence intervals (*CI*s) were calculated by including all potential risk factors in the multivariate logistic regression model. Two-sided tests were used for all analyses, $p \leq 05$ was considered statistically significant.

3. RESULTS

3.1. Sociodemographic Characteristics

Table 1 shows sociodemographic characteristics of the participants. The sample consisted largely of a midlife population with a mean (*SD*) age of 48 (7.27) years. The percentage of monthly income self-reported as *low* was much higher than that reported as *average* and *high*. The difference in income may be related to the difference in job type and years in sanitation work; monthly income of formally-employed workers was significantly higher than that of informally-employed, off-the-books workers ($\chi^2 = 114.93$; $p < .001$), and the longer the years in sanitation work, the higher the monthly income ($\chi^2 = 32.32$; $p < .001$).

3.2. Health Status

Overall, the health status of sanitation workers was poor. The prevalence of 2-week illness (22.86%) was higher than in China’s general population in 2008 (18.90%) [15]. The prevalence of self-reported doctor-diagnosed arthritis in sanitation workers (18.96%) was higher than the estimated prevalence in China’s general population in 2008 (15%) [16].

3.3. Occupational Protection Measures

Of the five occupational protection measures studied, the percentage of fluorescent clothes provided and used was the highest, whereas the percentage of masks used was the lowest (Table 2). The data show that both sanitation workers (users) and their managers (providers) neglected the role of low-cost protection measures, such as masks, soap/hand sanitizer and prejob training.

TABLE 1. Sociodemographic Characteristics of Sanitation Workers (n = 385)

Sociodemographic Characteristics	n (%)
Gender	
male	81 (21.04)
female	304 (78.96)
Years of age ^a	
<40	40 (10.78)
40–49	172 (46.36)
50–59	136 (36.66)
≥60	23 (6.20)
Years of education ^b	
0	82 (21.64)
1–6	93 (24.54)
7–9	163 (43.00)
≥10	41 (10.82)
Resident characteristics ^c	
urban resident	164 (43.39)
rural migrant resident	214 (56.61)
Job type ^d	
formal	34 (8.88)
informal, off-the-books	349 (91.12)
Marital status	
married	348 (90.39)
other	37 (9.61)
Years in sanitation work	
<5	144 (37.40)
5–9	107 (27.79)
10–19	92 (23.90)
≥20	42 (10.91)
Workload, self-reported	
<i>average/a little light</i>	126 (32.73)
<i>a little heavy</i>	210 (54.55)
<i>very heavy</i>	49 (12.73)
Individual monthly income, self-reported ^e	
<i>low</i>	215 (57.03)
<i>average</i>	105 (27.85)
<i>high</i>	57 (15.12)

Notes. a = 14 missing responses, b = 6 missing responses, c = 7 missing responses, d = 2 missing responses, e = 8 missing responses.

TABLE 2. Occupational Protection of Sanitation Workers (n = 385)

Protection Measure	Response, n (%)	
	“I have been provided”	“I now use”
Fluorescent clothes	383 (99.48)	380 (98.70)
Gloves	324 (84.16)	242 (62.86)
Soap/hand sanitizer	121 (31.43)	103 (26.75)
Masks	164 (42.60)	28 (7.27)
Prejob training ^a	168 (43.64)	N/A

Notes. a = “I have had prejob training”, N/A = not applicable.

TABLE 3. Risk Factors Associated With 2-Week Illness and Self-Reported Doctor-Diagnosed Arthritis (n = 385)

