Original Article

Effect of health, safety, and environment management system training on safety climate in a mine in Yazd Province, Iran

Firoozi Chahak A, MSc[1], Beheshti MH, MSc[1]*, Poursadeghiyan M, PhD[2]

1- Faculty Member, Dept. of Occupational Health, Faculty of Health, Gonabad University of Medical Sciences, Gonabad, Iran. 2- Faculty Member, Dept. of Ergonomics, School of Rehabilitation, Social Determinants of Health Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

Abstract

Received: February 2016, **Accepted**: July 2016

Background: Today, with the development of technology, the presence and role of human resources has been highlighted in industrial environments. Hence, the importance of safety culture is growing. Mining is the one of the most dangerous occupations. Therefore, this study was performed to determine the effect of health, safety, and environment management system (HSE-MS) on safety climate in one of the mines in Yazd Province, Iran, in 2014.

Materials and Methods: The study population consisted of 32 employees of the operations unit working in one of the mines in Yazd Province. The standard 20-item Safety Climate Questionnaire (α = 0.77) which was valid and reliable was used to evaluate the safety culture at the unit. In this questionnaire, the items were scored based on a 5-point Likert scale. Data were collected before and 2 months after the HSE-MS training courses. The inclusion and exclusion criteria were willingness to participate in the project, at least 1 year of work experience, and the lack of specific and neurological diseases. The collected data were entered into SPSS statistical software.

Results: In this study, 28.1% of the study population was single and 71.9% married. The average score of the safety climate dimensions of managerial commitment, safety communications, safe environment, responsibility of managers, perception of risk, job satisfaction, and knowledge and awareness of safety issues was 11.09 ± 2.66, 7.50 ± 2.36, 8.09 ± 1.92, 6.56 ± 1.58, 8.43 ± 1.56, 4.59 ± 1.58, and 4.25 ± 1.27, respectively. The dimension of understanding of risk and knowledge and awareness of safety issues were predictors of job satisfaction in workers.

Conclusions: It can be concluded that attitudes of the examined miners toward safety climate were at a moderate level, and that the level of their attitudes increased after the HSE-MS training course. Therefore, safety climate can be greatly improved with HSE-MS training course.

Keywords: Safety, Climate, Mining, Occupational Health

Introduction

Today, with the development of technology and the extensive use of hazardous materials, the presence and role of human resources has been highlighted in industrial environments (1). Presence of human in the workplace has caused disasters that have had destructive results for humans, and the economy and environment (2). In other words, the industry is like a double-edged sword, one edge helps in the promotion of the economy, and health and well-being, and the other edge leads to disability or death. This issue is more evident in developing countries that exert enormous pressure on workers in order to increase production, regardless of preventive safety principles, standards, working hours, training of workers, the use of suitable personal protective equipment (PPE), and etc. For example, the International Labour Organization (ILO), in 2009, reported an annual global incidence of 270 million occupational accidents leading to the loss of more than 3 working days. Moreover, Iran is a developing country, and thus, is not exempt

* **Corresponding author:** Mohammad Hossein Beheshti, Dept. of Occupational Health, Faculty of Health, Gonabad University of Medical Sciences, Gonabad, Iran.
Email: beheshtihasan8@gmail.com

from this rule (3). Therefore safety culture in Iran should be increased and a good safety culture is the demand of all organizations and humane societies. The planning and implementation of cultural programs must comply with the requirements, and lack of attention to these requirements will result in wasting of resources, frustration of staff, and lack of motivation in authorities. Changing a culture is a long-term and time-consuming process and if issues such as behavior change are not considered during this process, the community or organization will pay the cost of the consequences of the establishment of this culture for a long time. Scientists believe that individual behaviors are derived from the structure in which an individual is located; thus, providing an adequate infrastructure, in addition to creating an appropriate culture, requires measures to improve the safety culture (4). Various definitions have been provided for safety culture. According to the British Health and Safety Executive (HSE), safety culture is the ideas and beliefs that all organizations have about an accident and sickness (5). In another definition of this term, culture is described as a set of beliefs, ideas, and values of a group that is manifested in the behavior of that group (6). The study by Beriha et al. showed that the prediction of various types of accidents helps the managers to formulate organizational policies for improving safety performance (7).

