Work Stress, Sleepiness and Predicting Work Situation Awareness among Workers

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Article info:
Received: 20 Aug. 2014
Accepted: 03 Feb. 2015

Keywords:
Work stress, Sleepiness, Work situation awareness, Workers

ABSTRACT

Objective: An important factor in the prevention of industrial accidents is the employees' ability to maintain their awareness of the work situation, understand the information it holds, and predict the development of the situations. In this study, we examined the role of work stress and sleepiness in predicting work situation awareness among workers.

Methods: The present study was a cross-sectional study, conducted in 2014. The sample consisted of 180 employees in the National Petrochemical Company. They were selected according to the stratified random sampling method and responded to questionnaires about demographic characteristics, work situation awareness of Sneddon, Mearns, and Flin (2013), work stress of Cohen et al. (1983), and Epworth sleepiness scale. The data were analyzed by correlation coefficient and stepwise regression by using the SPSS 15.

Results: The results showed that there were internal correlation among work stress, sleepiness, and work situation awareness. Also, the results of stepwise regression analysis revealed that work stress and sleepiness significantly predicted, respectively, almost 23% and 26% of variances of work situation awareness among workers.

Conclusion: According to the findings of the present study, work stress and sleepiness can predict work situation awareness. Therefore, considering these variables can be important in promoting the awareness of work situation among workers.

1. Introduction

After a number of catastrophic events (most notably the Piper Alpha disaster in 1988 in which 167 workers died (Adie et al., 2005)), oil and gas companies are making every effort to ensure that their occupational accident rates are kept as low as possible (Sneddon, Mearns, & Flin, 2006). One critical element in predicting occupational accidents is the ability of employees to maintain an adequate understanding of their work situation, i.e. having a high awareness of job duties, workplace conditions, and how they change in the near future to predict the development of later situations (Sneddon, Mearns, & Flin, 2006). In industrial companies, the necessary attentional skills are referred to as 'situation awareness' (SA). SA is defined as the perception of the elements in the environment within a volume of space and time, comprehension of their meaning, and the projection of their status in the near future (Wright & Fallacaro, 2011). According to this definition, SA is the first step in decision-making because it provides an understanding of what is happening or likely to occur next. It has been described as an inherent model for safe decision-making. Cognitive skills such as work situation awareness are known to be susceptible to the elements of work-related conditions such as work stress and sleepiness (Sneddon, Mearns, & Flin, 2013).

So, it is important to identify factors reducing work situation awareness. High stress can result in reducing work-

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ing memory capacity and attention (Alhasan et al., 2014). Work-related stress is a significant occupational health concern (Cheng, 2015). High levels of stress can result in an overload on the person's cognitive resources, and consequently poor concentration/alertness. This state can interfere with the primary perception of the situation, ignoring the available information and data in the surrounding environment. Consequently, there may be a narrowing of the individual's attentional field to incorporate only a number of key aspects in her/his surrounding environment, resulting in little or no attention to peripheral information (Sneddon, Mearns, & Flin, 2006).

While this 'cognitive tunnel vision' may be an important adaptive (by preventing work overload) strategy in a dangerous environment, elements outside the main focus of attention may be those, which are most harmful. Relatively high levels of work stress has been reported in studies done in the oil and gas industry and relationships between stress and accident rates have also been established (Martín-Fernández et al., 2009). Sleepiness and fatigue cause damage to alertness levels and consequently increases the risk involved in the job injuries (Chiu et al., 2014), as the cognitive resources required are depleted due to physical actions or sleep deprivation. Fatigue due to sleepiness reduces the speed of cognitive processing, and therefore increases reaction times, tunnel vision, inattentiveness, and lower vigilance and concentration.

An increasing amount of evidence indicates that daytime sleepiness is a crucial factor for the occurrence of accidents (Perez-Chada et al., 2005). Sleepiness is highly prevalent (20%–30%) in contemporary society (Kao et al., 2008) and affects individuals' health and daily lives. These effects have been also reported in the maritime industry (Wadsworth et al., 2008), transportation (Fletcher & Dawson, 2001), and have also been reported in the oil and gas industry (Sneddon, Mearns & Flin, 2006). Regarding the above-mentioned issues, the aim of current research was to investigate the relationship between work stress, sleepiness with work situation awareness. So far, little research (particularly in Iran) about the work situation awareness has been carried out and the present research is new in this respect.

