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Original Article
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General Worker's Sleep Disturbances and the Degree of Cold-Heat Symptoms: a national cross-sectional survey

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Objectives: Few studies have examined the impact of healthy sleep among general workers on individuals and society. Therefore, the status and risk factors of sleep disturbances among general workers were investigated. In addition, this study assessed the degree to which cold and heat symptoms are associated with sleep disturbances.
Methods: A nationwide cross-sectional study was conducted through an online questionnaire focused on sleep disturbances of the general public in 2021. The degree of cold-heat pattern Identification (CHPI) of the general public was also surveyed. Descriptive statistics and multivariate logistic regression were used to derive the study results.
Results: Data from 2,822 workers out of 3,900 valid questionnaires were analyzed. Approximately half of the respondents (49.93%) had sleep disturbances. Among the types of work, self-employed, two-shift work, and working more than 53 hours were associated with sleep disturbances. Sleep disturbances were positively associated with six cold and heat symptoms: three cold symptoms (coldness of the abdomen, coldness of body, and pale face) and three heat symptoms (body feverishness, feverishness of the limbs, and drinking cold water).
Conclusion: Customized policies to maintain healthy work are needed for self-employed work, two-shift work, and long working hours, which are risk factors for workers' sleep disturbances. In addition, medical personnel can effectively diagnose and treat sleep disturbances considering the worker's cold and heat symptoms.

Keywords: occupational groups, sleep-wake disorders, surveys and questionnaires, cross-sectional studies, cold-heat pattern identification

INTRODUCTION

Healthy sleep positively influences individual working performance and corporate success [1, 2]. On the contrary, sleep disturbances are linked to various factors, such as extended work hours, higher workloads, and work schedules [3]. Recently, a longitudinal study involving 12 European adults revealed that sleep disturbances moderate the association between work-related stress and the long-term development of dementia [4]. In view of this, the United States National Institution has emphasized the need to promote workplace-based health as a vital tool to encourage population health practices, such as sleep [5].

Shift work sleep disorders specifically refer to the sleep disturbances encountered by a group of shift workers who are significantly affected by their shift work schedule, as evidenced in numerous studies [6]. According to the 6th Korean Working Conditions Survey (2020), among 50,000 employed individuals aged 15 years or older in Korea who worked over an hour for income, 9% of them were shift workers, representing 11% of wage workers [7]. The same survey also stated that 28% of employed individuals worked over 48 hours, while 13% worked over 52 hours [7]. The Republic of Korea (ROK) boasts some of the longest working hours (totaling 1,872 hours in 2023) among the Organization for Economic Cooperation and Development (OECD) member countries from 2008 to 2022, surpassing that of the OECD average (1,742 hours in 2023), and is notably longer than Japan (1,611 hours in 2023), a similar East Asian country [8]. Likewise, Singapore is among the non-OECD countries

that recorded poor sleep quality. This was evidenced in a 2017 study involving 464 full-time employees aged 21 or older in Singapore, where 42.5% of respondents reported poor sleep quality and 66.2% were categorized as short-sleepers [9]. However, a 2018 case study in the United States showed that the sleep time differed depending on the type of job. Accordingly, protective service and military personnel (50%) accounted for the highest number of individuals with short sleep times [10]. Therefore, this necessitates more research to address the relatively poor working environment and the prevalence of sleep disturbances.

Furthermore, the surrounding environmental temperatures and human sensory temperatures also affect sleep quality, with both high and low temperatures triggering more frequent sleep disturbance [11]. Several studies have shown the relationship between cold and heat sensations and sleep quality [12, 13]. Cold-Heat Pattern Identification (CHPI) is the most commonly used pattern recognition method in diagnosing cold-heat symptoms and in treatment with Korean medicine [14]. Although past studies have established the link between CHPI and a limited number of medical conditions, such as cancer, dysmenorrhea, rhinitis, and sleep disturbances, studies specifically targeting workers using CHPI are still lacking [15-17]. Realizing the need to address this gap, this study employs the CHPI method to investigate sleep disturbances among workers and their contributing factors, as well as establish the association between sleep quality and cold-heat symptoms.

MATERIALS AND METHODS

1. Study design and questionnaire

This study conducted a nationwide cross-sectional survey to identify sleep disturbances among workers in Korea. The research questions were as follows: 1) How many sleep disturbances do workers have? 2) Which type of workers experience sleep disturbances? 3) Is there a difference in the degree of cold-heat symptoms between workers with sleep disturbances and those without? 4) Does the degree of cold-heat symptoms among workers with sleep disturbances vary based on the job type?