Another study was conducted by Beriha et al. on safety performance evaluation of Indian organizations using data envelopment analysis (8). In this study, a total of 30 Indian organizations under the 3 industrial categories of construction, refractory, and steel were compared. They observed that safety performance of construction industries was consistently low compared to other industrial categories (8).

Safety culture is a psychological phenomenon and indicates employees' perceptions of the safety condition in a given time period. The importance of safety culture is its ability to predict safety behavior. According to this feature the impact of safety culture on various events such as perceived safety risks, accidents, and damage, has been observed (9, 10). In recent years, there has been a movement away from safety measures purely based on retrospective data or 'lagging indicators' such as fatalities, lost time and accident rates, towards so called 'leading indicators' such as safety audits or measurements of safety climate. It can be argued that these are predictive measures of accdent which enable safety condition monitoring (11).

The concept of safety climate that is a subset of a safety culture is concerned with the perceptions and inferences of employees of a workplace, the interest of managers in safety and safety measures and their participation in risk control (12). The concept of safety climate was introduced for the first time in 1980 as a multi-dimensional factor that plays a role in workplace safety. Since then, many studies have been conducted to evaluate safety climate and its related factors, especially after the occurrence of the Chernobyl accident. These studies found that safety climate can be effective in detecting potential problems and can evaluate the employees' work environment, increase efficiency, and reduce the rate of accidents in the event that safety culture is considered sufficiently. In other words, safety climate attempts to identify weaknesses regarding safety and opportunities for their modification. In recent years, the use of preventive measures (protective approach) such as safety climate and observing of unsafe behaviors have been considered along with reaction indices (reactive approach) such as incident indicators. Through the combination of preventive and reactive approaches, the implementation of safety programs can be achieved to help organizations. Thus, the assessment of safety climate, as an important indicator of health and safety in the workplace, has been proposed and implemented. Follow-up corrective actions resulting from it have significant impact on enhancement of employee efficiency and successful control of

injuries caused by accidents and can be used as a guide to safety policy in organizations (13). Attitude and culture in mines are among the main causes of unsafe behaviors that can lead to accidents. Safety climate in mines, which is considered as an important indicator of safety, illustrates employees' shared perceptions toward safety. Moreover, mining is acknowledged as a hazardous occupation; thus, this study aimed to assess the safety climate in one of the mines in Yazd Province, Iran, in 2014.

Materials and Methods

The present study was a cross-sectional descriptive study. The research population comprised all employees of one of the mines in Yazd Province. In this study, 32 individuals were studied through census method. The inclusion and exclusion criteria for this study were willingness to participate in the project, lack of disease and musculoskeletal disorders, and at least 1 year of work experience. The data collection tool was a 2-part questionnaire. The first part of the questionnaire was the 20-item standardized Safety Climate Questionnaire that was designed By Mohammad Zaidi (14). The validity and reliability of this questionnaire were confirmed through calculating Cronbach's alpha coefficient ($\alpha = 0.77$). The questionnaire has 7 dimensions, including managerial commitment (4 items) ($\alpha = 0.8$), safety communication (3 items) ($\alpha = 0.83$), secure environment (3 items) ($\alpha = 0.77$), responsibility of managers (3 items) ($\alpha = 0.75$), perception of risk (3 items) ($\alpha = 0.64$), job satisfaction (2 items) ($\alpha = 0.71$), and knowledge and awareness of safety issues (2 items) ($\alpha = 0.84$). In this questionnaire, items were scored based on a 5-point Likert scale ranging from completely disagree (1 point) to strongly agree. The second part of the questionnaire contained demographic questions on age, marital status (single or married), work experience, monthly income, education (illiterate, primary and secondary, diploma, associate degree, or bachelor's degree and higher), working time, and shift work. In addition to leveling the scope, earning of 33.3% scores was considered as poor rating, 33.4-66.6% as average, and 66.7-100% as good rating (5). In this study, the Safety Climate Questionnaire was distributed among the participants and, during a 16-hour health, safety, and environment management system (HSE-MS) training program, participants received theoretical and practical training on HSE procedures and requirements. After 2 months, the subjects completed the questionnaire once more and the results were analyzed.

