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The Prevalence and Correlates of Occupational Injuries in Small-Scale Manufacturing Enterprises

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Abstract: The Prevalence and Correlates of Occupational Injuries in Small-Scale Manufacturing Enterprises: Akinori NAKATA, *et al*. National Institute of Occupational Safety and Health—Workers involved in small-scale manufacturing businesses are known to comprise a high-risk population for occupational injury. The present study investigated the prevalence and correlates of occupational injury in this population. A self-administered questionnaire that solicited answers about occupational information including injury, demographic characteristics, health conditions and lifestyle factors was collected from a sample of 1,298 workers in 228 small-scale manufacturing enterprises (defined as fewer than 50 workers) aged 16–78 (mean 46) yr in Yashio city, Saitama, Japan (response rate 65.5%). The enterprises were randomly selected from the 2000 edition of the city commercial directory corresponding to the distribution of types of businesses in the city. Occupational injury was assessed by asking subjects, 'Have you ever been injured during your work, including minor scratches and cuts in the previous 1-yr period?' The possible response was either 'yes' or 'no.' The prevalence of study-defined occupational injury among the workers was 35.6% (male 43.0%, female 17.9%). Among job types, manufacturing (44.2%) and driving (43.5%) had high rates of occupational injuries. Similarly, occupational injuries were high in the papermaking (54.5%) and machinery (47.7%) industries. For males, younger age, current or former smoking, insomnia symptoms, and disease(s) currently under treatment were correlated with injury, whereas for females, being unmarried, higher educational status, and insomnia symptoms were the correlating factors. Occupational injury is common among small-scale manufacturing businesses, and is associated with multiple controllable factors. Countermeasures such as prohibiting smoking during work, sleep health education, job safety training for young/inexperienced workers are appropriate methods for eliminating or reducing injuries.
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Key words: Occupational injury, Safety, Small-scale enterprise, Manufacturing, Factory, Prevalence, Correlate, Smoking, Sleep, Occupational health

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Injury during work is one of the most important but preventable and modifiable occupational safety and health issues. Throughout the world, there are 270 million occupational accidents each year, causing 1.1 million work-related deaths annually as estimated by the International Labor Organization[1)].

Although the total of occupational injuries is decreasing every year in Japan, injuries in small-scale enterprises (SSEs) employing fewer than 50 persons remain a critical issue. According to the 2001 nationwide survey in Japan, there were 101,030 occupational injury cases requiring sick leave for 4 d or more among approximately 37.4 million workers in SSEs, and these cases accounted for 72% of all occupational injuries[2–4)]. Among SSE sectors, manufacturing accounted for 29% (n=29,803) of injuries, which was the largest percentage of all industry sectors. Thus it seems reasonable to say that there is a need for a systematic approach to the elimination or reduction of injuries in these enterprises.

Many previous epidemiological studies have identified potential risk factors for occupational injuries. These include younger or older age[5, 6)], male gender[7)], lack of experience or systematic training[8)], poor working

conditions[9], long working hours[10], job stress[6, 11–15], fatigue[16], shift/night work[17], poor sleep[6, 18–21], undesirable lifestyle factors such as smoking, drinking heavily, or lack of physical exercise[6, 7, 22–25], and poor health status[26, 27] or combinations of these factors. In addition to the above evidence, prevention of occupational injury in SSEs is often difficult because they generally have few safety resources, cannot usually hire staff devoted to safety activities, and often lack the ability to identify occupational hazards and conduct surveillance[28, 29]. Moreover, workers in SSEs have a tendency to be subcontracted by large-scale enterprises to do riskier tasks with high time pressures and constraints[26, 30]. Such circumstances may give rise to the excess incidence of injuries in SSEs. However, little information has been accumulated regarding associated factors of occupational injury in SSEs, especially in manufacturing.