Following a comprehensive review of relevant literature, a customized questionnaire was developed, encompassing items about demographic information, economic activities, and job types. In addition, the survey used self-reporting questionnaires with proven reliability and validity. In particular, the questionnaire included the Pittsburgh Sleep Quality Index (PSQI) and CHPI.

2. Sampling and participants

This study employed a non-probability sample with proportions that reflect the local population, as detailed in the resident registration demographics of the Korean Ministry of the Interior and Safety in October 2021. The sample represented the population proportion based on gender (male and female), age groups (five age categories spanning from 20 to 64 years old), and regions (17 ROK regions, including Seoul, Incheon, and Busan). An online panel survey was conducted from November 10 to 26, 2021. Invitations were sent to 9,220 participants who had given informed consent via email and text message. A total of 3,900 responses were received, yielding a response rate of 42.3%, where 2,822 (72.36%) were identified as workers.

The group of workers comprised 1,644 males and 1,178 females. Their age distribution was categorized into five age groups: 20s (454), 30s (639), 40s (743), 50s (719), and 60s (267). In terms of residence, 1,533 lived in the Seoul capital area, 529 in other metropolitan cities, and 782 in other regions.

3. Variables

1) Sleep disturbances

This study considered sleep disturbances as a categorical variable and was calculated using the PSQI, a widely used self-administered questionnaire [18, 19]. The PSQI score ranges from 0 to 21, with a cut-off score of 8.5 points or more on the Korean version denoting the presence of sleep disturbance [18, 19].

2) Workers

A worker is defined as a person who participates in various forms of economic or productive activities, but employment is usually in exchange for monetary compensation or wages [20]. Therefore, this study excluded the unemployed, students, unpaid family workers, and homemakers from the category of workers. The workers were then grouped based on the employment types and the job types.

The employment types were classified into permanent employees, self-employed workers, and irregular workers. A permanent employee has a fixed employment contract, enjoys job stability, and typically has access to worker protections and so-

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cial insurance benefits. They also work under clear regulations regarding work hours and wages and often engage in a long-term employment relationships.

In contrast, a self-employed individual operates their own business and generates income. This category includes individual business owners, freelancers, store owners, and peddlers or street vendors, as well as agricultural, forestry, and fisheries workers.

Meanwhile, an irregular worker refers to a person having non-regular forms of employment instead of a permanent position. This includes temporary workers, daily workers, and participants in public work programs.

The types of jobs investigated in this study include healthcare workers, shift workers, and working hours. Healthcare workers encompass professionals working in medicine, Korean medicine, dentistry, veterinary medicine, nursing, pharmacy, herbal medicine, physical therapy, radiology, clinical pathology, and nutrition. This sector covers those involved in diagnosing, examining, and nursing patients, as well as those related to research positions.

Shift work refers to work hours outside conventional daytime hours, including fixed night shifts, early morning shifts, and rotating shifts between morning, evening, and night [21]. In this study, shift work was analyzed using two variables: 1) shift work status (a binary variable indicating whether an individual works shifts or not) and 2) shift type (a categorical variable that classifies shift workers into three groups: no shift work, two-shift work, and three-shift work).

Furthermore, working hours were assessed according to the legal working hour limits enforced by the Korean Labor Standards Act, which allows for 40 hours per week, with a maximum overtime of 12 hours (including night and holiday work), totaling a maximum working time of 52 hours per week. Thus, the survey question was categorized into three groups: 40 hours or less, 40-52 hours, and more than 52 hours.

3) Cold-Heat Pattern Identification (CHPI) questionnaire

The CHPI questionnaire used in this study consists of 15 questions, with eight questions pertaining to the cold symptoms domain and seven questions related to the heat symptoms domain [14]. Each question is rated on a five-point scale, with a score range of 8-40 for the cold symptoms domain and 7-35 for the heat symptoms domain. A higher score indicates a greater degree of cold or heat pattern [14]. The sensitivity, specificity, and cut-off values were 0.707, 0.946, and 23.5 for the cold domain, respectively [14], and 0.719, 0.736, and 20.5 for the heat domain, respectively [14]. As proposed in the standardization study of the 15-item CHPI questionnaire, the presence or absence of cold and heat patterns was determined based on cut-off points of 23.5 for the total cold symptoms score and 20.5 for the total heat symptoms score [14].

4) Statistical analysis

Stata/MP version 17 (StataCorp LLC, College Station, Texas, USA) was utilized to conduct all data manipulations and statistical analyses. The chi-square test was employed to evaluate the differences between categorical variables, while the Student's t-test was utilized to compare the means of continuous variables between the two groups. Additionally, the Analysis of Variance (ANOVA) was applied to compare means of continuous variables across multiple groups.

