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## Original Article

# Association of Amplitude and Stability of Circadian Rhythm, Sleep Quality, and Occupational Stress with Sickness Absence among a Gas Company Employees—A Cross Sectional Study from Iran

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## ABSTRACT

**Background:** The present study was carried out to assess the relationship between sickness absence and occupational stress, sleep quality, and amplitude and stability of circadian rhythm as well as to determine contributing factors of sickness absence.

**Methods:** This cross sectional study was conducted on 400 randomly selected employees of an Iranian gas company. The data were collected using Pittsburgh sleep quality index, Karolinska sleepiness scale, circadian type inventory, and Osipow occupational stress questionnaires.

**Results:** The mean age and job tenure of the participants were  $33.18 \pm 5.64$  years and  $6.06 \pm 4.99$  years, respectively. Also, the participants had been absent from work on average 2.16 days a year. According to the results, 209 participants had no absences, 129 participants had short-term absences, and 62 participants had long-term absences. The results showed a significant relationship between short-term absenteeism and amplitude of circadian rhythm [odds ratio (OR) = 6.13], sleep quality (OR = 14.46), sleepiness (OR = 2.08), role boundary (OR = 6.45), and responsibility (OR = 5.23). Long-term absenteeism was also significantly associated with amplitude of circadian rhythm (OR = 2.42), sleep quality (OR = 21.56), sleepiness (OR = 6.44), role overload (OR = 4.84), role boundary (OR = 4.27), and responsibility (OR = 3.72).

**Conclusion:** The results revealed that poor sleep quality, amplitude of circadian rhythm, and occupational stress were the contributing factors for sickness absence in the study population.

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## 1. Introduction

Maintaining a healthy workforce is the basis of any successful society [1]. Sickness absence is among the factors which reduce the productivity of human resources in organizations [2,3]. It is also considered as a major public health and economic problem [1,4–6]. This issue is important because it can predict permanent disability [7]. Absence resulting from occupational diseases can also lead to permanent loss of the workforce [8]. Various studies have shown social status, workplace conditions, occupational conditions, demographic features, psychosocial stressors [9–12], sleep disturbances and insomnia [6,13,14], circadian rhythm disorder [15,16], and musculoskeletal disorders [17–19] as the contributing factors of sickness absence. Psychosocial problems have been reported to

comprise 30% of absences from work due to sickness [20]. Stress is defined as pressure resulting from extraordinary demands and constraints, and is among the psychosocial factors contributing to sickness absence [21]. In fact, stress is the prevalent occupational problem of the 21<sup>st</sup> century which affects humans. This issue is the reason for almost 40% of new cases of sickness absence [22]. According to the International Labor Organization, the occupational stress-related costs imposed on countries are equal to 1–5% of the gross domestic product (GDP) [23]. Moreover, other reports have indicated that 4% of working hours in each organization is lost annually due to staff stress and job dissatisfaction [24].

Sleep disturbances are also common among the working population and 30–50% of such individuals experience the signs of insomnia [25,26]. Evidence has revealed that poor sleep increases

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the risk of mortality, cardiovascular diseases, and diabetes [27]. Insomnia can also lead to sickness absence, reduction of productivity, and occupational accident. Furthermore, research has demonstrated that compared with the individuals with sufficient sleep, those suffering from insomnia experience more absences from work, physical and mental problems, and problems in occupational activities and personal relationships [25,28,29]. In a study, it was reported that individuals with insomnia lost at least five more work days per year as compared with those with sufficient sleep. Besides, it was pointed out that the rate of sickness absence was 1.4-fold higher among workers with poor sleep compared with those without sleep problems [30]. Moreover, in a study conducted by Daley et al [31], the indirect annual costs related to sickness absence due to insomnia was estimated to be 970.6 million dollars in Canada. According to Oenning et al [12], risk of sleep disorders was 2.2-fold higher among the individuals with absences from work. Sivertsen et al [32] also mentioned that risk of sickness absence was two times higher in individuals with insomnia compared with those having sufficient sleep. Similarly, Rahkonen et al [6] revealed a strong relationship between permanent sleep problems and sickness absence. Additionally, Bültmann et al [14] found that sleep disturbances were predictors of sickness absence.

Disturbance of circadian rhythm is another important factor affecting sickness absence [15,16]. Circadian refers to changes in behavioral and metabolic activities of humans during a day that is regulated by the biological clock [33–35]. Circadian rhythm plays a key role in regulation of sleep/wake cycles such that sleeping pattern is affected by this rhythm and its features [34].

The gas industry is an important industry in Iran from the view points of economics and employment. In the gas industry, there are different factors in the working environment which may lead to sickness absence. Studies have shown that a large number of workdays lost due to absenteeism is highly prevalent in the gas and oil industries [36]. There are critical jobs in the gas industry such as control room operation, maintenance, site operation, firefighting, etc. Activities such as exploration, extraction, exploitation, and transportation of gas from the main resources to refineries and petrochemical plants, require that the employees fulfill their duties in areas usually far from cities and sometimes offshore. In this situation, job stress and other workplace risk factors may have a negative impact on employees' wellbeing.