The HSE-MS is a management tool that evaluates a company's commitment to conduct its business in a way that protects the health and safety of its employees, contractors, and the public and is environmentally responsible. In this study, data were collected before the intervention and 2 months after the HSE-MS course. It should be noted that the questionnaires were completed through interviews by the Mine Safety and Environment officers who had been trained in this regard. The collected data were analyzed using descriptive statistics and analytical tests such as Pearson correlation coefficient, ANOVA, independent t-test, and linear regression in SPSS software (version 16, SPSS Inc., Chicago, IL, USA). It should be noted that before the start of the project, all participants were informed of study results and assured of the confidentiality of results.

Results

In this study, 9 (28.1%) subjects were single and 23 (71.9 %) were married. In general, 13 (40.6%) had elementary and Junior education, 7 (21.9%) had a diploma, and 9 (28.1%) had undergraduate degrees or higher. The demographic data of study population is presented in table 1.

Table 1: Demographic information of the participants in the study

Variable	In terms of	N (%)
Marriage	Single	9 (28.1%)
	Married	23 (71.9%)
Education	Elementary and Junior	13 (40.6%)
	Diploma	7 (21.9%)
	Associate degree	3 (9.4%)
	Bachelor's degree or higher	9 (28.1%)
Shift work	Morning	8 (25%)
	Morning and evening	11 (34.4%)
	Morning and night	4 (12.5%)
	Evening and night	5 (15.6%)
	Morning, afternoon, and night	4 (12.5%)

The average total score achieved by participants was equal to 46.88 ± 8.32. Moreover, scores in the dimensions of managerial commitment and safety communication were 11.09 ± 2.66 and 7.50 ± 2.36, respectively. The average scores in each of the dimensions before and after training are presented in table 2.

Table 2: Relationship between the average score of each safety climate dimension before and after training according to one-way ANOVA

Dimension	Before the intervention	After the intervention	t	df	P-Value
	Mean ± SD	Mean ± SD			
Managerial commitment	11.09 ± 2.66	2.79 ± 13.25	-7.83	31	< 0.0001
Safety communications	7.50 ± 2.36	1.53 ± 10.90	-12.66	31	< 0.0001
Safe environment	8.09 ± 1.92	1.66 ± 10.87	-8.61	31	< 0.0001
Responsibility of managers	6.56 ± 1.58	1.32 ± 9.9	-13.41	31	< 0.0001
Perception of risk	8.43 ± 1.56	1.56 ± 11.21	-10.22	31	< 0.0001
Job satisfaction	4.59 ± 1.58	1.41 ± 7.75	-13.75	31	< 0.0001
Awareness about safety	4.25 ± 1.27	1.24 ± 7.53	-11.81	31	< 0.0001
Total safety climate	46.88 ± 8.32	5.47 ± 73.41	-76.50	31	< 0.0001

*The significance level = 0.05

After HSE-MS training, the safety climate score was equal to 73.41 ± 5.47; there was a significant change compared to before the training. Table 2 shows the relationship between the dimensions before and after the intervention. According to Pearson correlation coefficient, there was a significant correlation between average age and the dimensions of management commitment (P = 0.008) (r = -0.458**), safety communication (P = 0.027) (r = -0.390**), safe environment (P = 0.032) (r = -0.281**), responsibility of managers (P = 0.042) (r = -0.383**), and safety climate (P = 0.022) (r = -0.451**).