The aim of this study was to estimate the prevalence of, and examine the associated factors related to, occupational injuries in manufacturing sectors of SSEs. Demographics (gender, age, educational and marital status), lifestyles (smoking habit, sleep, caffeine intake, and alcohol consumption), physical/psychological conditions (insomnia symptoms, body mass index (BMI), and presence of physical/psychological diseases), and occupational factors (job type, industry sector, and work experience) were assessed. We focused on workers of SSEs, because most SSEs have no medical staff at their companies and have difficulty in accessing health services compared to medium or large-scale enterprises[29].

Subjects and Methods

Subjects

The study subjects were workers of small-scale manufacturing factories (those with less than 50 workers) in Yashio city, Saitama prefecture, Japan. This city has the highest percentage of manufacturing plants and highest percentage of people working in manufacturing in a prefecture located next to Tokyo metropolitan area. In this city, 1,813 small and medium-scale manufacturing factories were listed in the 2000 edition of the city commercial directory, which covered more than 95% of all small and medium-scale enterprises in this area[31]. We randomly selected 20% of the factories from this directory according to the distribution of types of businesses in the city. We contacted 350 factories by telephone and asked them to participate in a questionnaire survey (n=3,514 as potential subjects). Two hundred forty-eight factories agreed to participate in the survey, and questionnaires were distributed during visits to each factory to all full-time workers (n=2,591). A total of 102 factories (n=923) did not participate in the present study, because i) the person responsible for the worksite did not have time to recruit workers, ii) workers/factories declined participation, iii) the factory was too far to visit, or iv) the worker had retired. Responses were obtained from 2,302 workers at 244 factories (response rate 65.5%). Among 244 factories, 228 were categorized as small-scale manufacturing enterprises, with a total of 1,668 workers. In consequence, 1,298 subjects (913 males and 385 females) were submitted for analysis, after excluding 370 subjects who worked at non-manufacturing factories or had missing values for demographics, lifestyles, and occupational information (list-wise exclusion).

Study design

Data were collected in this cross-sectional study with a self-rating questionnaire from August to December 2002. The workers were surveyed by soliciting responses to a questionnaire containing information concerning demographics, lifestyles physical/psychological conditions, and occupational information including injury (Table 1). This study was performed with the informed consent of all workers. The study protocol was approved by the Ethical Committee of the University of Tokyo, School of Medicine, Tokyo, Japan.

Questionnaire

Demographics, lifestyles, and physical/psychological health status: Demographic, lifestyle and physical/psychological factors included age in years, marital status (married/unmarried), highest education (junior high school, high school, vocational/college/university), smoking habits (never smoker, former smoker, current smoker), alcohol consumption (ethanol (g)/d), caffeine intake (cups of coffee or tea/d), BMI (calculated as weight in kilograms divided by the square of height in meters, self-reported), insomnia symptoms (yes/no), and presence of self-reported physical and/or psychological diseases currently under treatment are presented in Table 1. Continuous variables were grouped into 3 to 6 categories as follows: age (16 to 29, 30–39, 40–49, 50–59, 60–69, or 70 and over), alcohol consumption (0, 0.01–4.9, 5.0–14.9, 15.0–24.9, or 25.0 and over g/d), caffeine intake (0, 1–2, or 3 and over cups/d), BMI (<20.0, 20.0–22.5, 22.6–24.9, or 25.0 and over), and work experience (<3, 3–7, or 7 or more years). Current smokers were defined as those who smoked at least one cigarette/d. Insomnia symptoms were defined as either taking more than 30 min to fall asleep, awakening during sleep more than 3 times/wk, or early morning awakening more than 3 times/wk during the last 1-yr period[32, 33]. The presence of physical and/or psychological diseases were defined by reporting any of the following disease(s) currently under treatment; hypertension, hyperlipemia, diabetes mellitus, depression, menopausal syndrome, and other diseases including heart disease, cancer, liver disease, renal disease, peptic ulcer, gastrointestinal diseases, neurological diseases, musculoskeletal disorders, and psychiatric illnesses.

