JOB CATEGORY DIFFERENCES IN THE PREVALENCE AND ASSOCIATED FACTORS OF INSOMNIA IN STEEL WORKERS IN CHINA

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Abstract

Objectives: This study aimed to investigate the prevalence of insomnia and risk factors among different job categories of steel workers in China, in order to improve their quality of occupational life. Material and Methods: A cross-sectional face-to-face survey was conducted which involved 5834 steel workers from a large enterprise located in northern China, including front-line, maintenance and inspection, and other auxiliary workers. The Athens Insomnia Scale and the Job Content Questionnaire were used to assess the status of insomnia and job stress/social support, respectively. Multivariable logistic regression was used to identify factors influencing insomnia. Results: The overall prevalence of insomnia was determined at 42.0% (95% confidence interval: 40.7%–43.2%). For front-line, maintenance and inspection, and other auxiliary workers, the prevalence was 42.3%, 39.8%, and 47.9% (p = 0.001), respectively. The participants with high stress and low support, and those who had experienced ≥2 major life events in the past 12 months, compared to those with low stress and high support, and those without major events, displayed an increased risk of insomnia among all 3 job categories (the adjusted odds ratio ranged 1.56–2.38 and 1.30–1.75, respectively). The educational level, shift work, alcohol consumption, and present illness were identified as influencing factors of insomnia for 1 or 2 job categories. Conclusions: The prevalence of insomnia was the highest in the group of other auxiliary steel workers among the 3 job categories of steel workers under consideration. While the influencing factors of insomnia differed among the groups, job stress and major life events were common risk factors of insomnia among the 3 categories of steel workers. Int J Occup Med Environ Health. 2020;33(2):215–233

Key words: insomnia, shift work, job stress, life events, steel workers, job category

INTRODUCTION

At present, insomnia is one of the most common and widely recognized public health problems all over the world. In previous studies [1–4], the prevalence of insomnia ranged 7.1–79.8% in general populations in the world, e.g., 7.1% in Norway [2], 22.1% in the USA [1], 11.9% in Hong Kong of China [3], and 79.8% in Brazil [4]. In China, studies have shown that the prevalence of insomnia ranges 12.7–55.7% in different populations [5–8]. Although the prevalence of insomnia varies considerably in terms of criteria and symptoms, the prevalence above 30% for the global general population is commonly accepted. Meanwhile, several studies have reported that the prevalence of insomnia varies by job type [9–11]. For example, the prevalence of insomnia was determined at 23.2% among workers in the USA [9], 31% among manufacturing workers in South Korea [10], 23.2% among male public service workers in Japan [11], and 16.8% among financial workers in France [12]. Insomnia is said to increase the risk of numerous physical and mental diseases, including heart disease, depression,
in the annual occupational health examination in 2017 had been selected as potential research subjects, from whom 5896 workers eventually participated and completed the survey voluntarily. There were 48 subjects whose demographic information was missing, and 14 subjects who lacked more than a third of the items in the insomnia scale; these 62 subjects were, therefore, rejected. Thus, 5834 participants were included in the final analysis.

Data collection was performed in March–July 2017. All the subjects had given their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the North China University of Science and Technology (No. 16040).

The mean age of the subjects was 42.9 (±8.6) years, and 91.3% were male. As regards the educational level, junior high school education was reported by 23.2%, high school education by 51.9%, and college or university education by 24.9% of the participants. As regards the marital status, 92.4% of the participants were married, 4.7% unmarried, and 2.9% separated or divorced.

Measures
Questionnaire measurements
All the participants were interviewed face-to-face by members of the research team following a structured questionnaire. The questionnaire consisted of 5 parts:

- socio-demographic characteristics (sex, age, educational level, marital status, household income, household living area, etc.),
- living and behavioral habits (smoking, alcohol consumption, tea consumption, physical activity, etc.),
- job characteristics (shift work, employment relationship, job category, job stress, etc.),
- personal characteristics (height and weight, life events, present illness),
- an assessment of insomnia.
Definition of smoking
Current smokers were those who had regularly consumed ≥1 cigarette/day for at least the past 12 months. Some participants who had quit cigarettes within the past 12 months were also assigned as current smokers. Ever smokers were those who had quit cigarettes earlier than 12 months before. Never smokers were those who had never smoked in their lifetime.

Alcohol consumption status
Never drinkers were those who had not consumed alcohol in their lifetime. Ever drinkers were those who had once consumed alcohol, but had not done so for the past 6 months. Alcohol consumption was calculated according to the following formula:

\[
\text{Alcohol consumption (g/day)} = \frac{[\text{liquor (kg/month)} \times 1000 \times 0.45 + \text{beer (bottle/month)} \times 640 \times 0.036 + \text{wine/fruit wine (kg/month)} \times 1000 \times 0.0096]}{30}
\]

Tea drinking
Tea drinkers were those who drank ≥1 cup of Chinese black tea, green tea, or jasmine tea per week, continuously for at least 6 months.

Physical activity
The authors assessed physical activity using the Chinese version of the International Physical Activity Questionnaire (IPAQ) [22,23]. The Chinese version of IPAQ had been previously identified as having an acceptable reliability and validity. The participants were asked to supply information on their physical activity during the previous 7 days at work, at home, and any recreational or sport, and leisure-time activities. Activities that the individual performed for at least 10 min at a time were collected along with the total duration per day, the number of days, and the intensity (vigorous, moderate, or low) of each activity.

For each individual, the authors assessed their physical activity according to the guidelines for data processing and analysis of IPAQ. The recorded activities of the participants were converted into metabolic equivalent task (MET) [min/week]. The individuals with MET values <600 were classified as having a low level of physical activity, those with MET values 600–3000 as having a moderate level of physical activity, and those with MET values >3000 as having a high level of physical activity.

Employment relationship
The individuals who had signed long-term service (until retirement) contracts with the steel company were classified as contract workers; those who had not signed long-term service contracts, but only short-term service contracts or temporary service contracts, were classified as other forms; some people who were assigned to work by the labor dispatch agency, but had not signed any service contracts with the steel company, were also classified as other forms.

Shift work
A majority of the participants worked according to a 4-team/3-shift schedule, so this shift type was analyzed as a separate group. In this group, according to the International Labour Organization (ILO) [24], the day-shift worker is defined as a person working day shift at 8:00–16:00, evening shift at 16:00–24:00, or night shift at 24:00–8:00 of the following day. Some of the participants worked according to a 3-team/2-shift, 5-team/3-shift, or 4-team/2-shift schedule, and they were divided into other shift type groups. The rest of the participants who constantly worked according to a day-shift schedule, without night shifts, were assigned to the day-shift group.