The relationship between various variables and sleep disturbances was determined by performing multivariate logistic regression after adjusting for confounding factors. The study adjusted for demographic characteristics, work types, eight cold symptoms of CHPI (aversion to cold, desire for heat, coldness of the abdomen, coldness of the limbs, coldness of the body, pale face, drinking warm water, and profuse clear urine), and seven heat symptoms of CHPI (desire for cold, aversion to heat, body feverishness, feverishness of the limbs, flushed face and eyes, drinking cold water, and hot breath). A two-sided p-value < 0.05 was considered significant.

RESULTS

1. Characteristics of workers

The result showed that 1,409 (49.93%) of the 2,822 workers reported sleep disturbances. Significant differences were observed between workers with and without sleep disturbances in terms of healthcare worker status, shift work status, shift type, and working hours (Table 1).

2. CHPI of workers according to sleep disturbances

Workers classified as having a cold pattern (948, 67.28%) or a heat pattern (755, 53.58%) based on each cut-off value were higher in the group with sleep disturbances. Significant differences were recorded between with and without sleep disturbances in terms of the total cold symptom score (with sleep

Table 1. Characteristics of workers (n = 2,822)

Variables	No sleep disturbances (n = 1,413, 50.07%) n (%)	Sleep disturbances (n = 1,409, 49.93%) n (%)	p
Types of employment			0.057
Permanent employee	1,124 (50.70)	1,093 (49.30)	
Self-employed worker	150 (52.08)	138 (47.92)	
Irregular worker	139 (43.85)	178 (56.15)	
Healthcare worker			< 0.001
No	1,214 (53.98)	1,035 (46.02)	
Yes	199 (43.63)	374 (56.37)	
Shift work status*			< 0.001
No	1,214 (53.98)	1,035 (46.02)	
Yes	199 (34.73)	374 (65.27)	
Shift type*			< 0.001
No	1,214 (53.98)	1,035 (46.02)	
2-shifts	123 (30.22)	284 (69.78)	
3-shifts	76 (45.78)	90 (54.22)	
Working hours**			
Mean (SD)	36.31 (15.05)	36.33 (16.37)	0.972
≤ 40	990 (52.38)	900 (47.62)	0.001
41-52	344 (46.36)	398 (53.64)	
≥ 53	79 (41.58)	111 (58.42)	

*Shift work was analyzed using two variables: 1) shift work status (a binary variable indicating whether or not an individual works shifts); 2) shift type (a categorical variable classifying shift workers into three groups: no shift work, two-shift work, and three-shift work).
**According to the Korean Labor Standards Act, the legal working hours are 40 hours per week, with a maximum of 12 hours of overtime (including night and holiday work), allowing in a total maximum working time of 52 hours per week.

disturbances: 25.63 ± 4.95; without sleep disturbances: 23.50 ± 4.76), total heat symptom score (with sleep disturbances: 20.78 ± 4.81; without sleep disturbances: 18.81 ± 4.49), and in five cold symptoms and six heat symptom of the CHPI. Nevertheless, the groups were similar in terms of 'desire for heat,' 'drink warm water,' and 'profuse clear urine' among cold symptoms, and 'desire for cold' among heat symptoms (Fig. 1 and Appendix 1).

3. CHPI of workers with sleep disturbances by work types

Workers with sleep disturbances displayed significant differences in both CHPI patterns and CHPI symptom scores based on their shift work status and shift type. The proportion of workers with sleep disturbances experiencing cold patterns varied significantly according to both shift work status and shift type. Similarly, employment type, shift work status, and shift type significantly influenced the proportion of workers experiencing heat patterns. Moreover, the total cold symptom score of CHPI was significantly different across all job types, while working hours exhibited an insignificant difference in the total heat symptom score of CHPI (Table 2).

4. Determinants of sleep disturbances of workers

Sleep disturbances were associated with residents of other regions (aOR = 0.75, 95% CI = 0.62-0.91), having private health insurance (1: aOR = 1.38, 95% CI = 1.01-1.88; 2: aOR = 1.48, 95% CI = 1.09-2.02; 3 or more: aOR = 1.58, 95% CI = 1.14-2.18), two-shifts (aOR = 2.01, 95% CI = 1.55-2.59), working over 41 hours (over 52 hours: aOR = 1.63, 95% CI = 1.16-2.29), four cold symptoms of CHPI (coldness of abdomen: aOR = 1.19, 95% CI = 1.08-1.32; coldness of the body: aOR = 1.32, 95% CI = 1.18-1.49; pale face: aOR = 1.34, 95% CI = 1.20-1.50; profuse clear urine: aOR = 0.83, 95% CI = 0.75-0.91), and four heat symptoms of CHPI (desire for cold: aOR = 0.89, 95% CI = 0.80-