Table 1. Descriptive statistics for demographics, lifestyles, and occupational characteristics of the study population

Characteristics	Male		Female		Total	
Number of subjects	913	(100.0)	385	(100.0)	1,298	(100.0)
Occupational injury (Yes)	393	(43.0)*	69	(17.9)*	462	(35.6)
Age (yr), mean (SD)	45.3	(13.4)	46.7	(12.9)	45.7	(13.3)
Age group, yr						
16–29	124	(13.6)	52	(13.5)	176	(13.6)
30–39	248	(27.2)	69	(17.9)	317	(24.4)
40–49	143	(15.7)	62	(16.1)	205	(15.8)
50–59	251	(27.5)	142	(36.9)	393	(30.3)
60–69	132	(14.5)	55	(14.3)	187	(14.4)
70+	15	(1.6)	5	(1.3)	20	(1.5)
Marital status						
Married	644	(70.5)	282	(71.3)	926	(71.3)
Unmarried	269	(29.5)	103	(26.8)	372	(28.7)
Highest education						
Secondary school	211	(23.1)	81	(21.0)	292	(22.5)
High school	426	(46.7)	207	(53.8)	633	(48.8)
Vocational/college/university	276	(30.2)	97	(25.2)	373	(28.7)
Smoking history						
Current smoker	537	(58.8)	100	(26.0)	637	(49.1)
Number of cigarettes smoked per day, mean (SD)	21.5	(10.2)	15.9	(8.4)	20.6	(10.1)
Former smoker	108	(11.8)	21	(5.5)	129	(9.9)
Never smoker	268	(29.4)	264	(68.6)	532	(41.0)
Insomnia symptoms (Yes)	211	(23.1)	94	(24.4)	305	(23.5)
Drinking habit						
Alcohol (g ethanol/d)						
Non–drinker (0.0)	217	(23.8)	197	(51.2)	414	(31.9)
0.01 to 4.9	108	(11.8)	89	(23.1)	197	(51.2)
5.0 to 14.9	209	(22.9)	69	(17.9)	278	(21.4)
15.0 to 24.9	186	(20.4)	20	(5.2)	206	(15.9)
25.0 or more	193	(21.1)	10	(2.6)	203	(15.6)
Alcohol consumption (g ethanol/d), mean (SD)	17.9	(14.5)	7.8	(8.5)	15.7	(14.0)
Caffeine intake (cups of coffee or tea/d)						
Almost none	86	(9.4)	28	(7.3)	114	(8.8)
1 to 2	423	(46.3)	162	(42.1)	585	(45.1)
3 or more	404	(44.2)	195	(50.6)	599	(46.1)
Disease(s) currently under treatment (Yes)	283	(30.2)	102	(28.2)	385	(29.7)
Body mass index (kg/height $(m)^2$), mean (SD)	23.1	(3.2)	21.9	(2.9)	22.8	(3.2)
Less than 20.0	141	(15.4)	97	(25.2)	238	(18.3)
20.0 to 22.5	281	(30.8)	153	(39.7)	434	(33.4)
22.6 to 25.0	282	(30.9)	80	(20.8)	362	(27.9)
25.1 or more	209	(22.9)	55	(14.3)	264	(20.3)
Work experience (in yr)						
Less than 3	155	(17.0)	77	(20.0)	232	(17.9)
3 to 7	134	(14.7)	60	(15.6)	194	(14.9)
More than 7	624	(68.3)	248	(64.4)	872	(67.2)
Job type						
Managerial/clerical	125	(13.7)	200	(51.9)	325	(25.0)
Sales/service	94	(10.3)	3	(0.8)	97	(7.5)
Technical	41	(4.5)	7	(1.8)	48	(3.7)
Manufacturing	496	(54.3)	138	(35.8)	634	(48.8)
Driving	21	(2.3)	2	(0.5)	23	(1.8)
Other	136	(14.9)	35	(9.1)	171	(13.2)
Industry sector						
Leather	12	(1.3)	5	(1.3)	17	(1.3)
Textile	19	(2.1)	22	(5.7)	41	(3.2)
Food	33	(3.6)	18	(4.7)	51	(3.9)
Printing	29	(3.2)	14	(3.6)	43	(3.3)
Chemical	147	(16.1)	62	(16.1)	209	(16.1)
Woodwork	8	(0.9)	6	(1.6)	14	(1.1)
Metalworking	374	(41.0)	145	(37.7)	519	(40.0)
Papermaking	52	(5.7)	26	(6.8)	78	(6.0)
Machinery	193	(21.1)	64	(16.6)	257	(19.8)
Ceramics/clay/stone	24	(2.6)	7	(1.8)	31	(2.4)
Other	22	(2.4)	16	(4.2)	38	(2.9)

*$p<0.001$ (χ^2 test).