Despite the importance of this issue, no study has been conducted on sickness absence as well as the impact of occupational stress, sleep quality, and type of circadian rhythm on sickness absence among Iranian gas company employees. Therefore, the present study was carried out to assess the relationship between sickness absence and occupational stress, sleep quality, and amplitude and stability of circadian rhythm among an Iranian gas company staff. The present study hypothesized that job stress, quality of sleep, and circadian rhythm characteristics were associated with work absenteeism and by exploring these factors sickness absence among the employees of a gas factory would be predicted. Therefore, a questionnaire based survey was carried out on 400 employees of an Iranian gas company to evaluate these factors and to predict the sickness absenteeism in the selected gas company.

## 2. Materials and methods

### 2.1. Study population and sample selection

This cross-sectional study was conducted from January 2015 to June 2015 in an Iranian gas company. The participants were 400 randomly selected employees (179 office workers and 221 operational workers) with at least 1 year of job tenure who participated in the study voluntarily. It is to be noted that at the time of the

study, in total, 588 individuals (male/female) were employed in the company. Therefore, the sample represented 68% of all company employees.

As in the present study we aimed to explore risk factors of sickness absence with occupational origin among the employees, participants who suffered from mental disorders which were not necessarily work-related, were excluded from the study.

The process of sample selection was such that at first the list of the personnel was prepared. Then, based on the simple random sampling method, the participants were selected. Next, we referred to each participant's medical records (for mental health check) and personnel file (for job tenure check). If he/she met the criteria, he/she was included in the study. After explaining the aims and scope of the study for the individual, if he/she agreed to partake, we gave him/her the questionnaire to complete. The questionnaire was completed in the presence of the researchers. We continued this process so that 400 participants were sampled and studied.

Each individual received the questionnaire in person in his/her workplace during the last 30 minutes of their working shifts. He/she was given 30 minutes to complete the questionnaire and return it to the researchers. Data regarding the employees' number of absences from work during the past year, number of workdays lost due to sickness absence in the preceding year, job tenure, and medical history were extracted from their records in the company human resources section. All participants signed an informed written consent form before commencement of the study. The study protocol was reviewed and approved by Shiraz University of Medical Sciences Ethics Committee, Shiraz, Iran.

### 2.2. Measures

In this study, the data were collected using demographic, Circadian Type Inventory (CTI), Pittsburgh Sleep Quality Index (PSQI), Karolinska Sleepiness Scale (KSS), and Osipow occupational stress questionnaires.

#### 2.2.1. Demographic questionnaire

This questionnaire consisted of questions regarding age, sex, height, weight, education, marital status, number of children, job tenure, working system, overtime work (in the past year) and type of employment. The participants were also asked about overtime work in their job (in the past year).

#### 2.2.2. CTI

This inventory was designed by Folkard et al [37] in 1979 and benefits from high reliability and validity. In Iran, the reliability and validity of this scale have been approved with Cronbach  $\alpha = 0.76$  by Jafari-Roodbandi et al [16]. This 11-item questionnaire includes two separate variables: (1) the first one, i.e., flexible/rigid (FR), represents the stability of circadian rhythm. Individuals who gain a high score from this variable are flexible, suitable for shift working, can take part in shift schedules, and can stay up during abnormal hours of day or night; and (2) the second variable, i.e., languid/vigorous (LV), shows the amplitude of circadian rhythm. Individuals who obtain a high score from this variable are called languid and have difficulty dealing with feelings of sleepiness and lethargy resulting from insomnia. In this study, the individuals with FR score  $> 18.75$  were considered as flexible ones who could stay awake at abnormal hours. Besides, the individuals who obtained LV score  $> 22.5$  were considered as languid ones who had difficulty dealing with sleepiness [38].

#### 2.2.3. PSQI

This questionnaire investigates sleep quality within the past 4 weeks and includes seven scores for the following scales: subjective sleep quality, sleep latency, sleep duration, habitual sleep

**Table 1**  
Some demographic and occupational characteristics of the study population (N = 400)

Age (y)	Mean (SD)	33.2 (5.6)
	Min–Max	23–58
BMI (kg/m <sup>2</sup> )	Mean (SD)	25.6 (2.9)
	Min–Max	17.5–35.1
No. of children	Mean (SD)	1.3 (1.1)
	Min–Max	0–8
Job tenure (y)	Mean (SD)	6.1 (5)
	Min–Max	1–30
Daily working time (h)	Mean (SD)	10.5 (1.3)
	Min–Max	8–14
Weekly working time (h)	Mean (SD)	53.3 (8.2)
	Min–Max	36–96
Sex	Female	25 (6.3)
	Male	375 (93.8)
Marital status	Single	85 (21.3)
	Married	315 (78.8)
Education	Under diploma	20 (5)
	Diploma	55 (13.8)
	Associate's diploma	88 (22)
	BSc. or higher	237 (59.3)
Working system	Shift worker	77 (19.3)
	Day worker	323 (80.8)
Overtime work (in the past y)	Yes	353 (88.3)
	No	47 (11.8)

Data are presented as n (%), unless otherwise indicated.