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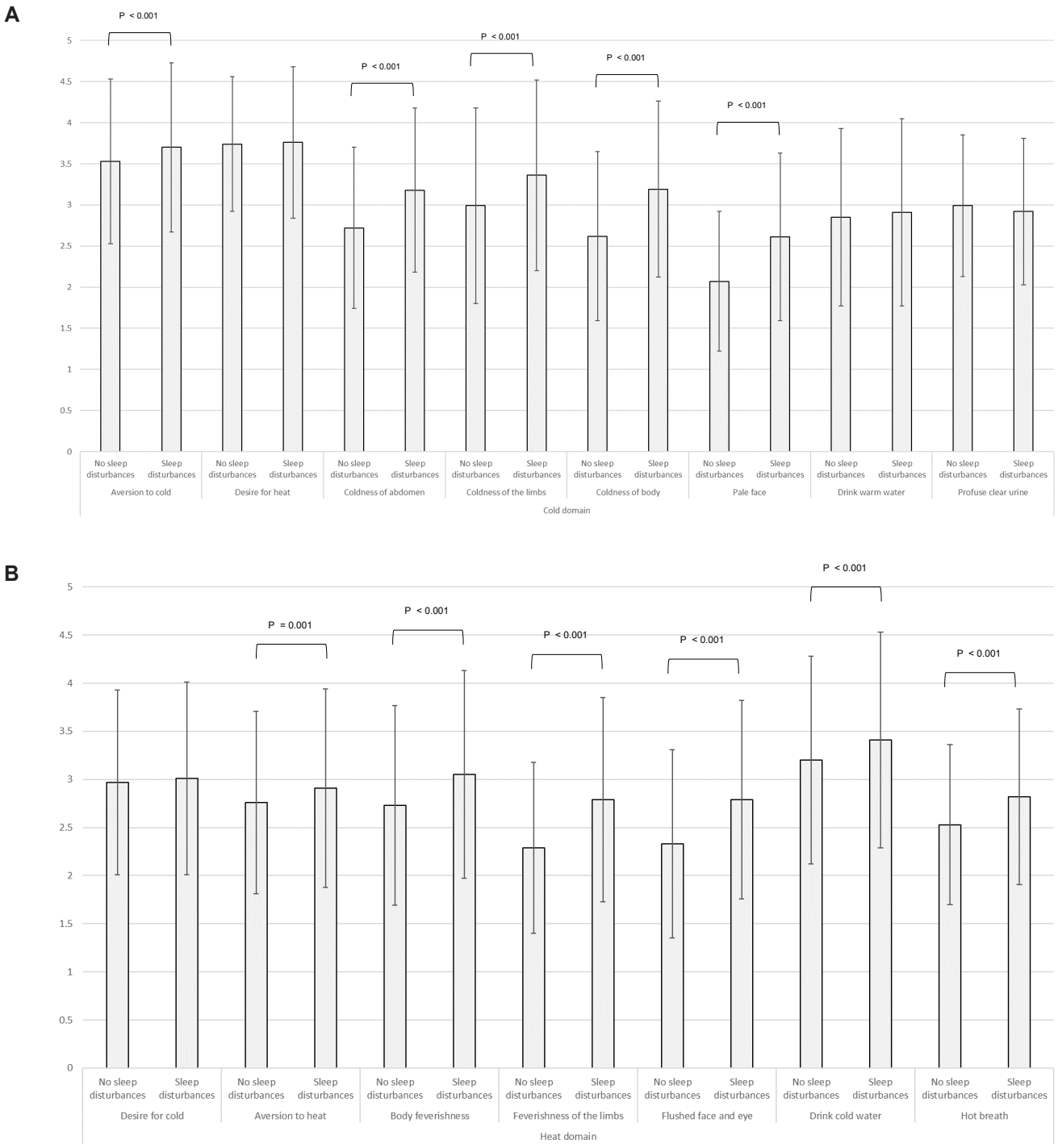

Figure 1. Score for each item of cold-heat of workers depending on the sleep disturbances (n = 2,822). (A) Cold domain. (B) Heat domain.

0.99; body feverishness: aOR = 1.15, 95% CI = 1.03-1.29; feverishness of the limbs: aOR = 1.32, 95% CI = 1.17-1.48; drinking cold water: aOR = 1.15, 95% CI = 1.04-1.27) (Table 3).