Table 2. Prevalence of occupational injury by job type (%)

Job type	Male	Female	Total
Managerial/clerical	27.2	8.5	15.7
Sales/service	29.8	33.3	29.9
Technical	29.3	14.3	27.1
Manufacturing	49.0	26.8	44.2
Driving	42.9	50.0	43.5
Other	49.3	34.3	46.2
Total	43.0	17.9	35.6

Occupational information: Occupational information such as job type, industry sector, and shift/non-shift work were included in the questionnaire. Job type was categorized into 6 groups: managerial/clerical, sales/service, technical, manufacturing, driving, and others. There were 11 types of industry: leather, textile, food, printing, chemical, woodwork, metalworking, papermaking, machinery, ceramics/clay/stone, and others. Only 11 workers (0.8%) were either shift or night workers.

Occupational injury: The question to assessing occupational injury was, "Have you ever been injured during your work, including minor scratches and cuts, in the previous 1-yr period?" The possible response was either 'yes' or 'no.'

Statistical analyses

We attempted to identify the associated factors underlying occupational injuries using univariable and multivariable logistic regression analyses. Univariable analyses were performed to detect the relationship of occupational injury with each of the variables, and the variables were then analyzed using the forward selection stepwise procedure ($p=<0.05$ for inclusion and $p>=0.10$ for exclusion) in multivariable analyses. Strong intercorrelations between variables were checked and excluded from the multivariable model (e.g., age and work experience). The variables entered into the model were gender, age group, marital status, educational level, smoking, alcohol drinking, caffeine intake, insomnia symptoms, BMI, diseases currently under treatment, job type, and industry sector. Since there was a large difference in prevalence of occupational injury between males and females (Table 1), we performed multivariable analysis independent of gender following the same statistical method as above. The significance level of all statistical analyses was $p<0.05$ (two-tailed test). All data were analyzed using the Statistical Package for the Social Sciences version 13.0 (SPSS Inc., Chicago, USA).

Results

The age of the participants ranged from 16 to 78 (mean 46) yr. Forty-six percent of the workers were elder than 50 yr of age (Table 1). Seventy percent of workers were males. Also, 70% of the participants were married. As for job type, manufacturing and managerial/clerical accounted for three quarters of all workers. The metalworking industry had the largest survey population (40%) among all the manufacturing sectors.

Table 3. Prevalence of occupational injury by industry sector (%)

Industry sector	Male	Female	Total
Leather	17.6	0.0	13.0
Textile	21.4	31.3	26.7
Food	44.4	23.5	34.3
Printing	42.9	26.7	36.1
Chemical	44.0	26.1	40.1
Woodwork	87.5	0.0	58.3
Metalworking	47.1	24.2	42.9
Papermaking	61.1	40.9	54.5
Machinery	50.3	37.5	47.7
Ceramics/clay/stone	40.0	100.0	44.4
Other	54.5	23.1	42.9
Total	43.0	17.9	35.6

A total of 462 workers (35.6%) responded that they had experienced an occupational injury in the previous 1-year period. Males (43.0%) had a statistically higher injury rate than females (17.9%) (χ^2 test, $p<.001$) (Table 1). The prevalence of occupational injury according to job type and industry sector is shown in Tables 2 and 3, respectively. Among job types, manufacturing and driving had high prevalence of injury. The papermaking, machinery, ceramics/clay/stone and metalworking industries had the highest prevalence.