Job stress
The Job Content Questionnaire (JCQ) developed by Karasek [25] was employed for evaluating job stress in this study. The reliability and validity of the Chinese version of
Present health status
The authors requested the participants to self-report all information regarding their current illnesses which had been diagnosed by physicians. The list of current illnesses included respiratory diseases such as chronic bronchitis, asthma, emphysema, phthisis, chronic rhinitis, and non-respiratory (other) diseases such as hypertension, cardiovascular disease, chronic gastritis, rheumatoid arthritis, diabetes, gout, thyroid disorders, liver disease, and alcoholism.

Assessment of insomnia
The Athens Insomnia Scale (AIS), which is widely used for assessing insomnia in many countries [27,28], was employed as the insomnia assessment tool in this study. The scale consisted of 8 items, each of which was scored on a 4-point Likert scale from 0 (no problem at all) to 3 (a very serious problem), with the total score ranging 0–24. A score of ≥6, with 6 being the widely accepted cut-off value for insomnia, classified the participant into the insomnia group; other participants were classified to the non-insomnia group.

Job categories
According to work content and workshops, all the participants were divided into the following 3 groups: front-line workers, maintenance and inspection workers, and other auxiliary workers. Front-line workers included the workers who engaged in iron-making, steel-making, hot steel rolling, and cold steel rolling. Maintenance and inspection workers were workers who mainly engaged in the monitoring and maintenance of steel-making instruments and equipment, and the testing of steel products. Other auxiliary workers included workers who engaged in steel deep processing, steel products logistics, and furnace material making.

Statistical analysis
Data were analyzed using SPSS 20.0 for Windows (IBM, Armonk, NY, USA). The socio-demographic characteris-
tics, living and behavioral habits, job characteristics, personal characteristics, and insomnia were described as percentage values of categorical variables. The comparison of the characteristics and percentage of insomnia across different job categories were analyzed using \( \chi^2 \) tests. A binary logistic regression analysis was used to analyze the association between essential characteristics and insomnia across different job categories, and crude odd ratios (ORs) were calculated. Adjusted odds ratios (aORs) for insomnia and the 95% confidence intervals (95% CIs) of each factor were separately calculated, while other factors were adjusted. In this study, \( p < 0.05 \) was established as the significance level.

RESULTS

Among the 5834 participants, the groups of front-line workers, maintenance and inspection workers, and other auxiliary workers comprised 2848, 2299 and 687 participants, respectively. The comparison of essential characteristics across the groups representing different job categories are shown in Table 1. The distribution of sex, age, educational level, marital status, household per capita income, household per capita living area, body mass index (BMI), smoking status, alcohol consumption, tea drinking, physical activity, employment relationship, shift work, job stress, life events, and present illness were significantly different among the 3 job categories (alcohol drinking factors, \( p = 0.001 \); life events factors, \( p = 0.015 \); other factors, \( p < 0.001 \)). The prevalence of insomnia across the groups representing the 3 job categories with different essential characteristics is compared in Table 2. The prevalence of insomnia was 42.0% in the total steel workers, and was the highest among other auxiliary workers (47.9% vs. 42.3% for front-line workers, vs. 39.8% for maintenance and inspection workers, \( p < 0.001 \)). The prevalence of insomnia among other auxiliary workers was higher than in other groups of steel workers representing different essential characteristics. These essential characteristics included sex, age of 30–49 years and 40–49 years, a high level of education (high school, college/university and above), being married, household per capita income, household per capita living area of \( \geq 20 \text{ m}^2 \), a BMI group of 18.5–24.9, never smoking or smoking 1–20 cigarettes/day, never drinking alcohol, tea drinking, light or heavy physical activity, contract workers, a 3-shift/4-team work schedule, high job stress, and experiencing life events in the past 12 months (\( p < 0.05 \)).

The associations were observed between each essential characteristic and insomnia using logistic regression analyses, as shown in Table 3. Compared to low stress and high support workers, low stress and low support workers (front-line workers: aOR = 1.50, 95% CI: 1.15–1.95; maintenance and inspection workers: aOR = 1.37, 95% CI: 1.02–1.84; other auxiliary workers: aOR = 2.46, 95% CI: 1.33–4.54), and high stress and low support workers (front-line workers: aOR = 2.28, 95% CI: 1.85–2.81; maintenance and inspection workers: aOR = 1.56, 95% CI: 1.23–1.98; other auxiliary workers: aOR = 2.38, 95% CI: 1.52–3.73) have a higher risk of insomnia among the 3 job categories.

Compared to the workers who had not experienced any major life events in the past 12 months, the workers who had experienced \( \geq 2 \) such life events in the past 12 months had a higher risk of insomnia among the 3 job categories (front-line workers: aOR = 1.72, 95% CI: 1.40–2.11; maintenance and inspection workers: aOR = 1.30, 95% CI: 1.02–1.65; other auxiliary workers: aOR = 1.75, 95% CI: 1.08–2.83). In the front-line workers group, workers with an educational level of college/university and above (aOR = 1.39, 95% CI: 1.07–1.81), a 3-shift/4-team work schedule (aOR = 1.26, 95% CI: 1.05–1.52), and respiratory diseases (aOR = 1.48, 95% CI: 1.23–1.78) had a higher risk of insomnia. In the maintenance and inspection workers group, workers who had household per capita income <1500 ¥/month (aOR = 1.29, 95% CI: 1.07–1.55) or drank alcohol daily had a higher risk of insomnia.
Table 1. Baseline characteristics of the participants by job category in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China