DISCUSSION

This nationwide cross-sectional study revealed that nearly half (49.93%) of workers experienced sleep disturbances. Those who were on two-shift work and working more than 53 hours

Table 2. Cold-heat pattern Identification in workers with sleep disturbances by work types (n = 1,409)

Item	Types of employment			Shift worker**				Working hours		
					Yes[1]					
	Permanent employee (n = 1,093, 77.57%)	Self-employed worker (n = 138, 9.79%)	Irregular worker (n = 178, 12.63%)	No[1) 2)] (n = 1.035, 73.46%)	Yes (n = 374, 26.54%)	2-shifts[2)] (n = 284, 20.16%)	3-shifts[2)] (n = 90, 6.39%)	≤ 40 (n = 900, 63.88%)	41-52 (n = 398, 28.25%)	53 ≤ (n = 111, 7.88%)
Cold pattern, n (%)										
Non-cold pattern	370 (33.85)	36 (26.09)	55 (30.90)	359 (34.69)*	102 (27.27)*	71 (25.00)*	31 (34.44)*	287 (31.89)	128 (32.16)	46 (41.44)
Cold pattern	723 (66.15)	102 (73.91)	123 (69.10)	676 (65.31)*	272 (72.73)*	213 (75.00)*	59 (65.56)*	613 (68.11)	270 (67.84)	65 (58.56)
Cold symptom score, mean (SD)										
Total cold score out of 40	25.48 (4.88)*	26.64 (5.08)*	25.73 (5.21)*	25.43 (4.93)*	26.17 (4.97)*	26.43 (4.99)*	25.34 (4.83)*	25.81 (5.01)*	25.56 (4.87)*	24.41 (4.55)*
Aversion to cold	3.69 (1.03)	3.81 (1.04)	3.65 (1.06)	3.74 (1.03)*	3.58 (1.03)*	3.59 (1.03)*	3.56 (0.85)*	3.70 (1.03)	3.74 (1.02)	3.54 (1.09)
Desire for heat	3.76 (0.90)	3.89 (0.86)	3.67 (1.03)	3.80 (0.89)*	3.66 (0.99)*	3.67 (1.00)*	3.61 (0.98)*	3.77 (0.92)	3.79 (0.91)	3.64 (0.93)
Coldness of abdomen	3.15 (1.00)	3.22 (1.02)	3.29 (1.00)	3.13 (1.01)*	3.32 (0.97)*	3.37 (0.96)*	3.16 (0.98) *	3.21 (1.01)	3.15 (1.01)	3.04 (0.89)
Coldness of the limbs	3.34 (1.16)	3.53 (0.96)	3.37 (1.28)	3.32 (1.18)*	3.46 (1.10)*	3.54 (1.12) *	3.22 (1.03) *	3.38 (1.17)	3.36 (1.17)	3.24 (1.08)
Coldness of body	3.16 (1.07)	3.36 (1.07)	3.20 (1.05)	3.15 (1.09)*	3.29 (1.00)*	3.32 (1.03)	3.19 (0.92)	3.20 (1.07)	3.22 (1.07)	2.98 (1.02)
Pale face	2.59 (1.03)	2.67 (0.91)	2.67 (1.03)	2.53 (0.98)*	2.83 (1.09)*	2.85 (1.11)*	2.78 (1.03)*	2.63 (1.01)	2.60 (1.05)	2.46 (0.97)
Drink warm water	2.87 (1.14)*	3.12 (1.13)*	2.99 (1.16)*	2.87 (1.12)*	3.01 (1.18)*	3.03 (1.20)	2.94 (1.15)	2.96 (1.14)*	2.85 (1.13)*	2.70 (1.17)*
Profuse clear urine	2.92 (0.89)	3.03 (0.93)	2.90 (0.84)	2.88 (0.86)*	3.03 (0.97)*	3.07 (0.96)*	2.89 (0.99)*	2.97 (0.90)*	2.85 (0.87)*	2.80 (0.87)*
Heat pattern, n (%)										
Non-heat pattern	486 (44.46)*	70 (50.72)*	98 (55.06)*	503 (48.60)*	151 (40.37)*	117 (41.20)*	34 (37.78)*	425 (47.22)	181(45.48)	48 (43.24)
Heat pattern	607 (55.54)*	68 (49.28)*	80 (44.94)*	532 (51.40)*	223 (59.63)*	167 (58.80)*	56 (62.20)*	475 (52.78)	217 (54.52)	63 (56.76)
Heat symptom score, Mean (SD)										
Total heat score out of 35	21.01 (4.74)*	20.14 (4.93)*	19.89 (4.99)*	20.42 (4.78)*	21.79 (4.76)*	21.61 (4.70)*	22.34 (4.93)*	20.68 (4.80)	21.02 (4.84)	20.72 (4.75)
Desire for cold	3.04 (0.98)	2.93 (1.08)	2.90 (1.04)	2.98 (0.99)*	3.10 (1.04)	3.04 (1.06)*	3.29 (0.96)*	3.01 (1.02)	3.00 (0.96)	3.05 (1.03)
Aversion to heat	2.95 (1.04)	2.80 (0.99)	2.79 (1.05)	2.87 (1.03)*	3.03 (1.04)*	2.96 (1.04)*	3.27 (1.00)*	2.91 (1.04)	2.92 (1.04)	2.96 (0.92)
Body feverishness	3.09 (1.08)*	3.01 (1.06)*	2.82 (1.07)*	3.00 (1.10)*	3.17 (1.01)*	3.14 (1.02)*	3.24 (0.96)*	3.03 (1.09)	3.08 (1.05)	3.05 (1.07)
Feverishness of the limbs	2.53 (1.01)	2.74 (1.08)	2.80 (1.06)	2.72 (1.05)*	2.99 (1.05)*	3.00 (1.06)*	2.98 (1.04)*	2.79 (1.05)	2.82 (1.08)	2.68 (1.08)
Flushed face and eye	2.82 (1.04)	2.70 (1.02)	2.66 (1.03)	2.72 (1.01)*	2.98 (1.07)*	3.00 (1.07)*	2.90 (1.06)*	2.79 (1.02)	2.80 (1.07)	2.69 (1.03)
Drink cold water	3.46 (1.10)*	3.23 (1.24)*	3.25 (1.17)*	3.38 (1.12)	3.49 (1.00)	3.50 (1.12)	3.47 (1.06)	3.34 (1.13)*	3.54 (1.08)*	3.48 (1.16)*
Hot breath	2.70 (0.91)*	2.73 (0.88)*	2.85 (0.91)*	2.75 (0.89)*	3.02 (0.95)*	2.97 (0.96)*	3.20 (0.88)*	2.81 (0.92)	2.87 (0.89)	2.80 (0.94)