BMI, body mass index; Max, maximum; Min, minimum; SD, standard deviation.

efficiency (the proportion of time that one is asleep over the total time spent in bed), sleep disturbances (defined as waking up at night), use of sleep medication, and daytime dysfunction (defined as troubles someone experiences during the day caused by sleeplessness) [39]. In this scale, scores 0–4 and 5–21 represent good and poor sleep quality, respectively. Farrahi et al [40] reported the sensitivity of 100% and Cronbach  $\alpha$  of 0.89 for the Persian version of this questionnaire.

#### 2.2.4. KSS

This scale was designed by Åkerstedt and Gillberg [41] in 1990 and benefits from high reliability and validity. KSS is a reliable tool for evaluation of sleepiness and ranges from 1 (strongly conscious) to 9 (trying to stay awake) [42]. In spite the fact that the Persian version of this scale has been used in diverse studies on Iranian people, the reliability and validity of this scale has not been addressed in the literature.

#### 2.2.5. Osipow occupational stress questionnaire

This 60-item questionnaire investigates occupational stress. Each of 10 items of this questionnaire deals with one dimension of occupational stress. The dimensions include role overload, role ambiguity, role insufficiency, role boundary, responsibility, and physical environment.

Role overload measures the extent to which job demands exceed resources (personal and work place), and the extent to which an individual is able to accomplish expected workloads.

Role insufficiency measures the extent to which the individual's training, education skills, and experience are appropriate to job requirements.

Role ambiguity measures the extent to which the priorities, expectations, and evaluation criteria are clear to the individual.

Role boundary measures the extent to which the individual has or feels a great deal of responsibility for the performance and welfare of others on the job.

Responsibility measures the extent to which the individual has or feels a great deal of responsibility for the performance and welfare of others on the job.

Physical environment measures the extent to which the individual is exposed to high levels of environmental toxins or extreme physical conditions.

The first five dimensions include 50 items responded through a 5-point Likert scale ranging from never (1) to most often (5). The sum of scores of each of the 10 items is used to assess the effect of each stressor dimension and the sum of scores of all the 50 items is used to evaluate total stress. Based on the scores, effect size of each dimension is divided into four categories, namely mild (10–19), mild to moderate (20–29), moderate to severe (30–39), and severe (40–50). Total stress is also divided into four classes as follows: mild (50–99), mild to moderate (100–149), moderate to severe (150–199), and severe (200–250) [43]. The 10 questions in the physical environment dimension, which are related to occupational stress, are computed and analyzed separately. This dimension is also divided into four grades, namely mild (5–9), mild to moderate (10–14), moderate to severe (15–19), and severe (20–25).

According to a study conducted in Iran, the Persian version of this questionnaire has acceptable reliability and validity (Cronbach  $\alpha$  = 83%) [44].

#### 2.3. Statistical analysis

Data analyses were performed using SPSS statistical software, version 19 (IBM, Armonk, NY, USA) and SAS statistical software, version 9.2 (SAS Institute, Cary, NC, USA). One way ANOVA was used to compare quantitative variables (i.e., age, height, job tenure, and body mass index) among the staff with 0 days, 1–4 days, and > 5 days of absence from work per year. Besides, Chi-square or Fisher's exact test were used to compare the frequency of qualitative variables (marital status, sex, and education) among the three groups. If the *p* value of these univariate tests for assessing association between the quantitative and the qualitative variables and sickness absence was  $\leq 0.25$ , the variable was included in the regression model [45]. Finally, multiple logistic regression analysis (forward: Wald) was performed to adjust for potential confounders to determine factors associated with sickness absence. Additionally, Kolmogorov–Smirnov test was used to assess normal distribution of the data.

### 3. Results

The participants' demographic characteristics and working conditions are presented in Table 1. The study population was relatively young with the mean age of  $33.18 \pm 5.64$  years and mean job tenure of  $6.06 \pm 4.99$  years. The results also showed that the majority of the study participants were male (93.8%), married (78.8%), and day workers (80.8%), had bachelor's degrees or higher (59.3%), and worked for extra hours (88.3%).

The mean number of absences from work was found to be  $2.16 \pm 4.56$  days per year. The overall lost working days during the past year due to sickness absence was, then, 1,270.08 days. Based on the average daily salary of the gas company employees at the time of the study which was equal to 780,000 Iranian Rials (US\$25), the total annual cost of 1,270.08 lost working days for the company was roughly estimated to be 990,662,400 Iranian Rials (US\$31,752).