| Variable                  | Participants (N = 5834) |χ² | p       |
|---------------------------|-------------------------|---|---------|
|                           | front-line workers (N = 2848) |   |         |
| Sex                       |                         |   |         |
| male                      | 2668                    | 40.931 | <0.001 |
| female                    | 180                     |         |         |
| Age                       |                         | 310.804 | <0.001 |
| <30 years                 | 293                     |         |         |
| 30–39 years               | 1030                    |         |         |
| 40–49 years               | 998                     |         |         |
| ≥50 years                 | 527                     |         |         |
| Educational level         |                         | 211.652 | <0.001 |
| junior high school or primary | 599                   |         |         |
| high school               | 1369                    |         |         |
| college/university and above | 880                   |         |         |
| Marital status            |                         | 35.419 | <0.001 |
| unmarried                 | 172                     |         |         |
| married                   | 2602                    |         |         |
| other                     | 74                      |         |         |
| Household per capita income |                       | 23.214 | <0.001 |
| <1500 ¥/month             | 891                     |         |         |
| ≥1500 ¥/month             | 1957                    |         |         |
| Household per capita living area |                | 17.560 | <0.001 |
| <20 m²                    | 738                     |         |         |
| ≥20 m²                    | 2110                    |         |         |
| BMI                       |                         | 40.311 | <0.001 |
| <18.5                     | 24                      |         |         |
| 18.5–24.9                 | 1150                    |         |         |
| 25.0–29.9                 | 1360                    |         |         |
| ≥30                       | 314                     |         |         |
| Smoking status            |                         | 54.213 | <0.001 |
| never                     | 1251                    |         |         |
| ever                      | 90                      |         |         |
Table 1. Baseline characteristics of the participants by job category in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                          | Participants (N = 5834) | \( \chi^2 \) | \( p \)  |
|-----------------------------------|-------------------------|---------------|---------|
|                                   | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) | total |
| Smoking status – cont.            |                         |               |         |
| 1–20 cigarettes/day               | 1279                    | 870           | 284     | 2433 |
| >20 cigarettes/day                | 228                     | 249           | 92      | 569  |
| Alcohol drinking                  |                         |               |         |
| never                             | 1772                    | 1413          | 395     | 3580 |
| ever                              | 51                      | 52            | 15      | 118  |
| <20 g/day                         | 516                     | 343           | 118     | 977  |
| ≥20 g/day                         | 509                     | 491           | 159     | 1159 |
| Tea drinking                      |                         |               |         |
| yes                               | 1665                    | 1211          | 387     | 3263 |
| no                                | 1183                    | 1088          | 300     | 2571 |
| Physical activity                 |                         |               |         |
| light                             | 152                     | 144           | 29      | 325  |
| moderate                          | 590                     | 593           | 154     | 1337 |
| heavy                             | 2106                    | 1562          | 504     | 4172 |
| Employment relationship           |                         |               |         |
| contract worker                   | 2528                    | 2016          | 664     | 5208 |
| other form                        | 320                     | 283           | 23      | 626  |
| Shift work                        |                         |               |         |
| 3 shifts/4 teams                  | 2097                    | 1066          | 265     | 3428 |
| other shift                       | 43                      | 51            | 186     | 280  |
| day shift                         | 708                     | 1182          | 236     | 2126 |
| Job stress                        |                         |               |         |
| low stress and high support       | 685                     | 446           | 144     | 1275 |
| low stress and low support        | 377                     | 345           | 71      | 793  |
| high stress and high support      | 821                     | 581           | 236     | 1638 |
| high stress and low support       | 965                     | 927           | 236     | 2128 |
| Life events                       |                         |               |         |
| 0                                 | 1806                    | 1478          | 454     | 3738 |
| 1                                 | 538                     | 478           | 140     | 1156 |
| ≥2                                | 504                     | 343           | 93      | 940  |
Table 1. Baseline characteristics of the participants by job category in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                  | Participants (N = 5834) | \( \chi^2 \) | p       |
|----------------------------|-------------------------|--------------|---------|
|                             | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) | total |
| Present illness             |                         |              |         |
| health                     | 2027                    | 1544         | 393     | 3964  |
| respiratory diseases       | 75                      | 49           | 20      | 144   |
| other diseases             | 746                     | 706          | 274     | 1726  |

Table 2. Distribution of insomnia in the workers representing 3 job categories with different baseline characteristics in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China