*Results with a p-value of 0.05 or less was considered statistically significant and was indicated with an asterisk (*).

**Shift work was analyzed using two variables: 1) shift work status (a binary variable indicating whether or not an individual works shifts); 2) shift type (a categorical variable classifying shift workers into three groups: no shift work, two-shift work, and three-shift work).

Table 3. Determinants of sleep disturbances of workers (n = 2,822)

Variables	OR**	95% CI	p
Sex			
Male	1		
Female	1.02	0.84-1.23	0.874
Age (year)	1.01	1.00-1.02	0.090
Marital status			
Spouseless	1		
Married	0.99	0.82-1.21	0.953
Region			
Seoul capital area	1		
Metropolitan city	0.97	0.78-1.21	0.797
Other regions	0.75*	0.62-0.91	0.003
Education period (years)			
≤ 12	1		
≥ 13	0.95	0.76-1.19	0.675
Private health insurance			
No	1		
1	1.38*	1.01-1.88	0.044
2	1.48*	1.09-2.02	0.012
≥ 3	1.58*	1.14-2.18	0.006
Types of employment			
Permanent employee	1		
Self-employed worker	1.27	0.97-1.67	0.088
Irregular worker	0.92	0.70-1.22	0.563
Healthcare worker			
No	1		
Yes	1.05	0.78-1.41	0.761
Shift work			
No	1		
2-shifts	2.01*	1.55-2.59	< 0.001
3-shifts	1.24	0.87-1.78	0.233
Working hours			
≤ 40	1		
41-52	1.19	0.98-1.45	0.072
≥ 53	1.63*	1.16-2.29	0.005
CHPI			
Cold pattern			
Aversion to cold	1.09	0.98-1.21	0.129
Desire for heat	0.94	0.83-1.06	0.340
Coldness of abdomen	1.19*	1.08-1.32	0.001
Coldness of the limbs	0.94	0.85-1.04	0.246
Coldness of body	1.32*	1.18-1.49	< 0.001
Pale face	1.34*	1.20-1.50	< 0.001
Drink warm water	1.00	0.91-1.10	0.979
Profuse clear urine	0.83*	0.75-0.91	< 0.001
Heat pattern			
Desire for cold	0.89*	0.80-0.99	0.040
Aversion to heat	0.97	0.87-1.08	0.543
Body feverishness	1.15*	1.03-1.29	0.011
Feverishness of the limbs	1.32*	1.17-1.48	< 0.001
Flushed face and eye	1.09	0.99-1.20	0.083
Drink cold water	1.15*	1.04-1.27	0.006
Hot breath	1.01	0.90-1.13	0.896
Constant	0.03*	0.01-0.07	< 0.001