Based on the results, 209 participants (52.2%) had no absences, 129 participants (32.2%) had one to four absences (short-term absenteeism) during the year prior to the study, and 62 participants (15.5%) had five or more absences (long-term absenteeism).

Amplitude and stability of circadian rhythm and sleep quality among the participants are shown in Table 2. Considering the amplitude of circadian rhythm, 35.3% of the staff was > 75<sup>th</sup> percentile (languid), while 64.8% were < 75<sup>th</sup> percentile (vigorous). In addition, 7% of the participants were > 75<sup>th</sup> percentile (flexible)

**Table 2**  
Amplitude and stability of circadian rhythm and sleep quality in the study participants ( $N = 400$ )

Variables studied	Status	Frequency	%
Amplitude of circadian rhythm (LV)	Languid	141	35.3
	Vigorous	259	64.8
Stability of circadian rhythm (FR)	Flexible	28	7
	Rigid	372	93
Sleep quality	Good	173	43.3
	Poor	227	56.8

F, flexible, L, languid; R, rigid; V, vigorous.

and 93% were < 75<sup>th</sup> percentile (rigid). As Table 2 depicts, 43.3% and 56.8% of the study participants had good and poor sleep quality, respectively.

The mean score of KSS was found to be  $5.65 \pm 2.19$ , indicating a moderate rate of sleepiness among the study participants.

The results of Osipow occupational stress questionnaire revealed that 1.5%, 32.5%, 36.3%, and 29.8% of the participants had low, low to moderate, moderate to severe, and severe occupational stress, respectively. Besides, the mean of total stress ( $172.45 \pm 34.37$ ) was within the moderate to severe range. This was also the case regarding the dimensions scores. It was found that the mean scores of role overload, role insufficiency, role ambiguity, role boundary, responsibility, and physical environment dimensions were  $33.39 \pm 7.56$ ,  $33.70 \pm 8.15$ ,  $37.91 \pm 7.33$ ,  $35.66 \pm 7.71$ ,  $31.80 \pm 8.07$ , and  $31.41 \pm 7.25$ , respectively.

Table 3 presents significant factors associated with sickness absence in the study population. The factors were identified by a multiple logistic regression analysis performed to adjust for potential confounding variables. Amplitude of circadian rhythm, sleep quality, sleepiness, role overload, role boundary, and responsibility were the main variables retained in the regression model with odds ratios (OR) generally > 2. The multiple logistic regression revealed a significant relationship between the short- and long-term absenteeism and amplitude of circadian rhythm [OR = 6.13, confidence interval (CI) = 1.44–26.17; OR = 2.42, CI = 1.18–29.22]. Short- and long-term absenteeism were also associated with Sleep quality (OR = 14.46, CI = 3.15–66.32; OR = 21.56, CI = 4.41–105.38) and sleepiness (OR = 2.08, CI = 1.27–2.43; OR = 6.44, CI = 3.43–12.4). These relationships were confirmed by regression analysis after adjusting for confounding variables (Table 3). Among the subscales

**Table 3**  
Multiple logistic regression model indicating factors with influence on sickness absence ( $N = 400$ )

Variables <sup>†</sup>	Sickness absence (d/y)*					
	1–4 d ( $n = 129$ )			$\geq 5$ d ( $n = 68$ )		
	OR	95%CI	<i>p</i>	OR	95%CI	<i>p</i>
Amplitude of circadian rhythm (LV)	6.13	1.44–26.17	0.01	2.42	1.18–29.22	0.03
Sleep quality	14.46	3.15–66.32	0.0006	21.56	4.41–105.38	0.0001
Sleepiness	2.08	1.27–3.43	0.004	6.44	3.43–12.4	0.0001
Role overload <sup>‡</sup>	–	–	–	4.84	1.3–17.97	0.02
Role boundary	6.45	2.09–19.94	0.0012	4.27	1.15–15.91	0.03
Responsibility	5.23	1.65–16.55	0.005	3.72	1.02–13.52	0.046

\* No sickness absence (0 d/y) category is considered as the reference group ( $n = 209$ ).

<sup>†</sup> Variables adjusted in the multiple logistic regression analyses were age, sex, number of children, type of employment, job tenure, daily working time, overtime work, stability of circadian rhythm, amplitude of circadian rhythm, sleep quality, Sleepiness, role overload, role boundary, role insufficiency, role ambiguity, responsibility, physical environment, and total stress.

<sup>‡</sup> Including both mental and physical workload.

CI, confidence interval; L, languid; OR, odds ratio; V, vigorous.

of occupational stress, long-term absenteeism was related to role overload (OR = 4.84, CI = 1.3–17.97), although both short- and long-term absenteeism were significantly associated with role boundary (OR = 6.45, CI = 2.09–19.94; OR = 4.27, CI = 1.15–15.91) and responsibility (OR = 5.23, CI = 1.65–16.55; OR = 3.72, CI = 1.02–13.52).