In addition, linear regression analysis showed that the dimensions of perception of risk and awareness of safety issues were predictors of job satisfaction in workers.

Level of understanding of 11 (34.4%), 16 (50%), and 5 (15.6%) participants in the dimension of managerial commitment was, respectively, poor, average, and good.

Table 3: Frequency of understanding of participants in relation to each of the dimensions of safety climate

Level of dimensions	Managerial commitment	Safety communications	Safe environment	Responsibility of managers	Perception of risk	Job satisfaction	Awareness about safety
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Weak	11 (34.4%)	19 (59.4%)	9 (28.1%)	23 (71.9%)	7 (21.9%)	20 (62.5%)	22 (8.68%)
Average	16 (50%)	12 (37.5%)	20 (62.5%)	9 (28.1%)	23 (71.9%)	10 (31.3%)	10 (3.31%)
Good	5 (15.6%)	1 (3.1%)	3 (9.4%)	----	2 (6.3%)	2 (6.3%)	---

N: Number

Discussion

Attitude of workers towards safety is affected by their perception of risk, management, rules, and safety procedures. Several studies have proposed the use of safety climate score for the comparison of different industries (15-18).

In the past decades, safety climate has been recognized as the fundamental and ultimate solution for improving workplace safety in various industries (11). A substantial number of researches have shown that lower workplace accident rates were associated with improved safety climates (19, 20).

According to the results of this study, in general, attitudes of the studied miners toward safety climate was at an average level. However, the level of their attitude increased after HSE-MS training courses. The results of the present study showed a poor safety climate among Mine workers that is in conflict with the results of the study performed by Mortazavi et al. (9).

The study of Adel et al. in the steel industry showed that safety climate was at an average level that is similar to the results of this study (13). Furthermore, the study by Roseanne showed a low level of safety climate (21). The study of Tabibi showed that, in hospital, attitude toward safety climate was at a lower level than other Dimensions of safety attitudes (22), which corresponds with the results of other studies (18). In the present study, there was no statistically significant relationship between any dimension of safety climate and level of education. This finding is in agreement with the results of the study by Adel et al. (13). In the present study, based on the results presented in table 2, the average score of each of the 7 dimensions studied are at moderate to high levels. Nevertheless, in the study by Adel et al. (13), from the 17 fields examined, only 5 fields, including managerial commitment, were at an acceptable level.

In this study, the scores of managerial commitment, safety communication, safe environment, and responsibility of managers, perception of risk, job satisfaction, and awareness of safety issues were differed significantly after the intervention compared to before the intervention. Generally, this study showed significant differences before and after the intervention in the safety climate score. The results of this study were consistent with several previous studies (24-26).

The study conducted by Glendon et al. showed that participants were weak in the area of communication (27). This finding was not in accordance with the results of the present study. The results of this study showed that the score of attitude towards safety climate has a significant inverse correlation with the work experience and age of the participants. This is in conflict with the findings of Heidari et al. (12) that showed no correlation between safety climate and work experience. The results of this study showed that the status of different dimensions of safety climate in the examined miners was at a medium level. Thus, the safety climate score can be used as a preventive indicator to develop safety policies and evaluate safety performance of organizations and the results can be used to improve safety.

Conclusion

It can be concluded that attitudes of the examined miners toward safety climate was at a moderate level, and that its level increased after the HSE-MS training course. Therefore, safety culture can be greatly improved with HSE-MS training course. Thus, it is suggested that managers pay more attention to safety training and management support to improve the safety climate. Improving workers' safety training is of paramount importance. Therefore, safety training should focus on the reduction of industry injuries. Management support is another vital factor in manufacturing enterprises. We hope that these findings can be helpful in the improvement of safety and health in the workplace.

Acknowledgments

The authors are grateful to faculty members of the Department of Occupational Health in Gonabad University of Medical Sciences and all managers and staff of mines in Yazd Province who helped us in this project.

