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Original

Association between Sleep Disorders and Occupational Accidents

Saeed Yazdaniraad[1], Amirhossein Khoshakhlagh[1], Hossein Fallah[2], Zahrasadat Keyvanian[3], Vali Sarsangi[1*]

[1] Department of Occupational Health Engineering, Faculty of Public Health, Tehran University of Medical Sciences, Tehran, Iran• [2] Department of Ergonomics, Health Faculty, Tabriz University of Medical Sciences, Tabriz, Iran• [3] Department of Occupational Health Engineering, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran• Corresponding Author: Vali Sarsangi, Email: valisarsangi@yahoo.com Tel: +98- 913-8525598

Abstract

Background: Occupational accidents occur every day across industries. One of the probable causes of this occurrence is the sleep disorders. This study aims to investigate the relationship between the sleep disorders, and occupational accidents in a group of Iranian workers. **Methods:** A cross-sectional study was conducted on 366 workers of steel parts production industries in Kashan, Iran. A three-part questionnaire was used in the study. The first part covered the demographic characteristics of the workers, the second part was related to the Pittsburgh Sleep Quality Index for sleep disorders and the third part was related to the information on the accident occurrence in the workplace. The collected data were analyzed using SPSS software and analyzed with Pearson correlation coefficient, ANOVA and t-test. **Results:** The results of this study showed that the average score of sleep quality was 5.84 (standard deviation: 2.66). The sleep quality of 53.7% of the subjects was poor. Over the past year, 27.4% of the workers had an occupational incident. There was no significant relationship between sleep disorders and occurrence of occupational accidents ($p > 0.05$). **Conclusion:** Our results showed that more than half of the workers suffered from poor sleep quality. However, there was no significant relationship between sleep disorders and occupational accidents.

Keywords: Occupational Accidents; Sleep Wake Disorders; Occupational Health

Introduction

Accidents are one of the most important causes of absenteeism, disability, and mortality in working environments.[1] According to the International Labor Organization's official statistics, one million workers are daily affected by occupational accidents worldwide, of which 5,500 die.[2] Occurrence of occupational accidents is a multi-factorial phenomenon and its causes are different according to the industry of interest. Ten percent of occupational accidents occur due to unsafe conditions and about 88% of them occur due to unsafe acts.[3] Poor sleep quality and long-term fatigue are among the reported causes of occupational accidents. Lack of sleep can lead to disruption of the physical and mental health of the workers and the incidence of health problems such as gastrointestinal disorders, heart problems, distractions, and unsafe behaviors in the workplaces.[4] Sleep disorders can also damage the overall health status of the man and it can lead to subsequent loss of the individual's professional performance.[5]

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Sleep disorders in general are a group of syndromes characterized by lack of sleep quantity, poor sleep quality, and behavioral and physiological impairments that occur during sleep.[6] The actual importance of human biological times and sleep cycle becomes more clear when some of the most important occupational and industrial accidents in the history occurred at the night shift. Shift workers who are not compatible with night shift, work at the lower level of consciousness and usually have difficulties in sleeping throughout the day and night. It may be an explanation to the increased number of deadly accidents at night shifts. Higher incidence of some diseases and also accidents previously reported in shift workers.[7] Inadequate sleep and its inadequate quality are associated with health and safety issues such as physical impairment, neurological problems, and reduced psychomotor actions, which ultimately can lead to occupational accidents.[8] Lack of sleep can also increase the likelihood of drowsiness during the day, which can result in occupational and non-occupational accidents.[9]

Working in steel industry is associated with heavy manual handling, exposure to huge amounts of fumes and high temperatures. Long working hours and unhealthy working conditions can lead to the physical and mental fatigue of workers, which can cause occupational accidents.[10] Poor sleep quality in such a hazardous work environment can cause difficulty in focusing, and can lead to errors and increase in the risk of accidents.[11] Sleep disorders, and irregularities in the pattern of sleep can lead to disruptions in social and occupational activities and cause significant disturbance in mental power.[12]

Considering the above mentioned issues which indicate the effect of sleep disorders on occupational accidents and considering the importance of occupational accidents in the industry, especially high frequency of occupational accidents in steel industry, the aim of this study was to determine the relationship between sleep disorders and occurrence of occupational accidents in the workers of selected steel industry.

