



Evaluating the effect of using warning signs on risk reduction using job safety assessment (JSA) in one of the automobile cable manufacturing companies

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ABSTRACT

Incidents are considered among the most important issues throughout of world, and in many industrialized countries, incident is the most important cause of death in people aged over 40 years. In this regard, one of the most important missions of professional health is reducing the work-related incidents and diseases. Accordingly, this research evaluates the effect of using warning signs on risk reduction using job safety assessment (JSA) method in one of the automobile cable manufacturing companies. This cross-sectional research was carried out on 9 jobs in one of the cable manufacturing factories. After identifying the considered jobs, the severity, probability and identification of risks of each of the jobs were extracted using the standard MIL-STD-E882 (fifth edition) tables and the assessed code of initial risk was calculated. The analysis was performed using the JSA method. After about one year, re-assessment was performed and the secondary assessment code was extracted and the results were analyzed using paired t-test statistical methods. In total, 9 jobs were selected. Based on the existing risks analysis, 73% of them were placed at the range of moderate risk, 16% of them were placed at the range of significant risk, and 11% of them were placed at the range of tolerable risk. The preparation, installation, and education of warning signs caused that 58% of the risks to be placed at the lower range. It should be noted that regularly holding of educational sessions for workers and supervisors during the year can contribute in stability of this result.

Key words: Warning Signs, Risk Assessment Code, Job Safety Assessment

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INTRODUCTION

At current time, nearly 45% of the world's population and 58% of people over the age of 10 years are at labor force age. Many people spend more than one third of their post-maturation life in risky job environments, where they are faced with different types of job risks [1]. Incidents are among the most important issues throughout of world, and in many industrial countries, the incident is the most important cause of death among people aged over 40 years. In the world, one million deaths occur due to job-related incidents annually [2].

Job incidents are important in three human, social, and economic dimensions [3]. Based on American National Association statistics, nearly 4500 deaths occur annually in job environments, so that the death rate in the whole American industries is 3 deaths per 100000 people annually [4]. In Iran, the number of workers is estimated to be 14 million people based on the statistics released in 1996 and the annual incidence of job-related injuries, which do not lead into death, is 150000 and the number of injuries leading to death is 1148 cases.

On the other hand, investigations have indicated that the main cause of most of the incidents and their consequences is the unsafe behavior of workers [5]. The relationship between incident and

prevention is evident economically. Higher investment in prevention would result in more reduction in costs caused by incident [6]. Henrich stated the reasons for the incidents with a ratio of 88: 10: 2. He argues that 88% of incidents are caused by unsafe behaviors, 10% of them are caused by unsafe conditions, and 2% of them have unknown cause. He argues that unsafe behaviors are more effective than unsafe conditions [10]. Based on available statistics, incidents are the third leading cause of death around the world and the second leading cause in our country.

In this regard, the results of recent extensive studies have well proven that the main cause in most of the incidents is human factors and unsafe behaviors. In the modern safety approach, the use of controlling methods, relying less on employees and minimizing the risks, is preferred. However, in cases where it is not feasible, using these measures or warning signs as a secondary defensive barrier in line with enhancing the safety of work environments is considered to be right action and economically acceptable and feasible one.

The main objective of using warning signs is informing employees of the risks to avoid unsafe behaviors [12]. In the manufacturing organizations, where the principles and standards of safety and technical protection are not observed, the morale of the workers is also weak and it is less likely that good worker to work in such organizations. As always emphasized, using a method which does not depend on the performance of employees is preferred, but the performance of individuals cannot be ignored in practice. Thus, the use of safety signs to improve the behavior of employees is emphasized.

Studies have indicated that using the warning signs and labels is one of the most appropriate methods for controlling risks. As most of the safety signs in Iran have been adopted from other countries, this research aims to determine the level of comprehensibility of job safety signs, especially in work environment, and provide the necessary solutions to improve its comprehensibility.

The current research is a quasi-experimental study, safety intervention type. Based on the type of study, there was no need for sampling.

1-Team formation:

Job safety analysis was performed by a team. A team including five people (researcher, HSE

manager, professional health expert, worker and supervisor who had full knowledge of the work projects).

2-Preparation of reference list of jobs and activities:

At the beginning of the process, a list of different jobs and activities was prepared (the reference list). After reviewing the existing jobs, those jobs were selected that had more important risks and put the person and the system at greater risk.

3) Job selection and risk assessment (estimating the probability, severity and identification of risk) Considered jobs: working with devices such as: die cast, pressing, ultrasonic, turnery, plastic injection, strand weaving, manual cable cutting, and items such as forklift drivers, electricians, and warehousing.