2. Methods

This cross-sectional correlation study was administrated between October 2014 and November 2014 at one petrochemical industrial area in Asalooyeh zone. In this study, with respect to the extent and distribution of the employees in the different parts of this company, stratified random sampling was used to select sample members. In stratified random sampling, the strata are formed based on the members' shared attributes or characteristics. The sample size was calculated using SPSS (version 15), following the procedure recommended by Molavi (2007).

Given the α level of 0.05 and a power of 90%, the required sample size was estimated to have 180 subjects. Regarding the likelihood of failure to complete or return questionnaires, almost 190 employees were selected using stratified random sampling and questionnaires were distributed among them. Informed consent was obtained from each participant and the research was approved by the appropriately constituted Ethics Committees where the study was carried out. The entry criterion of the employee was having at least one year work experience. The exclusion criteria were the delivery of incomplete questionnaire, lack of interest in participating the research, having current and/or history of mental disorder or accidents affecting the musculoskeletal system. Four members of the sample because of the lack of interest in research topic, and 6 members due to incomplete questionnaires (in total 10 people) were excluded from the main sample. A total of 180 participants completed questionnaires, which were collected. Participants were assured that their information will remain confidential. They could exit from our study whenever they wanted. Validated instruments were used for data collection on work situation awareness, work stress, and sleepiness.

At first, all questionnaires were translated from English into Persian and independently back-translated into English by a second translator. The few discrepancies between the original English and the back-translated version were adjusted based on direct discussion between the translators. Afterwards, psychometric characteristics of instruments were examined. Linguistic validation was performed by 3 experts of psychology and 5 experts of safety and health departments. Eventually, the questionnaires were piloted and finalized with an advisory group of workers to ensure that the scales items were comprehensible and appropriate to the context.

Moreover, the conceptual analysis was confirmed the content validity of all instrument. The questionnaires were distributed among workers with the help of union steward. The following questionnaires were used: Work situation awareness (SA). SA was measured with 20 items designed by Sneddon, Mearns, and Flin (2013). Respondents indicated the extent of agreement with each statement on a 5-point Likert-type scale (0=very often; 5=never). The questions of this scale consist of 5 positive questions such as "I think ahead of my work to plan for different possible outcomes" and 15 negative questions such as "I am easily distracted by my thoughts or feelings". In their study, they

calculated that this scale has acceptable internal reliability (Cronbach α=0.86) and good validity (Sneddon et al., 2013). Reliability of this scale, as administered to Iranian relevant populations, in this research, was evidenced by α Coefficient of 0.79 and split-half of 0.75. The validity coefficients of questions were between 0.25 and 0.79 and all the validity coefficients were significant at P<0.01

Work stress scale: Work stress was measured by Perceived Stress Scale (PSS) of Cohen, Karmark, and Mermelstein (1983), which was translated and validated in Persian. PSS is the most widely used psychological instrument for measuring the perceived stress. An item in case is "In the last month, in work environment, how often have you got angry because of the things that were outside of your control?" PSS was designed for using in community samples with at least a junior high school education. The items were grasped easily, and the response alternatives were understood simply. Furthermore, the queries are of a public nature and thus are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last month. In each case, respondents are asked about how often they felt in a certain way. Scoring is based on a Likert-scale format from never (0) to very often (4). This scale has validity (reliability=0.84, 0.85, 0.86 in three cases), high internal reliability (Cronbach α=0.79) and acceptable validity (Smith & Emerson, 2014). Also Orucu and Demir (2009) in their study, mentioned the Cronbach α of 0.84 and its correlation with the "Public Health" questionnaire as 0.61. Exploratory and confirmatory factor analysis of the PSS showed that the scale consisted of two dimensions: perceived job helplessness factor and perceived job self-efficacy. In Iran, the internal consistencies (Cronbach α) of this study, for the occupational stress, perceived job self-efficacy, and perceived job helplessness were reported as 0.83, 0.75, and 0.87, respectively, which were excellent for these scales (Kiani, & Khodabakhsh, 2014).