Methods

The study population consisted of all workers employed in the steel production factory in Kashan, Iran. Totally 366 workers were enrolled in to the study. The study protocol was in accordance with institutional medical ethics board and approved by the ethic committee of the University (IR.KAUMS.REC.1394.68). The inclusion criterion was having at least one year of work experience in the industry. The exclusion criterion was absence of the worker from industry during the study period.

For this study, a three-part questionnaire was used. The first part covered demographic characteristics of the workers. The second part included the Pittsburgh Sleep Quality (PSQ) Index, which has been validated by Montazeri and his colleagues. The Cronbach's alpha coefficient of the questionnaire was 0.83.[13] The questionnaire has 19 questions that determine the quality of sleep in seven aspects of mental sleep quality, delayed sleep, sleep duration, sleep habits, sleep disorders, use of medication for falling asleep and daily disorders associated with sleep problems. The general score was obtained by summing up scores of all scales. The score of each questionnaire scales is between 0 and 3. At each scale, the zero score represents a natural state, the score one indicates weak problem, the score two shows moderate problem, and the score three reflects severe problem. The total score of sleep quality varies from zero to 21. A total score of less than five indicates a good sleep quality and a total score of five or more represents a poor quality of sleep. The third part of the questionnaire pertained to the data on occurrence of occupational accidents over the past year, using two questions. The questionnaire was presented to the workers in person and the method of completion was described to them. After collecting

information, data entered into the SPSS software v.16 and analyzed by selected statistical tests according to the hypothesis of study. Mean comparison between two groups was conducted by t-test. ANOVA test was used to compare the mean between more than two groups.

Results

From 366 distributed questionnaires, 282 questionnaires were returned (response rate was 77.05%). The mean age of the participants was 32.21 years (SD=6.57). The mean work experience was 6.14 years (SD=4.30), and the average daily working hours was 8.74 hours (SD=1.59). During past year, 171 occupational incidents have occurred in the factory, with an average of 0.61 (SD=1.30) per worker. Over the last year, 78 workers (27.66%) had experienced an accident and there was no incident for 204 of them.

Table 1 shows the descriptive data on the sleep quality dimensions. The average PSQ index was estimated to be 5.45 (SD=2.96). It was in the range of 0 to 12. The results showed that 85.5% of the subjects are suffering from sleep disorders (PSQ index>5). Table 2 shows the PSQ index according to the different demographic characteristics. There was no significant difference in PSQ index according to age, work history, daily working hours, service sector, smoking, family problems, second job with sleep quality index (p>0.05). However, the PSQ index of single individuals, shift workers and those with lower socioeconomic status were significantly higher than married, day time workers, and those with high socioeconomic status (p<0.05). Caffeine drinking before sleep has a significant negative effect on the PSQ index (p<0.05).

Table 3 shows the occurrence of occupational accidents according to the demographic characteristics of the workers. There was no significant difference in frequency of occupational accident regarding to age, work experience, working hours, marital status, number of children, smoking and family problems (p>0.05). The occurrence of the occupational accident was significantly different across different units, and higher among those working in the more hazardous area (p<0.05). shift workers, those with inadequate socioeconomic conditions, lack of job security had significantly higher prevalence of occupational accident (p<0.05). The frequency of occupational accident was also significantly higher in workers who consumed caffeine before bedtime (p<0.05). Table 4 shows the numbers of occupational accidents according to the PSQ index.

Table 1. Descriptive statistics on sleep quality dimensions based on Pittsburgh Sleep Quality (PSQ) Index in steel factory workers (n=282)

PSQ sub-scale score	N (%)
Mental sleep quality	
Very good	65 (23.05)
Fairly good	158 (56.03)
Fairly bad	41 (14.54)
very bad	18 (6.38)
Delay to fall asleep	
0	57 (20.21)
1-2	141 (50.00)
3-4	48 (17.02)
5-6	36 (12.77)
Duration of sleep	
>7	204 (72.34)
6-7	45 (15.96)
5-6	12 (4.25)
5>	21 (7.45)
Sleep habits	
>%85	204 (72.34)
%75-%84	45 (15.96)
%65-%74	12 (4.25)
%65>	21 (7.45)
Sleep disorders	
0	27 (9.57)
1-9	192 (68.09)
10-18	57 (20.21)
19-27	6 (2.13)
Use the medicine to fall asleep	
I did not experience at all	261 (92.55)
Less than once a week	12 (4.26)
Once or twice a week	9 (3.19)
Three times or more per week	0 (0.00)
Daily disorders	
0	90 (31.91)
1-2	129 (45.75)
3-4	48 (17.02)
5-6	15 (5.32)
Sleep disorders	
No	117 (41.49)
Yes	165 (58.51)