Job assessment involves the following steps:

- A-Identifying the potential risky events.
- B. Calculating the frequency of events
- C. Calculating the probable consequences of events.
- D. Assessing the effects of the consequences
- D- Assessing the severity of the consequences.
- E. Calculating the risk level
- E-Conclusion

Risk assessment formula: severity of incident consequence × probability of occurrence of an incidence × risk identification = risk number
Using the warning safety signs

These symptoms are two types of visual and auditory. Visual signs include posters, stickers or labels, installed in areas where they do not interfere with work of the worker. Auditory alarming signs are also installed in an appropriate place, where they not interfere with the sound of the environment and can easily be heard and understood by the worker.

Risk re-assessment:

After installing warning signs (posters, labels and alarming ringtones), the risk was re-assessed in the same manner and method for previous jobs.

Reviewing the results and inserting the results in the software:

All the results of the primary and secondary assessments were collected and entered to software for analyzing. Pearson correlation coefficient, linear regression equation, and t-test were used for analytical analysis.

RESULTS

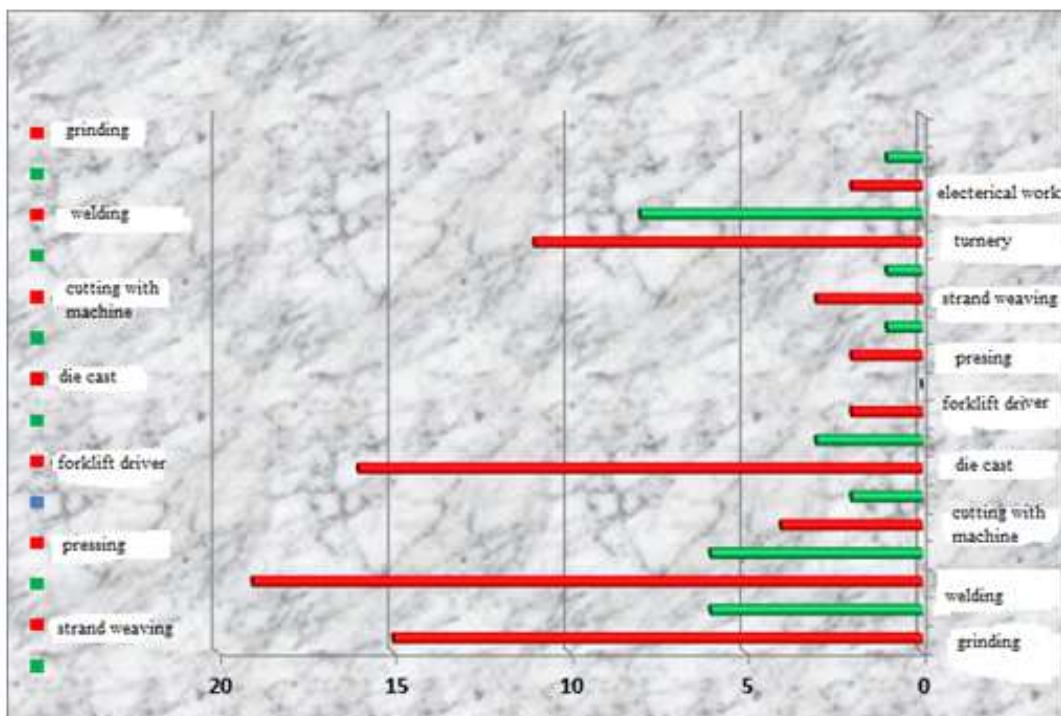
Among the 9 jobs analyzed, the highest level of risk in terms of frequency and repeatability are ergonomic factors (inappropriate body posture, repeatability, and uniformity), followed by the throwing of a hot flush to the workers' eyes and faces. Table 1 illustrates the incidents occurred in the previous year, the use of signs and the use of safety warnings at the same time interval. Out of the 118 cases of risk examined in the various jobs, the most frequent incident was related to welding job, which in addition to the problems stated in the ergonomic factors (in appropriate body posture and manual carrying), throwing flush to the eye, face and hands, multiple burns and working in risky conditions (height and closed spaces).

It should be noted that the noise in the manufacturing hall is also one of the problems of environmental conditions, which almost all people in the manufacturing halls face with them, but due to the repeatability of the tasks assigned to duplicative tasks and pressure on the wrists, fingers and neck pain are especially important. The results of the risks assessment with regard to the parameters of severity, probability, and identification of risk were analyzed by the paired t-test method:

The mean of the initial risk score was 56.36 with a standard deviation of 12.8, which this number was reduced to 25.65 with a standard deviation of 12.88 after the interventions in the secondary assessment. Paired t-test, with 99% confidence, showed a significant difference (P-value = 0.000). In this research, the mean of risk identification in the initial assessment was 4 with a standard deviation, which it was reduced to 2.8 with a standard deviation of 0.8 and after the secondary assessment. Paired t-test showed the significant mean difference was 99% confidence level (P-value = 0.000).