Variables	2-Week Illness		Self-Reported Doctor-Diagnosed Arthritis	
	Adjusted OR [95% CI]	<i>p</i>	Adjusted OR [95% CI]	<i>p</i>
Gender				
male	1.00		1.00	
female	0.98 [0.47, 2.06]	.96	1.91 [0.77, 4.74]	.163
Years of age				
<40	1.00		1.00	
40–49	1.71 [0.63, 4.59]	.29	0.42 [0.18, 1.02]	.051
50–59	1.52 [0.56, 4.19]	.42	0.52 [0.21, 1.29]	.158
≥60	0.48 [0.08, 2.91]	.42	0.64 [0.13, 3.21]	.593
Years of education				
0	1.00		1.00	
1–6	1.42 [0.64, 3.16]	.39	1.09 [0.46, 2.57]	.836
7–9	1.30 [0.62, 2.73]	.49	1.61 [0.74, 3.54]	.234
≥10	1.56 [0.57, 4.27]	.38	1.29 [0.42, 3.95]	.661
Marital status				
married	1.00		1.00	
other	1.85 [0.78, 4.37]	.16	0.52 [0.16, 1.65]	.262
Individual monthly income, self-reported				
low	1.00		1.00	
average	0.92 [0.49, 1.70]	.78	0.68 [0.35, 1.34]	.266
high	0.98 [0.41, 2.38]	.97	1.81 [0.76, 4.35]	.184
Years in sanitation work				
<5	1.00		1.00	
5–9	0.79 [0.41, 1.53]	.49	1.37 [0.66, 2.84]	.386
10–19	0.74 [0.36, 1.50]	.40	1.72 [0.82, 3.61]	.153
≥20	0.79 [0.30, 2.06]	.63	1.73 [0.65, 4.65]	.271
Workload				
average/a little light	1.00		1.00	
a little heavy	3.28 [1.63, 6.56]	.001	1.49 [0.78, 2.83]	.234
very heavy	3.58 [1.42, 9.02]	.007	1.17 [0.46, 3.00]	.739
Prejob training				
yes	1.00		1.00	
no	1.06 [0.62, 1.81]	.84	1.85 [1.03, 3.32]	.042
Soap/hand sanitizer				
yes	1.00		1.00	
no	1.23 [0.66, 2.30]	.51	0.89 [0.47, 1.68]	.722
Gloves				
yes	1.00		1.00	
no	1.07 [0.61, 1.88]	.80	0.48 [0.26, 0.92]	.034
Masks				
yes	1.00		1.00	
no	0.76 [0.30, 1.93]	.56	1.54 [0.55, 4.35]	.413

Notes. OR = odds ratio, CI = confidence interval.

3.4. Risk Factors Associated With Health Status

Table 3 shows results of multivariate logistic regression models for the association between potential risk factors and 2-week illness as well as self-reported doctor-diagnosed arthritis. Two-week illness was significantly more prevalent among sanitation workers with *very heavy* (adjusted *OR* 3.58; 95% CI [1.42, 9.02]) and *a little heavy* (adjusted *OR* 3.28; 95% CI [1.63, 6.56]) workload compared to those whose workload was *average/a little light*. Self-reported doctor-diagnosed arthritis was significantly more prevalent among those who had not had prejob training (adjusted *OR* 1.85; 95% CI [1.03, 3.32]) and less prevalent among those who did not wear gloves (adjusted *OR* 0.48; 95% CI [0.26, 0.92]). It may be strange that those who wore gloves reported a higher occurrence of arthritis than those who did not. This may be related to the limitations of this cross-sectional survey: sanitation workers may wear gloves because they suffer from arthritis or because they have had more years in sanitation. Data analysis shows that the difference in the years in sanitation work between those who wore gloves and those who did not was statistically significant (9.32 ± 9.76 versus 7.14 ± 6.72 , respectively; $p < .01$). The difference in the years in sanitation work between formal and informal workers was also statistically significant (21.56 ± 6.52 versus 7.22 ± 7.94 , respectively; $p < .001$), which indicates a need to undertake a further in-depth study in the future.

4. DISCUSSION

4.1. Limitations

This pilot study has a few limitations that must be addressed. First, the survey sample was not random and it was relatively small. This population was a challenge for those administering the survey due to the sanitation workers' scheduled hours and interviewing conditions. The sanitation workers' first shift began at 4:00 and ended at about 8:00. The third and last shift began at 18:00. The survey was carried out on the street, with those administering the survey usually

working on the street and standing near garbage cans. Second, it was only a pilot study and a cross-sectional survey, which decreases the power of the study to identify significant risk factors. Third, at present, there are relatively few studies on sanitation workers, so it was difficult to compare and discuss current results.