Table 2. Relationship between demographic characteristics Pittsburgh Sleep Quality (PSQ) Index in steel factory workers (n=282)

Factor	N	PSQ score Mean (SD)	*p*-value
Service sector			
Production	135	5.47(2.72)	0.13
Substrate	30	4.90(2.34)	
Furnace	21	7.14(3.48)	
Engineering	39	5.38(3.19)	
Services	36	5.08(3.50)	
Packing	21	5.28(3.03)	
Marital status			
Single	48	6.43(3.13)	0.01
Married	234	5.25(2.89)	
Child			
Yes	162	5.52(2.87)	0.77
No	120	5.38(3.09)	
Job security			
I have	87	4.51(2.91)	0.00
I do not have	195	5.87(2.90)	
Smoking			
Yes	29	5.67(3.28)	0.83
No	65	5.45(2.96)	
Economic status			
High	96	4.81(3.11)	0.01
Low	186	5.79(2.84)	
Work shift			
Yes	192	6.13(2.90)	0.00
No	90	4.03(2.56)	
Drinking caffeine			
Little	123	5.04(2.62)	0.01
Medium	120	5.45(3.22)	
A lot	39	6.77(2.84)	
Family problems			
Yes	33	5.18(2.83)	0.57
No	249	5.49(2.98)	
Second job			
I have	21	4.85(2.00)	0.09
I do not have	261	5.50(3.02)	
Occupational accident			
Yes	78	5.98(2.82)	0.01
No	204	5.25(3.01)	

Table 3. Relationship between demographic characteristics of steel factory workers and occurrence of occupational accident (n=282)

Factor	N	Has accident		*p*-Value
		Yes (N)	No (N)	
Service sector				
Production	135	39	96	0.00
Substrate	30	18	12	
Furnace	21	0	21	
Engineering	39	9	30	
Services	36	3	33	
Packing	21	9	12	
Marital status				
Single	48	9	39	0.09
Married	234	69	165	
Have a child				
Yes	162	45	117	0.53
No	120	33	87	
Job security				
I have	87	15	72	0.01
I do not have	195	63	132	
Smoking				
Yes	87	29	58	0.48
No	195	54	141	
Economic status				
High	96	15	81	0.00
Low	186	63	123	
Shift work				
Yes	192	60	132	0.03
No	90	18	72	
Caffeine drinking				
little	120	18	102	0.00
Medium	123	42	81	
A lot	39	18	21	
Family problems				
Yes	33	6	27	0.53
No	249	72	177	

There was no significant difference between the mean number of occupational accidents across different scores of sleep time and sleep habits (p>0.05). Sleep disturbance index, the average number of accidents also significantly increased (p<0.05).

Discussion

Our results showed that 58.5% of the subjects suffered from sleep disorders. The prevalence of disorders in the case of our study population was lower than the prevalence of sleep disorders in nurses.[14] A previous study investigated sleep disorders and related symptoms in the flight crew and land personnel of private airlines in Iran, which included 250 land personnel and 250 flight crew members. The results showed that the prevalence of insomnia was 60% in the ground crew and 66% in the flight crew. The prevalence of sleepiness was 27% in the ground personnel and 24% in the flight crew.[15] The main cause of difference between our study and Iranian airlines study is the difference in the groups of interest. The results of PSQ index showed that the least common problem in workers was the use of medication for sleep, which was consistent with the findings in nurses.[16]

Table 4. Mean number of occupational accident during past year across different demographic characteristics of steel workers (n=282)