Investigating the probabilities in the initial assessment included a mean of 4.23 with a standard deviation of 0.6, which this number was reduced to 3.1 with a standard deviation of 0.7 after the interventions in the secondary assessment. The mean difference with confidence level of 99% is significant (P-value = 0.000). Other parameters assessed in the initial risk analysis of the assessed jobs obtained the score of 3.3 and a standard deviation of 0.6 which this number was reduced to 2.99 with a standard deviation of 0.7 in the secondary assessment. Based on the paired t-test, this mean difference with confidence level of 99% is significant (P-value= 0.000).

Diagram 1. Comparison of the number of incidents before and after interventions



DISCUSSION AND CONCLUSION

According to the research conducted, it can be concluded that the use of warning signs in order to reduce incidents and, consequently, the "level of

risk" can be considered as a practical method. However, based on this research, the technical-engineering and management measures are the most basic measures and the use of personal protective tools is one of the other corrective measures, since educational intervention in the workers of the related industry could leave significant effect on the rate of incidents and the level of risk. On the other hand, as JSA method was used in this research to analyze the risks of the considered jobs, it can be concluded that the JSA method is a complete method for identifying and providing safety and controlling strategies at job positions.

It should be noted that all the efforts of professional health authorities and the HSE with a management approach should be based on intrinsically safe actions and this should be at the top of their agenda. The objective of this research was to evaluate the effect of warning signs on risk reduction in one of the cable manufacturing factories. Based on the results, it was found that out of a total of 118 identified risks in 9 jobs, the risk of ergonomic musculoskeletal problems had the highest percentage.

The results suggest that the level of risk before and after educational interventions, tested by the paired t-test method, showed a significant difference between the numbers obtained (P-value = 0.000). Thus, it could be said that the installation of safety signs has a positive effect on reducing the level of risk.

Given the parameters involved in the level of risk, it was revealed that the severity of the risk before and after the educational intervention was significantly different ($p = 0.000$). The probability of risk also showed significantly (P-value = 0/000) difference before and after the intervention by assessing paired t-test (P-value = 0.000). Moreover, the identification of the risk showed a significant difference with the above test (P-value = 0.000).

Given the analysis of existing risks, 73% of the risks were at the range of moderate risk, 16% of the risks were at the range of significant risk, and 11% of the risks were at the range of tolerable risk. The preparation, installation, and education of warning

signs reduced the risks by 58%. The result of this research is in line with that of Nasiri and Khosh Akhlag, who found that educating and providing safe working guidelines is one of the most important methods to control and reduce the risks and increasing the safety knowledge, since increasing the level of knowledge has a positive and direct impact on the reduction of unsafe actions (23 and 24).

The results of the research are in line with results of the research conducted by Ayatollah Malei *et al.*, on the effectiveness of educational intervention, in increasing the safe behaviors of workers (25). The results of this research are also consistent with those of research conducted by Mohammad Fam on the effectiveness of warning signs in controlling unsafe behavior after the intervention, which led to a reduction of 52.1% in unsafe behaviors. In addition, the research conducted by Joshuahw and Gelleres on the effect of interventional behaviors on job safety showed that safety signs had significant effect on employees, so that these behaviors decreased from 73% to 13%.

In this regard, Hashemi Nejad *et al* conducted a research on 30 different jobs and showed that the highest rate of incidents was related to the welding job, which this result is in line with that of our research.

This research was carried out using the JSA method and it was revealed that this method is a basic methodology for identifying job risks, which is consistent with the research conducted by Khalil *et al*.

In a research conducted by Rezaei Mohammadi and Naseri on risk assessment using the job safety analysis method, the JSA method was recognized as one of the incident prevention and risk analysis methods, which is consistent with the research conducted by Khalil *et al*. Based on this research, it was revealed that educating the workers has significant effect on incidence of identified risks, so that in addition to increasing the knowledge of people, it showed positive results in some job tasks. A number of unacceptable risks made the managers take the necessary steps to remove or control the mentioned cases.

Recommendations

- Holding educational regular courses and classes for managers and supervisors and workers
- Analyzing any work given the assigned tasks and identifying the existing risks

-Solving the problems by managers based on the solutions provided

-Every worker should be selected and employed based on the assigned work.

-Providing necessary educations to the worker with regard to the considered job and educating all risks and its controlling solutions

-Examining all incidents, even less important ones, in order to prevent it.

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