4.2. Main Findings

Most sanitation workers were female, rural migrant residents, with a low level of education. The sanitation workers' prevalence of 2-week illness and self-reported doctor-diagnosed arthritis was relatively higher than in China's general population. The findings related to occupational protection showed that both sanitation workers and their managers neglected the role of low-cost protection measures, especially masks, soap/hand sanitizer and prejob training. Regarding factors associated with health status, high-intensity workload was an important risk factor for 2-week illness (short-term health effects) and prejob training was an important protective factor against arthritis (long-term health effects).

4.3. Comparison With Previous Studies

Rapid urbanization has brought many challenges for urban health; sanitation workers provide a vital service for urban citizens [17, 18]. This job can be very unpleasant due to exposure to environmental pollution. Studies on sanitation workers are relatively rare. This means that the sanitation workers' very important role may be ignored. For developing countries, this is an important issue related to the urbanization process and the so-called healthy city status. Therefore, future research in this area is necessary.

When we compared our survey with other studies, we found consistency in the sociodemographic variables [4, 6, 7]: most sanitation workers had low incomes and a low level of education, and they were nonlocal residents. This may suggest that the social status of the occupation is low both in China and in other countries, e.g., India and Thailand, which may explain the distribution of sociodemographic characteristics, especially the gender composition, resident characteristics

and job type. In the present study, many sanitation workers considered their current job temporary (91.12%), which perhaps means that they did not like it because of its low social status. For the same reason, urban residents did not want to do the work and most sanitation workers were rural migrant residents (58.61%). In addition, the Chinese traditional preference of boys to girls affected women's education and employment [19, 20], which may explain the high proportion of female sanitation workers (78.96%) in the current study.

In addition, it is necessary to point out the proportion of self-reported *high* monthly income (15.12%), which was relatively higher compared with the findings in other developing countries [6, 7, 8]. The income status of sanitation workers was consistent with China's overall level of economic development. Considering the percentage use of low-cost occupational protection measures, the emphasis of sanitation workers' management may be not money, but safety awareness in China.

It is easy to understand the correlation between 2-week illness and workload. The prevalence of self-reported doctor-diagnosed arthritis in sanitation workers was higher than in the general population and prejob training was a protective factor, which confirmed some previous research on arthritis [21, 22]. According to research on arthritis, the risk factors associated with this illness include nonmodifiable risk factors, such as female gender, older age, genetic predisposition, and modifiable risk factors, such as obesity, joint injuries, infections and certain occupations, e.g., shipyard work, farming, heavy industry, and any occupation with repetitive knee bending. It is noteworthy that prejob training is a modifiable factor, which could benefit the lives of the sanitation workers with arthritis or prevent its occurrence or progression. To the best of our knowledge, there is no national model of prejob training for sanitation workers in China. Prejob training for sanitation workers is mainly related to professional ethics, labor laws, sanitation regulations, traffic laws, operating skills, safety and health protection, etc.

Although this study had some limitations, it provides some practical guidance. From the per-

spective of social ethics, we need to raise awareness of occupational protection of sanitation workers and strengthen research on this vulnerable group in developing countries. There have been hardly any studies on sanitation workers in the past 30 years in developed countries, where sanitation work is mechanized [23]. From the perspective of macropolicy, China already has an excellent legal system and the central government has worked actively in the field of occupational safety and health protection. However, there are many obstacles in the implementation process, which urgently needs some valid evidence to guide the implementation of the macropolicy [24]. For sanitation workers, according to China's occupational disease prevention law, employers must adopt effective protective measures against occupational diseases and must provide workers with personal protective equipment [25]. However, according to survey data, employers (managers of sanitation workers) do not effectively comply with this law. Both in employers and employees (sanitation workers), legal consciousness is very weak. Public participation and supervision may be required. The public should support the rights of struggling sanitation workers. Urban residents should protect their sanitation workers to protect themselves as well as city development.

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