Variable	N	Accident (SD)	*p*-value
Mental sleep quality			
Very good	63	0.38(0.90)	0.00
Fair	156	0.57(1.18)	
Bad	39	0.58(1.02)	
Very bad	16	1.50(1.48)	
Delayed to fall asleep			
0	57	0.53(1.28)	0.01
1-2	141	0.41(0.82)	
3-4	48	0.90(1.63)	
5-6	36	1.03(2.00)	
Sleep duration (hours)			
7<	204	0.71(1.45)	0.21
6-7	45	0.33(0.60)	
5-6	12	0.50(0.90)	
5>	21	0.29(0.71)	
Sleep habits			
%85<	204	0.71(1.45)	0.21
%75-%84	45	0.33(0.60)	
%65-%74	12	0.42(0.90)	
%65>	21	0.32(0.72)	
Sleep disorders			
0	27	0.22(0.42)	0.00
1-9	192	0.48(1.12)	
10-18	57	1.05(1.77)	
19-27	6	2.00(1.19)	
Use the medicine			
Not at all	261	0.59(1.28)	0.02
Less than once a week	12	1.50(0.73)	
Once or twice a week	9	0.00 (0.00)	
>Three times a week	0	0.00 (0.00)	
Daily disorders			
0	90	0.34(0.84)	0.02
1-2	129	0.51(0.11)	
3-4	48	1.00(1.59)	
5-6	15	1.20(1.65)	

On the other hand, the most frequent problem was due to restless sleep and night arousing, where individuals did not experience continuous and slow sleep, which could be due to daily stress or disturbation of the circadian cycle rhythm. Due to the high prevalence of sleep disorders in the population under the study, the low frequency of use of medicine could be due to lack of awareness on their sleep disorders and the lack of access to sleep medications without prescription. People need to refer to psychiatrists to determine their disorders and treat it, which is not common in the community.

The study of relationship between sleep quality and demographic variables showed that there was no significant relationship between sleep quality, age, job history, and working hours. The quality of sleep in shift workers was significantly lower than day workers. Other studies have also reported this result. Variable work schedules can create the huge disruption in sleep patterns and disrupt the normal circadian cycles. The sleep quality index of people working in the service department was significantly lower than other working groups. The main reason for this was the pre-scheduled working time and lack of shift working in this group. In the study on fabric factory workers, 196 subjects with rotary shifts and 204 people with a constant shift were investigated using the PSQ index. The results of their study indicated that the duration of nighttime sleep in shift workers was lower than that of daytime workers. The prevalence of poor sleep and insomnia among the shift workers was more common than normal day workers, and this difference was statistically significant. The most common type of sleeplessness in the shift workers was the difficulty in starting a dream. The result of their study implies that it is necessary to take more attention on the sleep disturbances in shift workers.[17]

In the study on sleep disorders in the shift workers employed in the automotive industry, 120 employees of the automotive industry in Tehran were evaluated using Epworth sleepiness scale. The mean of sleepiness index at night and in the morning were 16.3 and 12.55, respectively. Comparing the mean of sleepiness scores in two night and morning shifts indicate that the average scores are higher in night shift workers than morning shift workers and this difference was statistically significant.[18] Also, the results of this study showed that people who feel unsafe with job security and have poor socioeconomic conditions are more likely to have sleep disorder due to the stress from their job conditions.

The results of the present study indicate that there is a significant relationship between sleep disorders and occupational accidents and occupational

accidents are increased with the increase of sleep disorders. The relationship between fatigue and insomnia severity index was investigated in a study on 180 steel parts production and rolling workers on work shift and normal work. The highest percentage of fatigue in day and night workers scored 6 and 7 respectively. The mean of all signs related to fatigue and total score of insomnia severity index in rotating shift workers was higher than constant shift work and this difference was statistically significant. There was a significant relationship between the severity index of insomnia and fatigue symptoms.[19] In fact, sleep disorders can lead to accidents through fatigue and reduced consciousness. In the study on the sugar factory workers using Epworth Sleepiness Scale and fatigue severity, the results showed that the highest fatigue score in the night shift workers was 4.41. The average of all symptoms associated with fatigue and the total score of insomnia severity index was higher in night shift workers than day shift workers and this difference was statistically significant. There was a significant relationship between insomnia severity index and the signs of fatigue and accidents. The level of fatigue in the night group was higher than the day work group and the number of events was higher in this group. The incidence rate was higher in those who had more sleepiness.[20]

The results of this study show that more than half of the workers did not have good sleep quality. There was also a significant relationship between sleep disorders and occupational accidents. Therefore, these sleep disorders have reduced the consciousness of workers, and in addition can reduce product quality and increase production errors. It can lead to unsafe acts by individuals and cause serious accidents.

Conflict of interest

The authors declare no conflict of interest.

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