#### 4. Discussion

According to the study results, the prevalence of sickness absence was high among the gas company employees ( $2.16 \pm 4.56$ ). This finding was in line with those of Nakata et al [46] study conducted on 522 shift workers in which the mean of absences from work was 2.3 days per year in Japan. Besides, 235 study participants had no absences, 199 participants had one to four absences (short-term absenteeism), and 88 participants had five or more absences (long-term absenteeism) [46]. This finding of the present study contradicted the results of some of the past studies. For instance, Mohebbi and Sharifian [47] performed a study on 2,600 employees in an Iranian industrial setting and found out that the number of absences from work was small (0.35). This was attributed to the staff's income level. Kasiri Dolat Abadi et al [24] also carried out a research on 51 female and 31 male administrative staff and reported that 71.2% of the personnel had no absence within the past 6 months, 87.5% of them had no absence or were absent < 1 week, and the largest number of absences was 2 days. This could be due to the fact that Kasiri Dolat Abadi et al's [24] study was performed for 6 months and most of the study participants had > 10 years of job tenure. Therefore, they could predict the stressors and use appropriate problem-solving strategies to cope with them.

One of the main objectives of the current study was to examine the association between sickness absences and type of circadian rhythm. In this regard, the results revealed a significant association between the sickness absence and amplitude of circadian rhythm. In other words, the risk of short-term absenteeism (1–4 days) was higher in the languid individuals compared with the vigorous ones (OR = 6.13, CI = 1.44–26.17). The risk of long-term absenteeism ( $\geq 5$  days) was also higher among the languid participants in comparison to the vigorous ones (OR = 2.42, CI = 1.18–29.22) which was in agreement with the results of previous studies [15].

The findings of the present study indicated that short- and long-term absenteeism was significantly associated with sleep quality and sleepiness. Accordingly, the OR of short-term absenteeism (1–4 days) was 14.46 times higher in individuals with poor sleep quality as compared with those with good sleep quality (OR = 14.46, CI = 3.15–66.32). The OR of long-term absenteeism ( $\geq 5$  days) was also 21.56-fold higher among the participants with poor sleep quality as compared with those with good sleep quality (OR = 21.56, CI = 4.41–105.38). Moreover, with one unit increase in KSS (sleepiness), the odds ratio of short- and long-term absenteeism increased by 100% in comparison to individuals with no absences (OR = 2.08, CI = 1.27–2.43; OR = 6.44, CI = 3.43–12.4). In other words, with an increase in the rate of sleepiness, the risk of sickness absence increased two-fold. These results were similar to the findings of some other previous studies. For instance, Nakata et al [46] reported that short- and long-term absenteeism were higher in the workers with poor sleep features (waking up early in the morning, lack of night sleep, and sleep insufficiency). Additionally, Godet-Cayre et al [48] disclosed that the rate of sickness absence was higher in the individuals suffering from insomnia as compared with those with sufficient sleep. Bültmann et al [14], too, mentioned sleep disturbances as a predictor of sickness absence. Minowa and Tango [49] also found that sickness absence was 1.89-fold higher in the workers with poor sleep quality and symptoms of insomnia as compared with the others. In the same

line, Westerlund et al [50] demonstrated a strong relationship between sleep disturbances and sickness absence. Philip et al [51] also conducted a study on 2,265 employees of a gas company and a power plant and observed a strong association between sleepiness during the day and sickness absence. The study results also indicated that the staff who experienced sleepiness during the day lost more days due to absenteeism as compared with the others. Similarly, Åkerstedt et al [13] stated that the individuals with disturbed sleep and fatigue had longer absences from work and, therefore, recognized these two factors as the predictors of sickness absence. Our study also showed that poor sleep quality and sleepiness had an influence on sickness absence and that the employees with poorer sleep quality and higher sleepiness experienced more absences. Considering that sleep quality was the main factor affecting employee absenteeism (OR = 14.46), in order to reduce fatigue and sleepiness in employees, implementing training programs on sleep health for improving quality and quantity of sleep could be recommended and emphasized.