*Results with a p-value of 0.05 or less was considered statistically significant and was indicated with an asterisk (*).
**The association between several factors and sleep disturbance was investigated using multivariate logistic regression after adjusting for confounding factors and analyzed. The study adjusted for demographic characteristics, work types, and eight cold symptoms of CHPI and seven heat symptoms of CHPI.

were associated with having sleep disturbances. Besides, workers with sleep disturbances experienced more severe cold and heat symptoms compared to those without sleep disturbances. CHPI scores among sleep-disturbed workers also varied significantly based on shift work status and employment type.

The findings correspond to the results from a 2017 study conducted in Singapore involving 464 full-time employees aged 21 or older. Accordingly, the study found that 42.5% of participants experienced poor sleep quality [9], with 66.2% of them classified as short-sleepers [9]. However, the study followed the international PSQI cut-off score of less than 5 for poor sleep quality and less than seven hours for short sleep, based on the recommendations from the American Academy of Sleep Medicine and Sleep [16]. Therefore, the sleep disturbance frequency among Korean workers is much higher if the same criteria were applied in this study. Although Singapore and the ROK share a similar East Asian culture, the observed difference may be due to Singapore's better working environment compared to the ROK [22].

Healthy sleep is essential for workers, as sleep disturbances can reduce productivity, affect workplace safety, and trigger physical and mental health issues [23]. A 2017 study involving 2,897 employees in Japan found that workers sleeping less than five hours showed a marked decline in productivity compared to those with seven to eight hours [2]. Another survey of 18,682

full-time workers in Japan revealed that participants working over 51 hours per week reported a higher rate of job-related injuries resulting from sleep-related problems compared to those who worked 35-40 hours per week [24]. Apart from that, a Canadian survey of 8,520 public safety personnel, including communications officials, correctional workers, firefighters, paramedics, and police officers, discovered that sleep quality was correlated with mental health screening [25].

Based on these results, it is necessary to develop practical approaches to improve the sleep health of workers. A 2018 survey in the United States reported that sleep hygiene education is needed for workers with short sleep hours, especially those in the military, medical support workers, and transportation [10]. In addition, a study involving employees working at hospital districts and urban health services in Finland from 2015 to 2019 showed that participatory working time scheduling software effectively reduced the risk of short sleep and reduced work performance [26].

Furthermore, numerous studies have associated shift work and long working hours with an increased risk of chronic disease [27]. For instance, a 2017 study involving intensive care unit nurses showed that working two shifts was significantly related to sleep disturbances, contrary to the findings in the present study, where two work shifts had better sleep quality than three shifts. Hence, comparative research should be conducted across different job groups, as results may vary depending on each job group.

A 2014 Swedish Longitudinal Occupational Survey of Health conducted in revealed that self-employed workers had slightly lower sleep disturbance levels than employed workers [28]. However, the present study found that self-employment was a risk factor for sleep disturbances. This finding was similar to the harsh self-employed environment in the ROK affecting workers' physical and mental health [29]. Furthermore, self-employed individuals hold direct responsibilities and risks to their businesses and often lack stabilities in terms of schedules and incomes, which can result in severe occupational stress.

This study confirmed the relationship between cold and heat symptoms in workers and sleep disturbances. Sleep is controlled by the circadian rhythm, duration, and intensity of daytime brain activity; the symptoms associated with cold and heat can also interfere [30]. Furthermore, sleep deprivation may be related to fundamental negative changes in body temperature regulation, energy balance, and impaired homeostasis [11]. Thus, a proper body temperature and thermal environment are essential for good sleep quality. A 2021 narrative review also revealed moderate human-based evidence of the effects of sleep deprivation of less than four nights on autonomous and behavioral heat effectors during exposure to extreme temperatures [31]. Besides, a study involving 899 middle-aged women from the Korean Medicine Daejeon Citizen Cohort in the ROK demonstrated the correlation between cold and heat sensations and sleep quality [12]. The study also specifically linked these sensations with moderate/severe insomnia and prolonged sleep latency [12]. Although the target populations of the two studies differ, they are aligned with the findings in this present research, which suggest a similar link between cold and heat symptoms and sleep quality.