| Variable                  | Participants (N = 5834) | \( \chi^2 \) | p       |
|----------------------------|-------------------------|--------------|---------|
|                             | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) | total |
| Sex                        |                         |              |         |
| male                       | 2668                    | 1137 (42.6)  | 2046    | 807 (39.4) | 610 | 285 (46.7) | 5324 | 11.461 | 0.003 |
| female                     | 180                     | 69 (38.3)    | 253     | 107 (42.3) | 77  | 44 (57.1) | 510  | 7.925  | 0.019 |
| Age                        |                         |              |         |
| <30 years                  | 293                     | 118 (40.3)   | 180     | 66 (36.7)  | 19  | 8 (42.1)  | 492  | 0.688  | 0.709 |
| 30–39 years                | 1030                    | 430 (41.7)   | 501     | 182 (36.3) | 100 | 47 (47.0) | 1631 | 6.037  | 0.049 |
| 40–49 years                | 998                     | 446 (44.7)   | 916     | 378 (41.3) | 327 | 173 (52.9)| 2241 | 13.247 | 0.001 |
| ≥50 years                  | 527                     | 212 (40.2)   | 702     | 288 (41.0) | 241 | 101 (41.9)| 1470 | 0.204  | 0.903 |
| Educational level          |                         |              |         |
| junior high school or primary | 599               | 241 (42.0)   | 482     | 203 (42.1) | 270 | 125 (46.3)| 1351 | 2.806  | 0.246 |
| high school                | 1369                    | 583 (42.6)   | 1322    | 535 (40.5) | 338 | 167 (49.4)| 3029 | 8.833  | 0.012 |
| college/university and above | 880               | 382 (43.4)   | 495     | 176 (35.6) | 79  | 37 (46.8)| 1454 | 9.291  | 0.010 |
| Marital status             |                         |              |         |
| unmarried                  | 172                     | 74 (43.0)    | 90      | 36 (40.0)  | 11  | 4 (36.4)  | 273  | 0.359  | 0.836 |
| married                    | 2602                    | 1098 (42.2)  | 2126    | 839 (39.5) | 661 | 316 (47.8)| 5389 | 14.741 | 0.001 |
| other                      | 74                      | 34 (45.9)    | 83      | 39 (47.0)  | 15  | 9 (60.0)  | 172  | 1.018  | 0.601 |
Table 2. Distribution of insomnia in the workers representing 3 job categories with different baseline characteristics in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                              | Participants (N = 5834) |   |   |   |   |   |   |   |   |   |   |
|---------------------------------------|-------------------------|---|---|---|---|---|---|---|---|---|---|
|                                       | front-line workers      |   |   |   |   |   |   |   |   |   |   |
|                                       | total [n]               |   |   |   |   |   |   |   |   |   |   |
|                                       | with insomnia [n (%)]   |   |   |   |   |   |   |   |   |   |   |
| Household per capita income           |                         |   |   |   |   |   |   |   |   |   |   |
| <1500 ¥/month                         | 891                     | 377 (42.3) | 765 | 342 (44.7) | 162 | 86 (53.1) | 1818 | 6.547 | 0.038 |
| ≥1500 ¥/month                         | 1957                    | 829 (42.4) | 1534 | 572 (37.3) | 525 | 243 (46.3) | 4016 | 16.300 | <0.001 |
| Household per capita living area      |                         |   |   |   |   |   |   |   |   |   |   |
| <20 m²                                | 738                     | 335 (45.4) | 702 | 302 (43.0) | 218 | 111 (50.9) | 1658 | 4.232 | 0.121 |
| ≥20 m²                                | 2110                    | 871 (41.3) | 1597 | 612 (38.3) | 469 | 218 (46.5) | 4176 | 10.528 | 0.005 |
| BMI                                   |                         |   |   |   |   |   |   |   |   |   |   |
| <18.5                                 | 24                      | 8 (33.3)  | 20  | 8 (40.0)   | 11  | 6 (54.5)   | 55   | 1.414 | 0.493 |
| 18.5–24.9                             | 1150                    | 504 (43.8) | 887 | 361 (40.7) | 339 | 169 (49.9) | 2374 | 8.446 | 0.005 |
| 25.0–29.9                             | 1360                    | 558 (41.0) | 1188 | 470 (39.6) | 279 | 127 (45.5) | 2259 | 3.351 | 0.187 |
| ≥30                                   | 314                     | 136 (43.3) | 204  | 75 (36.8)  | 58  | 27 (46.6)  | 576  | 2.915 | 0.233 |
| Smoking status                        |                         |   |   |   |   |   |   |   |   |   |   |
| never                                 | 1251                    | 527 (42.1) | 1067 | 420 (39.4) | 274 | 132 (48.2) | 2592 | 7.215 | 0.027 |
| ever                                   | 90                      | 41 (45.6)  | 113  | 54 (47.8)  | 37  | 15 (40.5)  | 240  | 0.594 | 0.743 |
| 1–20 cigarettes/day                   | 1279                    | 525 (41.0) | 870  | 329 (37.8) | 284 | 134 (47.2) | 2433 | 8.005 | 0.018 |
| >20 cigarettes/day                    | 228                     | 113 (49.6) | 249  | 111 (44.6) | 92  | 48 (52.2)  | 569  | 2.025 | 0.363 |
| Alcohol drinking                      |                         |   |   |   |   |   |   |   |   |   |   |
| never                                 | 1772                    | 735 (41.5) | 1413 | 520 (36.8) | 395 | 192 (48.6) | 3580 | 19.504 | 0.000 |
| ever                                   | 51                      | 26 (51.0)  | 52   | 21 (40.4)  | 15  | 6 (40.0)   | 118  | 1.336 | 0.513 |
| <20 g/day                             | 516                     | 206 (39.9) | 343  | 147 (42.9) | 118 | 53 (44.9)  | 977  | 1.354 | 0.508 |
| ≥20 g/day                             | 509                     | 239 (47.0) | 491  | 2226 (46.0) | 159 | 78 (49.1)  | 1159 | 0.446 | 0.800 |
| Tea drinking                          |                         |   |   |   |   |   |   |   |   |   |   |
| yes                                   | 1665                    | 710 (42.6) | 1211 | 476 (39.3) | 387 | 180 (46.5) | 3263 | 7.104 | 0.029 |
| no                                    | 1183                    | 496 (41.9) | 1088 | 438 (40.3) | 300 | 149 (49.7) | 2571 | 8.574 | 0.014 |
| Physical activity                     |                         |   |   |   |   |   |   |   |   |   |   |
| light                                 | 152                     | 57 (37.5)  | 144  | 58 (40.3)  | 29  | 18 (62.1)  | 325  | 6.125 | 0.047 |
| moderate                              | 590                     | 228 (38.6) | 593  | 230 (38.8) | 154 | 67 (43.5)  | 1337 | 1.314 | 0.518 |
| heavy                                 | 2106                    | 921 (43.7) | 1562 | 626 (40.1) | 504 | 244 (48.4) | 4172 | 11.927 | 0.003 |
| Employment relationship               |                         |   |   |   |   |   |   |   |   |   |   |
| contract worker                       | 2528                    | 1081 (42.8) | 2016 | 815 (40.4) | 664 | 319 (48.0) | 5208 | 11.959 | 0.003 |
| other form                            | 320                     | 125 (39.1) | 283  | 99 (35.0)  | 23  | 10 (43.5)  | 626  | 1.447 | 0.485 |
The steel workers in the other auxiliary workers group had the highest rate of insomnia (47.9%), while this rate was the lowest in the maintenance and inspection workers group (39.8%). The following potential reasons for this striking discrepancy could be considered and proven in future studies:

1. The work environment (occupational hazards, hazardous circumstances, etc.) and work organization form (working time, job stability, workload, etc.) are very different, because they take on different tasks.
2. Some personal characteristics, such as personality, psychosocial stress, way of live, behavioral habits, etc., should be taken into account.

DISCUSSION
As shown in this study, the prevalence of insomnia was 42.0% in the total steel workers in China. Compared with the prevalence reported in most previous works, the insomnia prevalence revealed in this study is much higher. The prevalence was reported range 11.9–37.75% among the general population, community residents, adults, and the elderly in China [6,7]. Meanwhile, it was also higher than 24% reported for U.S. workers [9], 32.9% for Korean workers [10], and 4.7% for male workers in Japan [29], but similar to 39.7% for gas transmission industry workers in Iran [30].

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1. The work environment (occupational hazards, hazardous circumstances, etc.) and work organization form (working time, job stability, workload, etc.) are very different, because they take on different tasks.
2. Some personal characteristics, such as personality, psychosocial stress, way of live, behavioral habits, etc., should be taken into account.