Factors associated with occupational injury in total workers are shown in Table 4. The univariable logistic regression analyses suggest that male gender, younger age, being unmarried, current or former smoking, drink heavily, insomnia symptoms, and shorter work experience were significantly associated with increased risk of occupational injury. Among job types, manufacturing and driving showed significantly higher odds ratios (ORs) of injury than managerial/clerical. The woodwork, metalworking, papermaking, machinery, ceramics/clay/stone industry showed higher ORs for occupational injuries than the leather industry sector. The multivariable logistic regression analyses suggest that male gender, younger age, current or former smoking, and insomnia symptoms are significantly associated with increased risk of injury. Factors associated with occupational injury in male and female workers are shown in Table 5. In males, younger age, current or former smoker, insomnia symptoms, and presence of physical/psychological

Table 4. Associated factors underlying occupational injuries of 1,298 workers of small-scale manufacturing enterprises

Factor	n	Univariable OR (95%CI)	p value	Multivariable OR (95%CI)	p value
Demographics					
Gender			0.000		0.000
Female	913	1.00		1.00	
Male	385	3.46 (2.59–4.63)		2.28 (1.62–3.20)	
Age (in years)			0.000		0.001
16 to 29	176	2.11 (1.37–3.29)		2.24 (1.39–3.62)	
30 to 39	317	2.14 (1.45–3.16)		2.13 (1.39–3.27)	
40 to 49	205	1.38 (0.90–2.13)		1.37 (0.86–2.19)	
50 to 59	393	1.10 (0.75–1.63)		1.21 (0.80–1.84)	
60 to 69	187	1.00		1.00	
70 or more	20	1.44 (0.54–3.80)		1.88 (0.66–5.30)	
Marital status			0.008		
Married	926	1.00			
Unmarried	372	1.40 (1.09–1.79)			
Highest educational level			NS		
Junior high school	292	1.00			
High school	633	1.14 (0.85–1.53)			
Vocational/college/university	373	0.98 (0.71–1.35)			
Lifestyle and physical/psychological condition					
Smoking			0.000		0.019
Never smoker	532	1.00		1.00	
Former smoker	129	1.94 (1.30–2.89)		1.74 (1.12–2.69)	
Current smoker	637	1.91 (1.49–2.44)		1.38 (1.04–1.83)	
Alcohol (g ethanol/d)			0.001		
Non-drinker (0.0)	414	1.00			
0.01 to 4.9	197	1.29 (0.90–1.86)			
5.0 to 14.9	278	1.68 (1.22–2.31)			
15.0 to 24.9	206	1.29 (0.90–1.84)			
25.0 or more	203	1.95 (1.38–2.77)			
Caffeine (cups/d)			NS		
Almost none	114	1.00			
1 to 2	585	1.36 (0.88–2.10)			
3 or more	599	1.31 (0.85–2.02)			
Insomnia symptoms[a]			0.001		0.001
No	993	1.00		1.00	
Yes	305	1.56 (1.20–2.03)		1.64 (1.23–2.18)	
Body mass index (BMI)			NS		
Less than 20.6	314	1.33 (0.96–1.84)			
20.6 to 22.4	333	1.00			
22.5 to 24.6	339	1.23 (0.91–1.64)			
24.7 or more	312	1.04 (0.75–1.43)			
Disease(s) currently under treatment			NS		
No	936	1.00			
Yes	362	0.95 (0.74–1.23)			
Occupational					
Job type			0.000		0.000
Managerial/clerical	325	1.00		1.00	
Sales/service	97	2.29 (1.35–3.88)		1.41 (0.79–2.51)	
Technical	48	2.00 (0.99–4.03)		1.16 (0.55–2.45)	
Manufacturing	634	4.23 (3.03–5.96)		3.36 (2.32–4.87)	
Driving	23	4.13 (1.72–9.93)		2.80 (1.11–7.07)	
Others	171	4.61 (3.02–7.05)		3.48 (2.20–5.50)	

(continued on next page)

Table 4. Associated factors underlying occupational injuries of 1,298 workers of small-scale manufacturing enterprises (continued)