Epidemiological researches have referred to occupational stress as an effective psychosocial factors in sickness absence [3,52]. In the present study, short- and long-term absenteeism, were significantly related to high levels of occupational stress dimensions, including role overload, role boundary, and responsibility. According to the results, the rate of long-term absenteeism ( $\geq 5$  days) was 4.84-fold higher among individuals with higher role overload as compared with those with lower role overload (OR = 4.84, CI = 1.3–17.97). Also, the OR of short-term (1–4 days) and long-term absenteeism ( $\geq 5$  days) were, respectively, 6.45-fold and 4.27-fold higher in the staff with a higher role boundary as compared with those with a lower role boundary (OR = 6.45, CI = 2.09–19.94; OR = 4.27, CI = 1.15–15.91). In addition, short- and long-term absenteeism were respectively 5.23- and 3.72-fold higher among more responsible staff in comparison with the less responsible ones (OR = 5.23, CI = 1.65–16.55; OR = 3.72, CI = 1.02–13.52). Trybou et al [53] performed a study on 527 nurses and demonstrated that occupational stress increased long-term absenteeism. In other words, individuals with higher levels of occupational stress experienced long-term absences 2.26-fold more than the others. Wang et al [22] also reported in their research that occupational stress increased the incidence of long-term absenteeism. Our study, too, indicated that the number of absences from work was higher in individuals with higher occupational stress. However, some studies have come to contradictory results. For instance, Kasiri Dolat Abadi et al [24] found no significant relationship between the score of stress and sickness absence.

- According to the identified contributing factors of sickness absence in our study population (i.e., occupational stress, sleep quality, and amplitude of circadian rhythm) any interventional corrective measures to improve working conditions and reduce sickness absence should focus on these factors. Based on this, the following actions are recommended: (1) enhancing employees' decision latitude in the workplace; (2) providing proper communication mechanism in the organization; (3) determining job duties, responsibilities and authority clearly; (4) implementing stress management programs in the workplace [54]; (5) using bright light at night shift to affect circadian rhythms positively and increase workers consciousness [55]; (6) transferring employees who are not able to cope with shift work schedule to day work system; and (7) implementing training program on sleep health for improving quality and quantity of sleep in order to reduce fatigue and sleepiness in employees.

Due to the cross-sectional nature of the present study and self-report methodology for data gathering, the results are to be

cautiously interpreted. The methodology of self-report may have recall bias or denial problem. Furthermore, selection bias should also be taken into consideration, as this study was conducted only among workers who volunteered to participate in the survey. Additionally, because the analysis was limited to currently working employees, workers who had left their jobs due to inappropriate working conditions could have been excluded from the study and healthy worker effect might occur. Thus, the data may underestimate reported problems and the association of these factors with sickness absence. The sample size was the other limitation of the study. Further investigation with a larger sample size and considering the above mentioned limitations may produce more reliable results on this area. Finally, because the study was limited to a large gas company, the results of the present study may be extrapolated for industries with similar operations around the globe, but cannot be applied to individuals from those industries which are different in operations and settings.

## 5. Conclusion

Large number of workdays lost due to absenteeism is prevalent in the studied gas company. In the present study, amplitude of circadian rhythm, sleep quality, and occupational stress were found to be the contributing factors for sickness absence. According to the results, the employees with poor sleep quality, languid circadian rhythm, and occupational stress experienced more short- and long-term absences. Therefore, any interventional program for preventing or reducing sickness absence and its negative consequences should focus on these factors.

## Conflicts of interest

All contributing authors declare no conflicts of interest.

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## References

- [1] Andersen LL, Clausen T, Mortensen OS, Burr H, Holtermann A. A prospective cohort study on musculoskeletal risk factors for long-term sickness absence among healthcare workers in eldercare. *Int Arch Occup Environ Health* 2012;85:615–22.
- [2] Head J, Kivimäki M, Siegrist J, Ferrie JE, Vahtera J, Shipley MJ, Marmot MG. Effort-reward imbalance and relational injustice at work predict sickness absence: The Whitehall II study. *J Psychosom Res* 2007;63:433–40.
- [3] Lesuffleur T, Chastang JF, Sandret N, Niedhammer I. Psychosocial factors at work and sickness absence: Results from the French National Survey. *Am J Ind Med* 2014;57:695–708.
- [4] Henderson M, Glozier N, Elliott KH. Long term sickness absence: is caused by common conditions and needs managing. *Br Med J* 2005;330:802.
- [5] Laaksonen M, Pitkaniemi J, Rahkonen O, Lahelma E. Work arrangements, physical working conditions, and psychosocial working conditions as risk factors for sickness absence: Bayesian analysis of prospective data. *Ann Epidemiol* 2010;20:332–8.
- [6] Rahkonen O, Lallukka T, Kronholm E, Vahtera J, Lahelma E, Laaksonen M. Sleep problems and sickness absence among middle-aged employees. *Scand J Work Environ Health* 2012;38:47–55.
- [7] Haukka E, Kaila-Kangas L, Luukkonen R, Takala E-P, Viikari-Juntura E, Leino-Arjas P. Predictors of sickness absence related to musculoskeletal pain: a two-year follow-up study of workers in municipal kitchens. *Scand J Work Environ Health* 2014;40:278–86.
- [8] Odeen M, Magnussen L, Maeland S, Larun L, Eriksen H, Tveito T. Systematic review of active workplace interventions to reduce sickness absence. *Occup Med* 2013;63:7–16.

