ORIGINAL ARTICLE

Evaluation of Relationship between Job Stress and Unsafe Acts with Occupational Accident Rates in a Vehicle Manufacturing in Iran

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ABSTRACT

Nowadays, occupational accidents are one of the most important problems in developing countries. Job stress and unsafe acts have been also recognized as effective factors in increasing the risk of occupational accidents. The main goal of this research was to evaluate the relationship between job stress and unsafe acts with occupational accidents. This study was performed on 195 employees in Pars Khodro industry in 2007. Safety behavior sampling technique and standardized job stress questionnaire were used in current research. The information was then analyzed using SPSS and statistic tests. According to findings of job stress questionnaire 88 percent of workers were at level of high stress. Accidents at work were associated with job stress and unsafe acts. There was also a significant relationship between job stress and unsafe acts ($p < 0.05$). The regression logistic test showed that 1% increase in the rate of unsafe practice had a higher impact on the number of accidents than a 1% increase in job-related stress. Therefore, based on the degree of change in these two variables, it is possible to predict the number of accidents in an organization. Reducing or eliminating identified effective stress factors and decreasing unsafe acts have been suggested to control the consequences of accidents. To achieve this, implementing behavior based safety principles can be an effective measure.

Keywords: *Job stress, Occupational accidents, Unsafe acts*

INTRODUCTION

Today, occupational accidents are considered among the potential threats because of their serious humanitarian, economic, social, and environmental consequences [1]. Occupational accidents and injuries are the third cause of mortality in world and the second one in Iran [2]. In addition, the economic and environmental damages of occupational accidents are catastrophic too [3].

According to International Labor Organization (ILO) report in 1999 the average estimated fatal occupational accident rate was 14.0/100 000 workers and the number of fatal accidents was 335000 [4]. Though the registered number of accidents in Iran cannot be a faultless account of all the accidents happened, but in 2000, about 12000 work related accidents have been registered by the Department of Social Security [5].

Calculations indicated that approximately 345000 fatal occupational accidents occurred in 1998 and that

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Table 1. The causes of some major accidents

Name of accident	Causes of accident/failure				
	Managerial error	Human factor	Inadequate interface design	Safety issues	Inadequate system design
Chernobyl nuclear power plant accident (1986)	*	*	*	*	*
TMI nuclear power plant accident (1979)	*	*	*	*	*
Bhopal chemical processing plant accident (1983)	*	*	*	*	*
Aloha airlines accident (1988)		*	*		*
US telephone network accident in Chicago suburb (1988)					*
Thirty major accidents in chemical plants (1985–1989)	*	*			
NASA's space shuttle explosion (1986)	*				*
Proctor& Gamble Tylenol (1982)	*	*			*
US public phone network outage (1991)	*	*	*		*

over 260 million occupational accidents causing at least 3 days absence happened in the same year [6].

ILO has estimated that the total costs of occupational accidents and work-related diseases are 4% of the Gross National Product (GNP) [7].

Critical incidents and accidents are caused by a combination of equipment, active and latent failures [8]. Studies reveal that human factor is the main cause of accidents [9]. Most researchers believe that unsafe behaviors are the key agent for more than 70% of occupational accidents [10].

It is usually assumed that unsafe behaviors are one of the main contributors to catastrophic disasters likelihood [11]. Disastrous accidents like Chernobyl, Three Mile Island and Bhopal are all examples of these kinds (Table 1) [2].

In addition to lack of necessary skills, inherent characteristics, incorrect beliefs, and attitudes, one of the most important causes of unsafe behaviors is high occupational stresses [12].

Job stress factors cause a fall in concentration and the ability of decision making, and an increase in absent-mindedness, poor memory, and doubtfulness in people that lead to do unsafe acts of employees [13]. Several studies have also proved that stress has played a role in 37% of the accidents & injuries in industry [14].

Zare et al., (2009) argues that stress plays a role in non-fatal accidents [15]. Job stress should be recognized as an important factor causing occupational injuries among car manufacturing workers [16].

The purpose of the present study was to answer these questions 1) what is the unsafe behaviors rate and stress level in a vehicle manufacturing personnel in Iran. 2) Is there a relationship between job stress and unsafe acts with occupational accidents?

MATERIAL AND METHODS

This study was performed on 195 employees in Pars Khodro industry in Iran in 2007. Pars Khodro is an Iranian automobile manufacturer. It was the first

manufacturer of sport utility vehicles in Iran. Today, Pars Khodro builds Renault and Nissan models under licence. Other models include the Nissan Maxima, Nissan Roniz (Xterra) and the Nissan Patrol and Safari.