Factor	n	Univariable OR (95%CI)	p value	Multivariable OR (95%CI)	p value
Industry sector			0.026		0.006
Leather	17	1.00		1.00	
Textile	41	4.50 (0.52–38.7)		7.83 (0.87–70.8)	
Food	51	6.67 (0.81–54.9)		10.9 (1.25–94.5)	
Printing	43	7.72 (0.93–64.3)		9.12 (1.04–80.1)	
Chemical	209	7.22 (0.94–55.6)		8.23 (1.02–66.4)	
Metalworking	519	8.86 (1.17–67.4)		12.1 (1.52–96.0)	
Ceramics/clay/stone	31	11.8 (1.54–90.2)		16.7 (2.08–133.9)	
Machinery	257	6.52 (0.77–55.3)		9.94 (1.09–90.3)	
Papermaking	78	13.7 (1.73–108.5)		20.9 (2.50–174.0)	
Woodwork	14	12.0 (1.23–117.4)		21.6 (2.01–231.2)	
Other	38	8.80 (1.03–75.6)		12.8 (1.39–117.0)	
Work experience (in yr)			0.002		
Less than 3	232	1.56 (1.16–2.10)			
3 to 7	194	1.50 (1.09–2.06)			
More than 7	872	1.00			

OR, odds ratio; CI, confidence interval; NS, not significant.

[a]Defined by either taking more than 30 min to fall asleep, awakening during sleep more than 3 times/wk, or early morning awakening more than 3 times/wk during the last 1-year period. All the variables were entered and analyzed by the forward selection stepwise procedure (p=<0.05 for inclusion and p>=0.10 for exclusion) in a multivariable model. Strong intercorrelations between variables were checked and excluded from the multivariable model. Only the variables with statistical significance in multivariable analyses are shown.

diseases showed an increased risk. In females, being unmarried, higher educational status, and insomnia symptoms were strong factors associated with occupational injury.

Discussion

This study identified the prevalence and correlates of occupational injuries in small-scale manufacturing enterprises in Yashio city, Japan. The results revealed that 43% of men and 17.9% of women had experienced an occupational injury within the previous 1-yr period. A higher prevalence of occupational injury was found in workers engaged in manufacturing and driving as well as in the papermaking and machinery industry sectors. Multivariable logistic regression analyses showed that current and former smoking, insomnia symptoms, presence of physical/psychological diseases currently under treatment, and younger age were associated with occupational injury in males, while being unmarried, higher educational status, and insomnia symptoms were associated with occupational injuries in females. This study is the first of its kind to report that occupational injury is associated with different factors for males and females in small-scale manufacturing businesses, where occupational injury prevalence is high.

Industry sectors of papermaking and machinery showed a high occupational injury rate. According to the nationwide survey in 2002, woodwork and metalworking were the industry sectors with exceptionally high injury rates which required sick leave of 4 d or more with an incidence of 877 and 748 per 100,000 full-time workers, respectively. Incidences of occupational injury in machinery and papermaking were 267 and 90 per 100,000 full-time workers, respectively, and all manufacturing was 325[2–4]. The high prevalence of occupational injury reported in this study could possibly be due to the inclusion of minor injuries such as scratches and cuts, especially in the papermaking and machinery sectors. Precise information on the nature, severity, and circumstance of injury would help us to understand better the situation of occupational injuries in small-scale manufacturing enterprises.

In the current study, insomnia symptoms were significantly associated with occupational injuries in both genders. Several previous studies have shown that insomnia is related to the occurrence of occupational accidents/injuries. For example, Balter and Uhlenhuth[34] compared past-year prevalence of serious accidents/

Table 5. Factors associated with occupational injuries of 913 male and 385 female workers of small-scale manufacturing enterprises