- [9] Tsai SP, Wendt JK, Ahmed FS, Donnelly RP, Strawmyer TR. Illness absence patterns among employees in a petrochemical facility: Impact of selected health risk factors. *J Occup Environ Med* 2005;47:838–46.
- [10] Tüchsen F, Christensen KB, Lund T. Shift work and sickness absence. *Occup Med* 2008;58:302–4.
- [11] Clausen T, Nielsen K, Carneiro IG, Borg V. Job demands, job resources and long-term sickness absence in the Danish eldercare services: a prospective analysis of register-based outcomes. *J Adv Nurs* 2012;68:127–36.
- [12] Oenning NSX, Carvalho FM, Lima VMC. Risk factors for absenteeism due to sick leave in the petroleum industry. *Rev Saude Publ* 2014;48:103–22.
- [13] Åkerstedt T, Kecklund G, Alfredsson L, Selén J. Predicting long-term sickness absence from sleep and fatigue. *J Sleep Res* 2007;16:341–5.
- [14] Bültmann U, Nielsen MBD, Madsen IE, Burr H, Rugulies R. Sleep disturbances and fatigue: independent predictors of sickness absence? A prospective study among 6,538 employees. *Eur J Public Health* 2013;23:123–8.
- [15] Manjunatha R, Kiran D, Thankappan K. Sickness absenteeism, morbidity, and workplace injuries among iron and steel workers—A cross sectional study from Karnataka, Southern India. *Australas Med J* 2011;4:144.
- [16] Jafari-Roodbandi A, Hasheminejad N, Sadeghi M, Baneshi MR, Haji Maghsoudi S, Rastegari A. Internal consistency and confirmatory factor analysis of Persian version circadian type inventory in Iranian day worker and shift worker, 2011–2012. *Iran Occup Health* 2013;10:45–51 [in Persian].
- [17] Kant I, Jansen NW, van Amelsvoort LG, Swaen GM, van Leusden R, Berkouwer A. Screening questionnaire Balansmeter proved successful in predicting future long-term sickness absence in office workers. *J Clin Epidemiol* 2009;62:408–14.
- [18] Holmgren K, Fjällström-Lundgren M, Hensing G. Early identification of work-related stress predicted sickness absence in employed women with musculoskeletal or mental disorders: a prospective, longitudinal study in a primary healthcare setting. *Disabil Rehabil* 2013;35:418–26.
- [19] Holtermann A, Hansen JV, Burr H, Søgaard K. Prognostic factors for long-term sickness absence among employees with neck-shoulder and low-back pain. *Scand J Work Environ Health* 2010;1:34–41.
- [20] Olde HT, Hassink-Franke L. Proactive monitoring of sickness absence for psychosocial problems. *Ned Tijdschr Geneesk* 2014;158:A7387.
- [21] Ferguson JM. Understanding the sources of occupational stress and burnout among assembly of god clergy and the resulting implications. Minnesota (United States): ProQuest; 2008. p. 1–52.
- [22] Wang MJ, Mykletun A, Møyner EI, Øverland S, Henderson M, Stansfeld S, Harvey SB. Job strain, health and sickness absence: results from the Hordaland health study. *PLoS One* 2014;9:e96025. 1–9.
- [23] Tangri RP. What stress costs. Special report. Halifax, Nova Scotia (Canada): Chrysalis Performance Strategies Inc; 2003.
- [24] Kasiri Dolat Abadi N, Hosseini Kokamari P, Sharifirad G, Hassanzadeh A, Shahnazi H. Relationship between occupational stress level and the absence of administrative personnel in Isfahan Health Center. *J Health Sys Res* 2011;7:1243–9 [in Persian].
- [25] Salo P, Oksanen T, Sivertsen B, Hall M, Pentti J, Virtanen M, Miika K. Sleep disturbances as a predictor of cause-specific work disability and delayed return to work. *Sleep* 2010;33:1323–31.
- [26] Sivertsen B, Björnsdóttir E, Overland S, Bjorvatn B, Salo P. The joint contribution of insomnia and obstructive sleep apnoea on sickness absence. *J Sleep Res* 2013;22:223–30.
- [27] Åkerstedt T, Kecklund G, Selén J. Disturbed sleep and fatigue as predictors of return from long-term sickness absence. *Ind Health* 2010;48:209–14.
- [28] Vahtera J, Pentti J, Helenius H, Kivimäki M. Sleep disturbances as a predictor of long-term increase in sickness absence among employees after family death or illness. *Sleep* 2006;29:673–82.
- [29] Murata C, Yatsuya H, Tamakoshi K, Otsuka R, Wada K, Toyoshima H. Psychological factors and insomnia among male civil servants in Japan. *Sleep Med* 2007;8:209–14.
- [30] Daley M, Morin CM, LeBlanc M, Gregoire J, Savard J, Baillargeon L. Insomnia and its relationship to healthcare utilization, work absenteeism, productivity, and accidents. *Sleep Med* 2009;10:427–38.