Table 2. Distribution of insomnia in the workers representing 3 job categories with different baseline characteristics in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                  | Participants (N = 5834) | [n] | front-line workers | [n] | maintenance and inspection workers | [n] | other auxiliary workers | [n] | total [n] with insomnia | total [n] with insomnia | total [n] with insomnia | total [n] with insomnia | total [n] with insomnia | total [n] with insomnia | χ²   | p       |
|---------------------------|-------------------------|-----|--------------------|-----|------------------------------------|-----|-------------------------|-----|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------|---------|
| Shift work                |                         |     |                    |     |                                    |     |                        |     |                      |                      |                      |                      |                      |                      |       |         |
| 3 shifts/4 teams          | 2097                    | 917 (43.7) | 1066               | 430 (40.3) | 265                  | 137 (51.7) | 3428                   | 11.581 | 0.003                |                      |                      |                      |                      |                      |       |         |
| other shift               | 43                      | 17 (39.5)  | 51                  | 27 (52.9)  | 186                  | 87 (46.8)  | 280                     | 1.684  | 0.431                |                      |                      |                      |                      |                      |       |         |
| day shift                 | 708                     | 272 (38.4) | 1182               | 457 (38.7) | 236                  | 105 (44.5) | 2126                    | 3.096  | 0.213                |                      |                      |                      |                      |                      |       |         |
| Job stress                |                         |     |                    |     |                                    |     |                        |     |                      |                      |                      |                      |                      |                      |       |         |
| low stress and high support | 685                   | 225 (32.8) | 446                | 146 (32.7) | 144                  | 49 (34.0)  | 1275                    | 0.088  | 0.957                |                      |                      |                      |                      |                      |       |         |
| low stress and low support | 377                   | 162 (43.0) | 345                | 145 (42.0) | 71                   | 38 (53.5)  | 793                     | 3.248  | 0.197                |                      |                      |                      |                      |                      |       |         |
| high stress and high support | 821                   | 301 (36.7) | 581                | 209 (36.0) | 236                  | 116 (49.2) | 1638                    | 14.032 | 0.001                |                      |                      |                      |                      |                      |       |         |
| high stress and low support | 965                   | 518 (53.7) | 927                | 414 (44.7) | 236                  | 126 (53.4) | 2128                    | 16.814 | <0.001               |                      |                      |                      |                      |                      |       |         |
| Life events               |                         |     |                    |     |                                    |     |                        |     |                      |                      |                      |                      |                      |                      |       |         |
| 0                         | 1806                    | 701 (38.8) | 1478               | 568 (38.4) | 454                  | 205 (45.2) | 3738                    | 7.133  | 0.028                |                      |                      |                      |                      |                      |       |         |
| 1                         | 538                     | 241 (44.8) | 478                | 192 (40.2) | 140                  | 70 (50.0)  | 1156                    | 4.934  | 0.085                |                      |                      |                      |                      |                      |       |         |
| ≥2                        | 504                     | 264 (52.4) | 343                | 154 (44.9) | 93                   | 54 (58.1)  | 940                     | 7.117  | 0.028                |                      |                      |                      |                      |                      |       |         |
| Present illness           |                         |     |                    |     |                                    |     |                        |     |                      |                      |                      |                      |                      |                      |       |         |
| health                    | 2027                    | 800 (39.5) | 1544               | 568 (36.8) | 393                  | 186 (43.7) | 3964                    | 14.725 | 0.001                |                      |                      |                      |                      |                      |       |         |
| respiratory diseases      | 75                      | 40 (53.3)  | 49                 | 27 (55.1)  | 20                   | 13 (65.0)  | 144                     | 0.877  | 0.645                |                      |                      |                      |                      |                      |       |         |
| other diseases            | 746                     | 366 (49.1) | 706                | 319 (45.2) | 274                  | 130 (47.4) | 1726                    | 2.195  | 0.334                |                      |                      |                      |                      |                      |       |         |
Table 3. Logistic regression analysis of the factors associated with insomnia in 3 job categories in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China

| Variable                  | Participants (N = 5834) | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) |
|---------------------------|-------------------------|-------------------------------|---------------------------------------------|----------------------------------|
|                           | crude OR (95%CI)        | adjusted OR (95%CI)          | crude OR (95%CI)                           | adjusted OR (95%CI)              |
| Sex                       |                         |                               |                                             |                                  |
| male                      | 0.62 (0.87–1.62)        | 0.522 (0.80–1.57)            | 0.73 (0.68–1.16)                           | 0.76 (0.57–1.03)                |
| female                    | 1.00                    | 1.00                          | 1.00                                        | 1.00                             |
| Age                       |                         |                               |                                             |                                  |
| <30 years                 | 1.00                    | 1.00                          | 1.00                                        | 1.00                             |
| 30–39 years               | 1.06 (0.82–1.38)        | 0.99 (0.72–1.36)             | 0.99 (0.69–1.40)                           | 0.95 (0.64–1.40)                |
| 40–49 years               | 1.20 (0.92–1.56)        | 1.19 (0.85–1.68)             | 1.21 (0.87–1.69)                           | 0.98 (0.65–1.47)                |
| ≥50 years                 | 1.00 (0.75–1.34)        | 0.93 (0.64–1.35)             | 1.20 (0.86–1.69)                           | 0.93 (0.61–1.40)                |
| Educational level         |                         |                               |                                             |                                  |
| junior high school or primary | 1.00                    | 1.00                          | 1.00                                        | 1.00                             |
| high school               | 1.10 (0.91–1.34)        | 1.19 (0.96–1.48)             | 0.93 (0.76–1.15)                           | 0.98 (0.78–1.21)                |
| college/university and above | 1.14 (0.92–1.41)       | 0.93 (0.96–1.48)             | 0.76 (0.64–1.50)                           | 0.49 (0.46–1.24)                |
| Marital status            |                         |                               |                                             |                                  |
| unmarried                 | 1.00                    | 1.00                          | 1.00                                        | 1.00                             |
| married                   | 0.97 (0.71–1.32)        | 0.82 (0.56–1.20)             | 0.98 (0.64–1.50)                           | 0.76 (0.46–1.24)                |
| other                     | 1.13 (0.65–1.95)        | 0.81 (0.44–1.48)             | 1.33 (0.73–2.43)                           | 0.99 (0.52–1.92)                |