Factor	Male			Female		
	n	Multivariable OR (95%CI)	p value	n	Multivariable OR (95%CI)	p value
Demographics						
Age (in yr)			0.001			
16 to 29	124	2.66 (1.51–4.69)		52		
30 to 39	248	2.51 (1.54–4.10)		69		
40 to 49	143	1.49 (0.88–2.54)		62		
50 to 59	251	1.27 (0.79–2.03)		142		
60 to 69	132	1.00		55		
70 or more	15	1.69 (0.54–5.39)		5		
Marital status						0.026
Married	644			282	1.00	
Unmarried	269			103	2.04 (1.09–3.80)	
Highest educational level						0.042
Junior high school	211			81	1.00	
High school	426			207	2.12 (0.97–4.62)	
Vocational/college/university	276			97	3.02 (1.27–7.18)	
Lifestyle and physical/psychological condition						
Smoking			0.040			
Never smoker	268	1.00		264		
Former smoker	108	1.71 (1.06–2.77)		21		
Current smoker	537	1.42 (1.03–1.96)		100		
Insomnia symptoms[a]			0.012			0.037
No	702	1.00		291	1.00	
Yes	211	1.52 (1.10–2.12)		94	1.90 (1.04–3.48)	
Disease(s) currently under treatment			0.040			
No	653	1.00		283		
Yes	260	1.43 (1.02–2.02)		102		
Occupational						
Job type			0.000			0.000
Managerial/clerical	125	1.00		200	1.00	
Sales/service	94	0.96 (0.52–1.79)		3	7.74 (0.64–93.1)	
Technical	41	0.84 (0.37–1.90)		7	1.91 (0.21–17.3)	
Manufacturing	496	2.58 (1.63–4.08)		138	4.26 (2.23–8.13)	
Driving	21	1.87 (0.69–5.08)		2	9.74 (0.55–173.4)	
Others	136	2.63 (1.52–4.54)		35	5.36 (2.21–13.0)	
Industry sector			0.005			
Leather	12	1.00		5		
Textile	19	5.98 (0.58–61.9)		22		
Food	33	10.6 (1.14–98.0)		18		
Printing	29	6.99 (0.74–66.1)		14		
Chemical	147	6.50 (0.78–54.2)		62		
Metalworking	374	10.9 (1.33–89.4)		145		
Ceramics/clay/stone	24	14.1 (1.70–117.4)		7		
Machinery	193	8.02 (0.81–79.9)		64		
Papermaking	52	18.5 (2.11–161.7)		26		
Woodwork	8	43.1 (2.93–634.2)		6		
Other	22	7.40 (0.76–72.1)		6		

OR, odds ratio; CI, confidence interval.

[a]Defined by either taking more than 30 min to fall asleep, awakening during sleep more than 3 times/wk, or early morning awakening more than 3 times/wk during the last 1-yr period. All the variables were entered and analyzed by the forward selection stepwise procedure (p=<0.05 for inclusion and p>=0.10 for exclusion) in a multivariable model. Strong intercorrelations between variables were checked and excluded from the multivariable model. Only the variables with statistical significance are shown.

injuries in subjects with chronic untreated insomnia and normal controls and found a 4.5 times higher rate in subjects with insomnia ($p<0.05$). Similarly, Leger *et al.*[35] reported that persons with severe insomnia had more problems at work such as decreased concentration, difficulty performing duties, and work-related accidents than did good sleepers. In a population of construction workers, sleep disorders were reported to be the major factor (OR 1.92, 95% confidence interval (CI) 1.38–2.69) contributing to occupational injuries[20] in a case-control study and this was also reported for railway workers (OR 1.30, 95%CI 1.08–1.57)[22]. A recent study by Simpson *et al.*[6] reported increased minor injuries in workers who reported sleep problems compared to workers without problems (OR 1.61, 95%CI 1.23–2.10). Since the prevalence of insomnia in this population was as high as those reported in previous studies (20–30%)[18, 36–39], early treatment for insomnia or the introduction of a sleep health technique such as taking a brief nap at lunchtime to avoid sleepiness during work[40–42] could be an effective countermeasure.