- [31] Daley M, Morin CM, LeBlanc M, Grégoire J-P, Savard J. The economic burden of insomnia: direct and indirect costs for individuals with insomnia syndrome, insomnia symptoms, and good sleepers. *Sleep* 2009;32:55–64.
- [32] Sivertsen B, Øverland S, Bjorvatn B, Mæland JG, Mykletun A. Does insomnia predict sick leave?: The Hordaland Health Study. *J Psychosom Res* 2009;66:67–74.
- [33] Roberts RD, Kyllonen PC. Morningness–eveningness and intelligence: early to bed, early to rise will likely make you anything but wise! *Pers Indiv Differ* 1999;27:1123–33.
- [34] Golden SS, Canales SR. Cyanobacterial circadian clocks—timing is everything. *Nat Rev Microbiol* 2003;1:191–9.
- [35] Hastings M, O'Neill JS, Maywood ES. Circadian clocks: regulators of endocrine and metabolic rhythms. *J Endocrinol* 2007;195:187–98.
- [36] Waage S, Moen BE, Pallesen S, Eriksen HR, Ursin H. Shift work disorder among oil rig workers in the North Sea. *Sleep* 2009;32:558–65.
- [37] Folkard S, Monk TH, Lobuan MC. Towards a predictive test of adjustment to shift work. *Ergonomics* 1979;22:79–91.
- [38] Di Milia L, Smith PA, Folkard S. Refining the psychometric properties of the circadian type inventory. *Pers Indiv Differ* 2004;36:1953–64.
- [39] Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28:193–213.
- [40] Farrahi J, Nakhaee N, Sheibani V, Garrusi B, Amirkafi A. Psychometric properties of the Persian version of the Pittsburgh Sleep Quality Index addendum for PTSD (PSQI-A). *Sleep Breath* 2009;13:259–62.
- [41] Åkerstedt T, Gillberg M. Subjective and objective sleepiness in the active individual. *Int J Neurosci* 1990;52:29–37.
- [42] Kaida K, Takahashi M, Åkerstedt T, Nakata A, Otsuka Y, Haratani T, Fukasawa K. Validation of the Karolinska sleepiness scale against performance and EEG variables. *Clin Neurophysiol* 2006;117:1574–81.
- [43] Osipow SH, Spokane AR. Occupational Stress Inventory, revised edition (OSI-R). Odessa, FL: Psychol Assess Resources; 1998. p. 1–15.
- [44] Sharifian S, Aminian O, Kiyani M, Barouni S, Amiri F. The evaluation of the degree of occupational stress and factors influencing it in forensic physicians working in legal medicine organization in Tehran-autumn of 2005. *Sci J Forensic Med* 2006;43:144–57 [in Persian].
- [45] Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic research: principles and quantitative methods. 1st ed. New York: Van Nostrand Reinhold; 1982. 529 p.
- [46] Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Kobayashi F, Araki S. Association of sickness absence with poor sleep and depressive symptoms in shift workers. *Chronobiol Int* 2004;21:899–912.
- [47] Mohebbie I, Sharifian A. Prevalence and risk factors of absenteeism due to illness among employees of an industrial plant. *Urmia Med J* 2005;16:229–34 [in Persian].
- [48] Godet-Cayre V, Pelletier-Fleury N, Le Vaillant M, Dinot J, Massuel M, Leger D. Insomnia and absenteeism at work. Who pays the cost? *Sleep* 2006;29:179–84.
- [49] Minowa M, Tango T. Impact and correlates of poor sleep quality in Japanese white-collar employees. *Sleep* 2003;26:467–71.
- [50] Westerlund H, Alexanderson K, Åkerstedt T, Hanson LM, Theorell T, Kivimäki M. Work-related sleep disturbances and sickness absence in the Swedish working population, 1993–1999. *Sleep* 2008;31:1169–77.
- [51] Philip P, Taillard J, Niedhammer I, Guilleminault C, Bioulac B. Is there a link between subjective daytime somnolence and sickness absenteeism? A study in a working population. *J Sleep Res* 2001;10:1111–5.
- [52] Niedhammer I, Chastang J-F, Sultan-Taieb H, Vermeylen G, Parent-Thirion A. Psychosocial work factors and sickness absence in 31 countries in Europe. *Eur J Public Health* 2013;23:622–9.
- [53] Trybou J, Germonpre S, Janssens H, Casini A, Braeckman L, Bacquer DD, Clays E. Job-related stress and sickness absence among Belgian nurses: a prospective study. *J Nurs Scholarsh* 2014;46:292–301.
- [54] Khaneshenas F, Allahyari T, Khalkhali H. Investigation of the relationship between psychosocial stressors and job performance among bank employees. *J Ergon* 2014;1:1–10 [in Persian].
- [55] Badia P, Myers B, Boecker M, Culpepper J, Harsh JR. Bright light effects on body temperature, alertness, EEG, and behavior. *Physiol Behav* 1991;50:583–8.