Table 3. Logistic regression analysis of the factors associated with insomnia in 3 job categories in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                                | Participants (N = 5834) | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) |
|-----------------------------------------|-------------------------|--------------------------------|-----------------------------------------------|----------------------------------|
|                                          | crude OR (95% CI) | adjusted OR (95% CI) | crude OR (95% CI) | adjusted OR (95% CI) | crude OR (95% CI) | adjusted OR (95% CI) | crude OR (95% CI) | adjusted OR (95% CI) | crude OR (95% CI) | adjusted OR (95% CI) |
| Household per capita income             |                        |                                |                                         |                                  |                                |                                         |                                |                                  |                                |                                         |
| <1500 ¥/month                           | 1.00 (0.85–1.17)      | 0.98 (0.79–1.12)              | 1.36 (1.14–1.62) | 0.001 (1.07–1.55) | 1.31 (0.92–1.87) | 0.130 (0.91–1.98) | 1.00 (0.85–1.04) | 0.001 (0.79–1.12) | 1.00 (0.85–1.04) | 0.001 (0.79–1.12) |
| ≥1500 ¥/month                           | 1.00 (1.00–1.00)      | 1.00 (1.00–1.00)              | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) |
| Household per capita living area        |                        |                                |                                         |                                  |                                |                                         |                                |                                  |                                |                                         |
| <20 m²                                  | 1.00 (1.18–1.19)      | 0.052 (0.99–1.40)             | 1.22 (1.02–1.46) | 0.034 (0.93–1.36) | 1.19 (0.87–1.65) | 0.279 (0.85–1.70) | 1.00 (1.18–1.19) | 0.052 (0.99–1.40) | 1.22 (1.02–1.46) | 0.034 (0.93–1.36) |
| ≥20 m²                                  | 1.00 (1.00–1.00)      | 1.00 (1.00–1.00)              | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) | 1.00 (1.00–1.00) |
| BMI                                     |                        |                                |                                         |                                  |                                |                                         |                                |                                  |                                |                                         |
| <18.5                                   | 1.00 (1.56–3.67)      | 0.309 (0.66–4.67)             | 1.03 (0.42–2.54) | 0.950 (0.34–2.12) | 0.83 (0.25–2.77) | 0.780 (0.24–2.93) | 1.00 (1.56–3.67) | 0.309 (0.66–4.67) | 1.03 (0.42–2.54) | 0.950 (0.34–2.12) |
| 18.5–24.9                               | 1.00 (1.39–3.27)      | 0.449 (0.67–3.97)             | 0.98 (0.67–3.97) | 0.968 (0.42–2.42) | 0.81 (0.21–2.33) | 0.536 (0.19–2.37) | 1.00 (1.39–3.27) | 0.449 (0.67–3.97) | 0.98 (0.67–3.97) | 0.968 (0.42–2.42) |
| 25.0–29.9                               | 1.00 (1.53–3.68)      | 0.344 (0.64–3.99)             | 0.87 (0.64–3.99) | 0.872 (0.40–2.42) | 0.64 (0.21–2.33) | 0.487 (0.19–2.37) | 1.00 (1.53–3.68) | 0.344 (0.64–3.99) | 0.87 (0.64–3.99) | 0.872 (0.40–2.42) |
| ≥30                                     | 1.00 (1.53–3.68)      | 0.344 (0.64–3.99)             | 0.87 (0.64–3.99) | 0.872 (0.40–2.42) | 0.64 (0.21–2.33) | 0.487 (0.19–2.37) | 1.00 (1.53–3.68) | 0.344 (0.64–3.99) | 0.87 (0.64–3.99) | 0.872 (0.40–2.42) |
| Smoking status                           |                        |                                |                                         |                                  |                                |                                         |                                |                                  |                                |                                         |
| never                                   | 1.00 (1.15–1.77)      | 0.525 (0.75–1.77)             | 1.41 (0.96–2.10) | 0.083 (0.87–1.99) | 0.73 (0.37–1.48) | 0.652 (0.39–1.79) | 1.00 (1.15–1.77) | 0.525 (0.75–1.77) | 1.41 (0.96–2.10) | 0.083 (0.87–1.99) |
| ever                                    | 1.00 (0.96–1.05)      | 0.829 (0.79–1.12)             | 0.94 (0.82–1.12) | 0.486 (0.78–1.13) | 0.487 (0.71–1.07) | 0.856 (0.69–1.34) | 1.00 (0.96–1.05) | 0.829 (0.79–1.12) | 0.94 (0.82–1.12) | 0.486 (0.78–1.13) |
| 1–20 cigarettes/day                     | 1.00 (1.35–1.34)      | 0.038 (1.02–1.79)             | 1.24 (0.99–1.82) | 0.131 (0.94–1.64) | 1.10 (0.73–1.88) | 0.306 (0.78–2.24) | 1.00 (1.35–1.34) | 0.038 (1.02–1.79) | 1.24 (0.99–1.82) | 0.131 (0.94–1.64) |
| >20 cigarettes/day                      | 1.00 (1.31–1.34)      | 0.038 (1.02–1.79)             | 1.24 (0.99–1.82) | 0.131 (0.94–1.64) | 1.10 (0.73–1.88) | 0.306 (0.78–2.24) | 1.00 (1.31–1.34) | 0.038 (1.02–1.79) | 1.24 (0.99–1.82) | 0.131 (0.94–1.64) |
Alcohol drinking

|                | never | ever | <20 g/day | ≥20 g/day |
|----------------|-------|------|-----------|-----------|
|                | 1.00  | 1.00 | 1.00      | 1.00      |
| Alcohol drinking |       |      |           |           |
| never | 1.00  | 1.00 | 1.00      | 1.00      |
| ever   | 1.47  | 0.117| 0.285     | 1.16      |
|         | (0.84–2.56) | (0.77–2.47) | (0.66–2.05) | (0.59–1.92) |
| <20 g/day | 0.94  | 0.527| 0.93      | 1.29      |
|         | (0.77–1.45) | (0.75–1.15) | (1.01–1.64) | (1.06–1.75) |
| ≥20 g/day| 1.25  | 0.028| 1.22      | 1.47      |
|         | (1.02–1.52) | (0.99–1.52) | (1.19–1.80) | (1.16–1.82) |

Tea drinking

|                | yes  | no   | yes  | no   |
|----------------|------|------|------|------|
| Tea drinking |       |      |      |      |
| yes   | 0.72  | 0.000| 0.95 | 0.568|
|        | (0.89–1.20) | (0.81–1.12) | (0.81–1.14) | (0.77–1.09) |
| no    | 1.00  | 1.00 | 1.00 | 1.00 |

Physical activity

|                | light | moderate | heavy |
|----------------|-------|----------|-------|
| Physical activity |      |          |       |
| light | 1.00  | 1.05     | 1.30  |
|       | (1.00) | (0.796)  | (0.92–1.82) |
| moderate | 0.796| 1.02     | 0.98  |
|          | (0.73–1.52) | (0.70–1.49) | (0.69–1.38) |
| heavy   | 0.24  | 0.92     | 0.890 |
|         | (0.88–1.77) | (0.65–1.36) | (0.70–1.41) |

Employment form

|                | contract worker | other form |
|----------------|-----------------|------------|
| Employment form |                 |            |
| contract worker | 1.00            | 0.75       |
| other form      | (1.00)          | (0.68–1.09) |

Shift work

|                | 3 shifts/4 teams | other shift | day shift |
|----------------|------------------|-------------|-----------|
| Shift work     |                  |             |           |
| 3 shifts/4 teams | 1.25            | 1.05        | 1.00  |
|                 | (1.05–1.48)     | (1.05–1.52) | (1.00) |
| other shift    | 1.05             | 1.05        | 1.00  |
|                 | (1.05–1.97)     | (1.05–1.71) | (1.00) |