First, evaluation of occupational stress was carried out by questionnaire. Mentioned questionnaire was given to authorities and experts to determine its validity regarding different sources and referring to books, journals, and publications and the questionnaire's reliability was confirmed using test-retest exam (Test-Retest) (r=0.82). This questionnaire has 57 questions in 3 sections about interpersonal relationships, physical demands of work and job interest that is completed in five-scale responding alternative, "never", "rarely", "sometimes", "often", "most times" [17]. Furthermore, the demographic information of the employees such as age, occupation, workplace, duration of employment etc was completed by all samples. The methodology used to complete the questionnaires consisted of a semi-supervised implementation.

Then, safe behaviors of workers sample were evaluated by safety behavior sampling (SBS) technique. SBS is a technique of measuring unsafe acts and is based on the laws of probability [18]. Numbers of necessary observations of workers' behaviors were carried out in order to determine the proportion of their unsafe acts. The number of observations required is based on data collected during the pilot study, the degree of accuracy required and the given level of confidence.

Two terms are recorded during the pilot study:

1. Total number of observations made (N1).

2. Number of observations in which unsafe behavior was observed (N2).

Thus, the proportion of unsafe behavior is

$$P = \frac{N2}{N1}$$

If S is the desired accuracy, N the total number of observations required and K the value obtained from standardized normal tables for a given level of

Table 3. Distribution of unsafe behavior in occupational groups

Occupation	Number of people	Total number of observations	Total number of unsafe acts	Unsafe act percent (%)
Painter	20	256	97	37.8
Welder	20	348	67	19.2
Assembler(trim)	17	400	173	43.2
Controller	16	191	64	33.5
Assembler	18	384	179	46.6
Adjuster	17	256	125	48.8
Mechanician	16	340	82	24.1
Serviceman (body shop)	17	384	169	44
Operator	9	160	36	22.5
Liftruck driver	14	336	120	35.7
Press operator	13	256	53	20.7
Chiseler	9	145	58	40
Total mean stress	195	3456	1193	35.4

Table 2. Job stress scores of occupational groups by occupational stress questionnaire

Mean grade of stress / Occupation	Mean grade of stress (Interpersonal relationships)	Mean grade of stress (Physical demands of work)	Mean grade of stress (Job interest)	Total mean grade of stress
Painter	73.1	59.3	28.1	160.6
Welder	76.6	68	24.9	169.4
Assembler (trim)	75.1	73.6	24.3	173.2
Controller	71.5	63.7	26.1	161.4
Assembler	78.9	68.1	28.4	175.5
Adjuster	75.9	72.7	26.2	175
Mechanician	73.8	65.5	26.1	165.6
Serviceman (body shop)	78.5	76.4	27	182
Operator	69.1	58.1	23.4	150.6
Lift truck driver	74.1	76.8	25.2	176.2
Press operator	76	69.2	22.8	168.1
Chiseler	80.4	66.8	26.2	173.5
Total mean stress	75.2	74.9	25.7	169.2

confidence, then the total number of required safety behavior observations is derived from [19]:

$$N = \left(\frac{K}{S}\right)^2 P(1-P)$$

After conducting a pilot study the total number of observations was estimated to be 3456.

After that, accident Frequency rate index were calculated by available registered accidents statistic in company from:

$$AFR = \left(\frac{No. of\ lost\ time\ accidents \times 200000}{Total\ no. of\ man\text{-}hours\ worked}\right)$$

Finally, the information was then analyzed using SPSS and statistic tests namely, analysis of variance (ANOVA), correlation and logistic regression.

RESULTS

This study was performed on 195 male employees' from production lines in a vehicle manufacturing company. The workers were between 20 and 55 years old and their mean age was 29.8 ± 5.9 years. 46.2% of the workers were between 25-30 years old. The mean work experience was 6.2 ± 5.3 years and work experience of 65.5 percent of employees was less than 5 years. Twenty six percent of workers were single and 74% were married. Workers who had injuries during their work experience were 49%. Workers engaged in 1 to 3 injuries were 90% and 10% in 4 or more injuries. In addition, 83% of the population stated that they had received the technical related training with their occupation. Seventy four percent of the populations were graduates from senior high school, 15% were unread, and 11% were graduated from university. Accident frequency rate index was 10.2.