Aside from that, workers in other regions exhibited fewer sleep disturbances than those living in the Seoul capital area and metropolitan city. Based on previous studies, it was assumed that residents living in the Seoul metropolitan area may be exposed to more intense work stress, such as competition, job insecurity, and night lighting that obstructs good sleep [32-35]. In contrast to countries that offer universal public health insurance to their entire population, private health insurance ownership reflects economic ability and socioeconomic status. Past studies have also highlighted the relationship between socioeconomic status and sleep disturbances [36], which corresponds with the results of the present study. Conversely, other reports have indicated that a lower socioeconomic status is associated with more sleep disturbances [37]. The varying outcomes may be due to the socioeconomic environment of each country.

Despite the promising outcome, this study exhibits several limitations. Firstly, the workers participating in this study were exposed to varying working environments, depending on the type of job. Thus, the result of this study is only applicable to a specific group of workers. Nevertheless, this study is worthwhile because it provides a groundwork for future studies on general workers before conducting more comprehensive studies. Thus, future research should supplement the result of this study across various job groups. Secondly, caution is warranted when interpreting the results, as the survey design may not have captured all relevant risk factors for sleep disturbances among workers. These factors include pain, discomfort, psychological distress (comprising anxiety and depression), and occupational stress and environment [38, 39].

Thirdly, since the PSQI and CHPI questionnaires used in this study are self-reported questionnaires, the participants may

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not have been diagnosed and evaluated by medical professionals. Hence, future studies should consider conducting well-designed clinical studies to confirm the study results. Finally, this study did not examine patients with cold and heat symptoms in a medical setting. Consequently, the impact of various interventions on sleep quality remains unknown. However, a Japanese study involving 16 healthy women aged 20-21 with cold sensitivity suggests a potential link between short-term aerobic exercise and reduced cold sensitivity in the extremities, as well as improved subjective sleep quality [40]. Considering this, a prospective study should be performed to investigate the impact of treatment for cold and heat sensitivity in patients visiting Korean medical institutions and changes in sleep patterns.

CONCLUSION

This nationwide cross-sectional survey revealed that about half of workers experienced sleep disturbances. The identified risk factors include shift work, prolonged working hours, and self-employed workers. Based on the results, detailed attention and policies of companies and communities should focus on improving healthcare and mitigating sleep disturbances among workers. In addition, the cold and heat symptoms were associated with workers' sleep disturbances, especially among shift workers. Hence, medical professionals should consider these findings when diagnosing and treating workers with sleep disturbances. Subsequent studies using clinical data should also be conducted to confirm the results of the present study.

ETHICAL APPROVAL

This study was approved by the Institutional Review Board of Dongguk University, Gyeongju (DRG IRB 20210039). The participants voluntarily agreed to participate in line with the consent questions contained in the survey. In addition, the confidentiality of their personal data and their anonymity during data processing were guaranteed.

DATA AVAILABILITY

The author will discuss with departments involved in the provision of datasets upon reasonable request.

CONFLICTS OF INTEREST

The author has no conflicts of interest to declare with respect to the authorship and publication of this article.

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Appendix 1. Cold-heat pattern Identification of the workers (n = 2,822)

Item	No sleep disturbances (n = 1,413, 50.07%)	Sleep disturbances (n = 1,409, 49.93%)	p
	Mean (SD)	Mean (SD)	
Cold pattern			
Total cold score out of 40	23.50 (4.76)	25.63 (4.95)	< 0.001
Aversion to cold	3.53 (1.00)	3.70 (1.03)	< 0.001
Desire for heat	3.74 (0.82)	3.76 (0.92)	0.386
Coldness of abdomen	2.72 (0.98)	3.18 (1.00)	< 0.001
Coldness of the limbs	2.99 (1.19)	3.36 (1.16)	< 0.001
Coldness of body	2.62 (1.03)	3.19 (1.07)	< 0.001
Pale face	2.07 (0.85)	2.61 (1.02)	< 0.001
Drink warm water	2.85 (1.08)	2.91 (1.14)	0.148
Profuse clear urine	2.99 (0.86)	2.92 (0.89)	0.058
Heat pattern			
Total heat score out of 35	18.81 (4.49)	20.78 (4.81)	< 0.001
Desire for cold	2.97 (0.96)	3.01 (1.00)	0.205
Aversion to heat	2.76 (0.95)	2.91 (1.03)	0.0001
Body feverishness	2.73 (1.04)	3.05 (1.08)	< 0.001
Feverishness of the limbs	2.29 (0.89)	2.79 (1.06)	< 0.001
Flushed face and eye	2.33 (0.98)	2.79 (1.03)	< 0.001
Drink cold water	3.20 (1.08)	3.41 (1.12)	< 0.001
Hot breath	2.53 (0.83)	2.82 (0.91)	< 0.001

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