Job stress

|                | low stress and high support | low stress and low support |
|----------------|-----------------------------|---------------------------|
| Job stress     |                             |                           |
| low stress and high support | 1.00  | 1.00  |
| low stress and low support | 1.54 | 0.001 |
|                        | (1.19–1.99) | (1.15–1.95) |
Table 3. Logistic regression analysis of the factors associated with insomnia in 3 job categories in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                        | Participants (N = 5834) | front-line workers (N = 2848) | maintenance and inspection workers (N = 2299) | other auxiliary workers (N = 687) |
|---------------------------------|-------------------------|-------------------------------|-----------------------------------------------|----------------------------------|
|                                 | crude OR (95%CI)        | adjusted OR (95%CI)          | p                                             | adjusted OR (95%CI)              | p | crude OR (95%CI)        | adjusted OR (95%CI) | p | crude OR (95%CI)        | adjusted OR (95%CI) | p |
| Job stress – cont.              |                         |                               |                                               |                                  |   |                         |                      |   |                         |                      |   |
| high stress and high support    | 1.18 (0.96–1.47)        | 1.14 (0.92–1.42)             | 0.242                                         | 1.15 (0.89–1.50)                | 0.420 | 1.11 (0.85–1.45)        | 0.430 | 1.87 (1.22–2.88)        | 0.004 | 2.05 (1.30–3.23)        | 0.002 |
| high stress and low support     | 2.37 (1.93–2.91)        | 2.28 (1.85–2.81)             | 0.000                                         | 1.66 (1.31–2.10)               | 0.000 | 1.56 (1.23–1.98)        | 0.000 | 2.22 (1.45–3.41)        | 0.000 | 2.38 (1.52–3.73)        | 0.000 |
| Life events                     |                         |                               |                                               |                                  |   |                         |                      |   |                         |                      |   |
| 0                               | 1.00                    | 1.00                          | 1.00                                          | 1.00                            | 1.00 | 1.00                    | 1.00 | 1.00                    | 1.00 | 1.00                    | 1.00 |
| 1                               | 1.28 (1.05–1.55)        | 1.26 (1.03–1.54)             | 0.024                                         | 1.08 (0.87–1.33)               | 0.514 | 1.07 (0.87–1.33)        | 0.514 | 1.22 (0.83–1.78)        | 0.315 | 1.16 (0.78–1.73)        | 0.464 |
| ≥2                              | 1.73 (1.42–2.12)        | 1.72 (1.40–2.11)             | 0.000                                         | 1.31 (1.03–1.66)               | 0.035 | 1.30 (1.02–1.65)        | 0.035 | 1.68 (1.07–2.64)        | 0.024 | 1.75 (1.08–2.83)        | 0.023 |
| Present illness                 |                         |                               |                                               |                                  |   |                         |                      |   |                         |                      |   |
| health                          | 1.00                    | 1.00                          | 1.00                                          | 1.00                            | 1.00 | 1.00                    | 1.00 | 1.00                    | 1.00 | 1.00                    | 1.00 |
| respiratory diseases            | 1.48 (1.25–1.75)        | 1.48 (1.23–1.78)             | 0.000                                         | 1.42 (1.18–1.70)               | 0.001 | 1.38 (1.14–1.68)        | 0.001 | 1.01 (0.74–1.37)        | 0.976 | 1.02 (0.72–1.44)        | 0.930 |
| other diseases                  | 1.75 (1.10–2.78)        | 1.56 (0.97–2.52)             | 0.066                                         | 2.11 (1.19–3.74)               | 0.017 | 2.03 (1.13–3.64)        | 0.017 | 2.07 (0.81–5.29)        | 0.130 | 2.15 (0.80–5.76)        | 0.127 |
Table 4. Logistic regression analysis of the factors associated with insomnia in steel workers in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China

| Variable                              | Participants (N = 5834) | crude OR (95%CI) | p     | adjusted OR (95%CI) | p     |
|---------------------------------------|-------------------------|------------------|-------|---------------------|-------|
|                                       |                         |                  |       |                     |       |
|Sex                                    |                         |                  |       |                     |       |
| male                                  | 0.95 (0.79–1.14)        | 0.579            | 0.196 | 0.87 (0.71–1.07)    | 0.196 |
| female                                | 1.00                    |                  |       | 1.00                |       |
|Age                                    |                         |                  |       |                     |       |
|<30 years                              | 1.00                    |                  |       | 1.00                |       |
|30–39 years                            | 1.51 (0.86–1.30)        | 0.584            | 0.942 | 0.99 (0.78–1.26)    | 0.942 |
|40–49 years                            | 1.25 (1.03–1.53)        | 0.027            | 0.358 | 1.13 (0.88–1.45)    | 0.358 |
|≥50 years                              | 1.08 (0.88–1.33)        | 0.467            | 0.571 | 0.93 (0.71–1.21)    | 0.571 |
|Educational level                      |                         |                  |       |                     |       |
|junior high school or primary          | 1.00                    |                  |       | 1.00                |       |
|high school                            | 1.01 (0.89–1.15)        | 0.850            | 0.185 | 1.10 (0.96–1.26)    | 0.185 |
|college/university and above           | 0.95 (0.82–1.11)        | 0.521            | 0.106 | 1.16 (0.97–1.39)    | 0.106 |
|Marital status                         |                         |                  |       |                     |       |
|unmarried                              | 1.00                    |                  |       | 1.00                |       |
|married                                | 1.00 (0.78–1.28)        | 0.987            | 0.170 | 0.82 (0.61–1.09)    | 0.170 |
|other                                  | 1.27 (0.87–1.87)        | 0.221            | 0.766 | 0.94 (0.62–1.43)    | 0.766 |
|Household per capita income            |                         |                  |       |                     |       |
|<1500 ¥/month                          | 1.15 (1.03–1.28)        | 0.017            | 0.090 | 1.11 (0.98–1.25)    | 0.090 |
|≥1500 ¥/month                          | 1.00                    |                  |       | 1.00                |       |
|Household per capita living area       |                         |                  |       |                     |       |
|<20 m²                                 | 1.20 (1.07–1.34)        | 0.002            | 0.002 | 1.16 (1.03–1.31)    | 0.002 |
|≥20 m²                                 | 1.00                    |                  |       | 1.00                |       |
|BMI                                    |                         |                  |       |                     |       |
|<18.5                                  | 1.00                    |                  |       | 1.00                |       |
|18.5–24.9                              | 1.16 (0.67–1.99)        | 0.603            | 0.632 | 1.15 (0.66–2.01)    | 0.632 |
|25.0–29.9                              | 1.04 (0.60–1.79)        | 0.898            | 0.864 | 1.05 (0.60–1.84)    | 0.864 |
|≥30                                    | 1.06 (0.60–1.86)        | 0.849            | 0.885 | 0.95 (0.54–1.71)    | 0.885 |
|Smoking status                          |                         |                  |       |                     |       |
|never                                  | 1.00                    |                  |       | 1.00                |       |
|ever                                   | 1.19 (0.91–1.55)        | 0.207            | 0.414 | 1.12 (0.85–1.49)    | 0.414 |
|1–20 cigarettes/day                    | 0.96 (0.86–1.07)        | 0.463            | 0.245 | 0.93 (0.82–1.05)    | 0.245 |
|>20 cigarettes/day                     | 1.28 (1.07–1.54)        | 0.007            | 0.053 | 1.22 (0.99–1.48)    | 0.053 |
Table 4. Logistic regression analysis of the factors associated with insomnia in steel workers in the study on the prevalence of insomnia and risk factors among 5834 steel workers in Tangshan, China – cont.