Table 4. Relationship between job stress, unsafe acts, and accidents with age, education etc

Variable	Job stress (P-value)	Unsafe acts (P-value)	Accidents (P-value)
Workplace	0.001	0.29	0.03
Occupation	0.002	0.004	0.005
Age	0.8	0.5	0.01
Education	0.2	0.001	0.002
Technical training	0.97	0.6	0.01

Table 5. An examination of the link between the combinations of job-related stress, unsafe acts with number of accidents

Variable	β	SD	Wald	df	Sig	O.R.
Unsafe act	1.115	0.540	4.266	1	0.039	3
Stress	0.015	0.007	4.771	1	0.029	2
Constant	-3.043	1.207	6.362	1	0.012	0.048

Based on the questionnaires, 88% of the workers were at a level of high stress, 10% at a level of moderate stress and 2% at a level of low stress. Table 2 illustrates those dealing with the bodywork had the highest mean grade of occupational stress and operators had the lowest mean grade. The pace of work, the physical conditions of the workplace, and the ergonomic conditions were the most important three factors of 20 stress factors measured by the questionnaire.

Based on safety behavior sampling 3456 observations were conducted that 1193 observations were unsafe and 2263 were safe. Therefore, the proportion of unsafe acts was 35.4. Table 3 shows the rate of unsafe behavior in occupational groups.

Statistic tests showed correlation between job stress, unsafe act and the rate of accidents with age, education etc (Table 4).

The correlation coefficients between the score of job stress with the workplace, occupation were 0.82 and 0.71 respectively. The correlation coefficients between the Unsafe acts rate with the workplace, occupation and age were 0.83and 0.71 respectively. The correlation coefficients between Accident frequency rate with the Workplace, occupation, age and technical training were 0.73, 0.87, 0.69, and 0.71 respectively.

Correlation test showed significant correspondence between job stress and unsafe act ($p<0.05$, $r=0.81$). It means that as the level of stress increases, the unsafe behavior practices will increase correspondingly. There was also a correlation between the level of stress and the rate of unsafe act with the accidents frequency rate that had been be fallen the individuals under study ($p<0.05$, $r=0.76$). (Confidence interval=95%, standard error=5% as methodology). Logistic Regression test also distinguished the link between independent variables (job-related stress, unsafe behavior) with the accidents frequency rate in organization. The related test showed that if the extent of unsafe practice increases by one percent, the rate of accident increases three-fold. If the rate of job-related stress also increases by one percent, the number of accidents will go up two-fold (Table 5).

DISCUSSION

The data set in this study is broader than in previous ones because of existing three studious areas. Results of job stress level, unsafe behaviors, and accident Frequency rate index indicted that six of 12 occupational groups were critical occupations. These occupational groups were technician in body shop, lift truck driver, assembler, chiseler, adjuster and trim assembler.

According to previous studies the relationship between job stress and physical conditions of workplace is significant ($r=0.7$) [14-15]. Physical conditions of workplace are consist of stressors such as harmful physical agents (noise, lighting), harmful chemical agents (fumes from welding process, ventilation condition of saloons) and ergonomic risks (lifting and handling blocks, bad posture during working and lack of awareness to correct method of working) [20-22].

The research findings showed corrective interventions in three categories: performing ergonomic job analysis, engineering interventions in order to reduce or eliminate harmful agents and managerial interventions decreasing the work pressure [23]. Results of current research in Vehicle Manufacturing indicate that a large number of employees' behaviors were unsafe (35.4%), which seems to be quite less than the results of previous studies. The rate of unsafe behaviors in other researches in a foundry and a metal working company in Iran was 59.2% and 27%, respectively [24, 25].

The results of the study were consistent with the findings of previous studies in significant relationship between the number of unsafe acts and the previous accidents records [26]. This result approves accident proneness theory that some employees have a natural ability or tendency in causing accidents [27].

Overall, there are several different reasons that individuals engage in unsafe work practices, for example, the lack of positive attitudes in both management and coworkers toward safety or inadequate supervision of management and supervisors [28]. This suggests that it may be a shift from the notion that workers engage in unsafe behavior are not aware of the risks involved to workers who understand the risks associated with their behavior and continue to choose unsafe practices [29]. Studies showed that supervisory safety interactions attained a near-70% mark and unsafe behaviors dropped to near-zero by the end of four month follow-up period [30]. Furthermore, implementation of participatory safety methods and updating educational requirements based on occupational needs for all employees, will be necessary to reduce unsafe behavior practices [31].

In line with previous studies, significant relationship between accident Frequency rate index and three components (interpersonal relationships, physical demands of work and job interest) illustrates that in the occupational groups which have more stress, the rate of unsafe acts is higher which result in more accidents [32-34].

Implementation of occupational stress management program seems to be essential in order to control identified effective factors in stress and unsafe act induced to accidents in this study. This program should be associated with behavior based safety principles and emphasis should be placed on implementing safety culture fundamentals at all organizational levels [35].

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