Epworth Sleepiness Scale (ESS). This sleep assessment was based on a sleep scale, of 8 items (Canani et al., 2005). This eight-item questionnaire has been designed to determine participant's likelihood to doze off or fall asleep in different situations. A sample item is "How likely are you to doze off or fall asleep in situations, like sitting and talking to someone, in contrast to feeling just tired?" All items are rated on a scale of 0-3; a score above 10 is considered positive for Excessive Daytime Sleepiness (EDS) (Melamed & Oksenberg, 2002). This scale is one of the most widely-used subjective methods to measure EDS. It is a question-

Table 1. Demographic characteristics of the sample members (n=180).

Variable		Frequency	Frequency Percentage (%)
Age	18 to 29 years	49	27.5%
	30 to 41 years	122	67.5%
	42 to 53 years	9	5%
Sex	Male	180	100%
	Female	-	-
Marital status	Married	162	90%
	Single	18	10%
Education	MSc (MA) degree or higher	58	32.5%
	BSc (BA) degree	49	27.5%
	High school graduates	73	40%
	Primary school graduates and lower	-	-
Work experience	5 years and lower	63	35%
	6 to 15 years	43	24%
	16 to 25 years	43	24%
	26 years and higher	31	17%
Shift status	Shift	130	72.5%
	Not shift	50	27.5%

Table 2. Mean, Standard Error and internal correlations of variables.

	Variable	Mean	SD	Correlations		
				1	2	3
1	Work stress	35.13	6.12	1		
2	Sleepiness	37.97	7.21	0.29**	1	
3	Work situation awareness	64.65	8.14	-0.53**	-0.55**	1

** P<0.01

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naire-based scale, its application is brief and simple, with minimal cost involved. In addition, this scale has a suitable level of internal consistency for application in study. The cutoff score of higher than 10 has 93.5% sensitivity and 100% specificity to distinguish EDS from normal daytime sleepiness (Canani et al., 2005). Evidence of reliability of this inventory in this research, as administered to Iranian relevant populations, was calculated by α Coefficient of 0.77 and split-half of 0.73. The validity coefficients of questions are between 0.23 and 0.88 and all validity coefficients are significant at P<0.01.

The Statistical Package for the Social Sciences (SPSS) version 15 was used to analyze the data. Descriptive statistics was used to summarize and organize the data, and then stepwise regression analysis was performed.

3. Results

Demographic characteristics of participants of this study are presented in Table 1.Mean, standard deviation, and internal correlations of variables under study are presented in Table 2. As it can be seen, there were significant relationships among work stress, sleepiness, and work situation awareness (P<0.01).

To assess the predictive power of work situation awareness, work stress and sleepiness variables were used in the stepwise regression analysis. The results of the model summary are presented in Table 3.

The results of regression model for explaining work situation awareness based on work stress and sleepiness indicated that F-statistic for both models was significant as P<0.01. Therefore, explanation of work situation awareness was possible based on both variables. In Table 4, the regression coefficients of stepwise regression analysis are presented.

As it can be seen, sleepiness variable with β=-0.45 can significantly predict almost 26% of the variance of work situation awareness. Also, work stress variable with β=-0.41 can significantly predict almost 23% of the variance of work situation awareness.