Current and former smokers showed a significant increased risk of occupational injury compared to never a smoker among males. The results are consistent with previous studies showing that current smokers have a higher incidence of occupational injuries than non-smokers[16, 20, 22, 23, 43–46]. Most studies report injury rates to be 1.2–2.8 times higher among smokers with statistical significance. On the other hand, former smokers in this study showed a higher injury rate than never a smoker and current smokers among males. One possible explanation for current smokers having a lower injury rate than former smokers is that current smokers may have under-reported their injuries because they may have had difficulty in recalling their injury. This hypothesis could be supported by the fact that heavy smoking is associated with cognitive impairment/decline in middle-aged people[47]. Alternatively, current smokers may smoke during work to avoid sleepiness since nicotine has the effect of increasing alertness[48, 49]. The higher injury rate of former smokers might also be explained by nicotine withdrawal syndrome associated with quitting smoking[50]. As prevalence of smoking is higher than general[51] and in the other working population[52] in Japan, workplace smoking restrictions and informing potential risk of former smoking may reduce occupational injuries among males.

Young age was associated with the occurrence of injury as reported in many previous studies[5, 6]. As most of the young employees in the present study population were required to acquire skills on the job and without training[53], they have a higher risk of being injured. It has been reported that employees who did not have job safety training had twice the rate of occupational injuries than those who underwent training[8]. Small-sized enterprises with occupational hazards do need safety training for young workers.

Among males, presence of physical/psychological disease(s) currently under treatment was significantly associated with injury. Approximately 30% of male workers in this study were suffering from some sort of illnesses, mostly in a chronic condition. In a large national health survey, disabled workers showed a greater number of occupational injuries (OR 1.36, 95%CI 1.19–1.56) compared to non-disabled workers. Specifically, physical disabilities such as arthritis, upper extremity impairment, blindness, deafness, and hearing impairment were all independently related to occupational injury[27]. These findings suggest that the presence of disease or disability could be a promoting factor in causing occupational injuries for males. However, the reasons why we could not detect any association among female workers remain open to speculation. Females suffering from chronic diseases may have fewer work demands than males[15] and this could lead to avoidance of injury.

Alcohol drinking was weakly associated with occupational injury. In construction workers, there were no significant relationships between frequency of alcohol consumption and occupational injury[23]. When alcohol consumption was compared between heavy and non-heavy users, a 1.74 times higher occupational injury rate was observed among heavy users in a community-based survey[24]. For farm workers, there was a significant increase (risk ratio 1.44, 95%CI 1.06–1.95) in risk of occupational injury among moderate drinkers (alcohol consumption, 1–2 times a week) compared to non-drinkers, but no significant association was found for moderate to heavy drinkers (alcohol consumption, 3 or more times a week, risk ratio 1.45, 95%CI 0.93–2.26); the result was also similar when using quantity of alcohol as a measure[25]. Miller *et al.*[54] pointed out that binge-drinking episodes are a more sensitive indicator of injury-related outcomes than merely asking quantity and frequency to assess daily alcohol consumption. To precisely estimate the association between drinking alcohol and occupational injury, not only daily alcohol consumption but also binge-drinking episodes should also be taken into account.

There was a significant positive association between educational status and occupational injury in females, which is an opposite finding to 2 previous studies[55, 56]. When our analysis was limited to manufacturing workers which was the second largest population of females, workers with higher educational levels tended to report more injuries (44.0%) than those with lower educational levels (23.0%), and these injured workers tended to be young (data not shown). The reasons why females with higher education reported more injuries in small manufacturing businesses should be explored in further studies.

Several methodological issues have to be considered. First, the cross-sectional nature of the study does not permit an interpretation of clear causal relation between the associated factors found in this study and occupational injury. Second, occupational injury was self-reported and did not ask the nature, severity, or circumstances of injury. Thus, it does not allow us to know which factor was related to the occupational injury in detail. Third, we did not measure working hours in our survey, which may have a significant impact on occupational injury; injury may have occurred more often in workers with long work hours[57].

In conclusion, the present study showed that occupational injury was common among small-scale manufacturing enterprises and were associated with preventable and modifiable factors such as smoking and sleep. Countermeasures such as a smoking ban, providing job safety training, and the introduction of proper rest breaks or nap times may decrease injuries in small-scale manufacturing enterprises.

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