| Variable                        | Participants (N = 5834) | crude OR (95%CI) | p     | adjusted OR (95%CI) | p     |
|---------------------------------|-------------------------|------------------|-------|---------------------|-------|
| Alcohol drinking                |                         |                  |       |                     |       |
| never                           | 1.00                    | 0.328            |       | 1.16 (0.79–1.70)    | 0.461 |
| ever                            | 1.20 (0.83–1.74)        | 0.000            |       | 1.29 (1.11–1.49)    | 0.001 |
| <20 g/day                       | 1.05 (0.91–1.21)        | 0.521            |       | 1.07 (0.92–1.25)    | 0.355 |
| ≥20 g/day                       | 1.30 (1.14–1.49)        | 0.000            |       | 1.29 (1.11–1.49)    | 0.001 |
| Tea drinking                    |                         |                  |       |                     |       |
| yes                             | 0.73 (0.89–1.10)        | 0.000            |       | 0.71 (0.59–0.86)    | 0.001 |
| no                              | 1.00                    | 0.000            |       | 1.00                |       |
| Physical activity               |                         |                  |       |                     |       |
| light                           | 1.00                    | 0.000            |       | 1.00                |       |
| moderate                        | 0.93 (0.73–1.20)        | 0.584            |       | 0.92 (0.72–1.19)    | 0.539 |
| heavy                           | 1.09 (0.86–1.37)        | 0.482            |       | 1.06 (0.83–1.34)    | 0.657 |
| Employment form                 |                         |                  |       |                     |       |
| contract worker                 | 1.00                    | 0.000            |       | 0.92 (0.76–1.12)    | 0.923 |
| other form                      | 0.74 (0.68–0.96)        | 0.000            |       |                     |       |
| Shift work                      |                         |                  |       |                     |       |
| 3 shifts/4 teams                | 1.18 (1.06–1.32)        | 0.003            |       | 1.21 (1.08–1.37)    | 0.001 |
| other shift                     | 1.36 (1.06–1.75)        | 0.016            |       | 1.17 (0.89–1.54)    | 0.265 |
| day shift                       | 1.00                    | 0.000            |       | 1.00                |       |
| Job stress                      |                         |                  |       |                     |       |
| low stress and high support     | 1.00                    | 0.000            |       | 1.53 (1.27–1.84)    | 0.001 |
| low stress and low support      | 1.57 (1.31–1.88)        | 0.000            |       | 1.22 (1.04–1.43)    | 0.012 |
| high stress and high support    | 1.26 (1.08–1.47)        | 0.003            |       | 1.96 (1.69–2.28)    | 0.000 |
| high stress and low support     | 2.01 (1.74–2.33)        | 0.000            |       |                     |       |
| Life events                     |                         |                  |       |                     |       |
| 0                               | 1.00                    | 0.000            |       | 1.00                |       |
| 1                               | 1.18 (1.04–1.35)        | 0.014            |       | 1.18 (1.03–1.36)    | 0.016 |
| ≥2                              | 1.55 (1.34–1.79)        | 0.000            |       | 1.55 (1.69–2.28)    | 0.000 |
| Present illness                 |                         |                  |       |                     |       |
| health                          | 1.00                    | 0.000            |       | 1.79 (1.27–2.52)    | 0.001 |
| respiratory diseases            | 1.39 (1.24–1.56)        | 0.000            |       | 1.36 (1.20–1.54)    | 0.000 |
| other diseases                  | 1.94 (1.39–2.71)        | 0.000            |       |                     |       |
The 3 groups of workers under analysis exhibit significant differences in terms of socio-demographic characteristics, living and behavioral habits, job characteristics, and personal characteristics considered in this study. Therefore, the authors analyzed the relationship between each variable and insomnia while adjusting for the other remaining variables using a multivariate logistic regression analysis. The results of the multivariate logistic regression analysis show that job stress and life events are common risk factors of insomnia for workers in all 3 job categories. The authors also obtained the same results in all the participants, when analyzing the influencing factors of insomnia (Table 4). Meanwhile, they also observed that alcohol consumption in the quantity of >20 g/day, shift work and current illness were associated with insomnia in all the participants.

Job stress is another risk factor of insomnia, which has been reported in many previous studies [18]. The results presented in this study found that steel workers with high stress and low social support were most likely to suffer from insomnia, and that steel workers struggling with stress had a higher risk of insomnia than steel workers without stress. This finding proves that high job stress is closely associated with an increased risk of insomnia in steel workers in China, just like in workers in other industries or companies. The authors recommend that, in order to ensure a better health condition of steel workers, they should undergo stress management training and team building activities to improve their stress-coping strategies and sleep quality.

The authors also found that the 3 groups of steel workers who had experienced more life events in the past 12 months were associated with a greater risk of insomnia. A study of stressful life events, insomnia, and suicide risks in Chinese adolescents has reached the same hypothesis that stressful life events are related to insomnia [31]. The same results have also been reported in studies that focused on U.S. Army soldiers prior to deployment [32], and on a community of older people in 4 cities in the Hebei Province, China [33]. These results suggest that, when conducting occupational health management, more attention should be paid to the workers who experience major life events, and that necessary help and mental health promotion should be provided to them. However, the effects of positive and negative events associated with insomnia have not been analyzed, which could be the subject of future studies.

There were several limitations associated with this study. First, this was a cross-sectional study, so it was impossible to explore the causal effect between insomnia and numerous factors. Second, the participants came from a steel company located in a heavily industrialized city in northern China, so the results of this study are limited in terms of generalization to all Chinese steel workers. Third, work conditions and the workplace environment were not evaluated, which could exclude some confounding factors and influence others. Finally, the mental health of the participants should be thoroughly evaluated in order to analyze the insomnia status of steel workers in China.

CONCLUSIONS
This study suggests that the prevalence of insomnia was different in the steel workers groups representing 3 job categories, and that its rate was the highest among other auxiliary workers. Job stress and life events are the common risk factors of insomnia in the 3 job categories of steel workers under analysis. When preparing the appropriate strategies for the prevention and treatment of insomnia among steel workers, policy-makers are recommended to pay more attention to job stress. Furthermore, psychological counseling should be provided to workers who have experienced recent life events.

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