4. Discussion

The result of the present research showed that work stress could significantly predict work situation awareness among workers. This result is consistent with the findings of the previous studies (Sneddon, Mearns, & Flin, 2006) and can be interpreted on the basis of the following possibilities:

Individuals reporting higher levels of stress were found to have poorer work situation awareness (Wickens, 2002). The literature shows that stress pushes people to narrow their field of attention and can impair cognitive functions by undermining working memory. High levels of stress can result in poor concentration/alertness as a result of an overload on the person's cognitive resources. Stressors can be physical such as vibration, crowding, noise, pollution, temperature, and high/low light levels which feature predominantly and are nearly unavoidable in the harsh oil and gas industrial environment (Ma et al., 2014). There can also be psychological stressors such as anxiety, or social stressors (e.g. a drilling rig is a small, isolated work environment). In relation to situation awareness, the recent research reports that high stress can interfere with the primary perception of the work situation. The most common effect is narrowing of the attentional field to a restricted number of main elements, whereas data on the periphery is less likely to be encoded. The high levels of stress from several directions was also thought to affect situation awareness as heavy work-

Table 3. Summary of regression analysis model.

Model	R	R^2	Adjusted R^2	Std. Error the estimate	Sig.
1	0.68	0.468	0.46	7.19	0.002

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Table 4. Summary of stepwise regression analysis to predict work situation awareness based on work stress and sleepiness.

Variable	β	B	SE B	t	R^2	Sig.
Sleepiness	-0.45	-0.55	0.15	-3.62	0.26	0.000
Work stress	-0.41	-0.26	0.07	-3.35	0.23	0.002

load increases (it was felt that it was more difficult to focus on a task if there was a lot of work ongoing, as attention had to be divided among several tasks, and also there was danger of attention narrowing to concentrate on one task, sight of the 'big picture' could be lost, which reduce working memory capacity and diminish attention); supervisor pressure (to get a job done quickly), and also self-imposed pressure to complete a work by a certain time (Sneddon, Mearns, & Flin, 2006).

Also, the results showed that sleepiness variable significantly predict work situation awareness among workers. This is consistent with the findings of the previous studies (Jay et al., 2015) and can be interpreted on the basis of the following possibilities:

Individuals who scored higher on day-time sleepiness and fatigue also experienced more cognitive failures. Fatigue due to sleep disruption in petroleum and chemical industries is part of the working and these results show that this is detrimental to employees by decreasing their work situation awareness levels (Sneddon, Mearns, & Flin, 2013). Mental and physical fatigue impair cognitive control and decrease situation awareness. The previous researches about the simple tests of attention and concentration indicated that some impairment in situation awareness was influenced by fatigue. Decreased attention and increased cognitive errors are obvious results of physical and mental fatigue among employees. So, tired workers lose their vigilance and alertness, and therefore cannot pay attention to the workplace conditions. Unfortunately, there are many conditions and factors in working environment that cause fatigue in individuals. One of these factors is the change in shift workers. Many employees work in a shift pattern (known as 'short change') which involves changing half-way through day-shift to night-shift or vice versa), that result to disrupting sleep patterns and increasing fatigue (Ho et al., 2013).

The previous research (Wallace, Vodanovich, & Restino, 2003) found that the daytime sleepiness related significantly with their 'distractions' factor. Sleep deprivation results in degraded perception and vigilance, as well as increased distractibility and confusion. Each of these factors affects an individual's ability to work safely and may play a central role in accidents and injuries. A recent research (Connor, et al., 2002) showed that there were relationships between sleepiness and risk of injury resulting from an accident. Individuals with less than 5 hours of sleep in the last 24 hours prior to the crash had a significantly higher risk of a crash resulting in accident than individuals who had more than 5 hours of sleep.

The findings of this research emphasize the importance of work stress and sleepiness variables in predicting work situation awareness among workers. Safety intervention needs to focus on these variables, as well as on the prevention methods coping against them, and these concepts directly or indirectly influence the increase of work situation awareness. It is recommended that the future research examine the effects of safety interventions on increasing situation awareness. Furthermore, with designing these interventions and more attention to them, we can affect one of the most important influential variables in incidence of occupational accidents. The present study needs to be replicated in different populations with more empirical support. Until then, the findings of the study should be interpreted with caution.

Furthermore, the cross-sectional design of the study and its participants (i.e. a group of employee) exert some limitations on the generalization of the findings. Finally, the problems and limitations on the use of self-repotting instruments should not be overlooked.

Acknowledgments

The authors would like to acknowledge the generosity of the workers who agreed to participate in this research.

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