Conflict of Interest: None declared

References

1- Sepehr P, Mohammad Fam I, Ketabi D, Sepehr N. Effect of engineering and management interventions on promoting safety culture indicators among workers of Iranian pipe rolling factory. The Journal of Toloo-e-behdasht 2014; 13(3):11-20.
2- Kirchsteiger C. Trends in accidents, disasters and risk sources in Europe. J Loss Prev process Ind 1999; 12(1):7-17.
3- Parker D, Lawrie M, Hudson P. A framework for understanding the development of organization safety culture. Saf Sci 2006; 44(6):551-62.
4- Guldenmund FW. The use of questionnaires in safety culture research-an evaluation. Saf Sci 2007; 45(6):723-43.
5- Dedobbeleer N, Beland F. A safety climate measure for construction sites. J Safety Res 1991; 22(2):97-103.
6- Feng X, Bobay K, Weiss M. patient safety culture in nursing: a dimensional concept analysis. J Adv Nurs 2008; 63(3):310-19.
7- Beriha GS, Patnaik B, Mahapatra SS, Padhee S. Assessment of safety performance in Indian industries using fuzzy approach. Expert Syst Appl 2012; 39(3):3311-23.
8- Beriha GS, Patnaik B, Mahapatra SS. Safety performance evaluation of Indian organizations using data envelopment analysis. Benchmarking: An International Journal 2011; 18(2):197-220.
9- Mortazavi SB, Asilian H, Avestakhan M. Relationship between safety climate factors and the risk of dangerous situations in height among construction workers. Iran Occupational Health Journal 2011; 8(1):51-60.
10- Cooper MD, Phillhps RA. Exploratory analaysis of the safety climate and safety behavior relation. J Safety Res 2004; 35(5):497-512.
11- Flin R, Mearns K, O'Connor P, Bryden R. Measuring safety climate: identifying the common features. Saf Sci 2000; 34(1):177-92.
12- Heidari MH, Farshad AA, Arghami Sh. A study on relationship between production link worker's safety attitude and their safe act in of Arak metal industry. Iran Occupational Health Journal 2007; 4(3 and 4):1-9.
13- Adl J, Jahangiri M, Rismanchian M, Mary Oriad H, Karimi A, Ghaderi MR. Safety climate in a steel-manufacturing plant. Journal of School of Public Health and Institue of Public Health Research 2011; 9(1):23-34.
14- Mohammadi Zeadi E, Heidarinia AR, Neaknami Sh. Measure the safety climate at the workplace: the design, Validity and reliability of questionnaires. Payesh Journal 2011;10(2):157-66.
15- Zohar D, Luria G. A multilevel model of safety climate: cross-level relationships between organization and group-level climates. J Appl Psychol 2005; 90(4):616-28.
16- Ma Q, Yuan J. Exploratory study on safety climate in Chinese manufacturing enterprises. Saf Sci 2009; 47(7):1043-6.
17- Niskanen T. Assessing the safety environment in the work organization of road maintenance jobs. Accid Anal Prev 1994; 26(1):27-39.
18- Lindell MK, Brandt CJ. Climate quality and climate consensus as mediators of the relationship between organizational antecedents and outcomes. J Appl Psychol 2000; 85(3):331-48.
19- Smith GS, Huang YH, Ho M, Chen PY. The relationship between safety climate and injury rates across industries: the need to adjust for

injury hazards. Accid Anal Prev 2006; 38(3):556-62.

20- Arezes PM, Miguel AS. Risk perception and safety behavior: a study in an occupational environment. Saf Sci 2008; 46(6):900-7.

21- Fairchild RM, Pesut DJ, Harrington CF. Creating safety culture on nursing units: human performance and organizational system factors that make a difference. J Patient Saf 2006; 2(4):198-206.

22- Tabibei J, Nasireipour AA, Maleki MR, Raessi P, Mahmmoudi M, Azimi L. Survey of employees' safety attitude in a teaching hospital Tehran 2010. Iran Occupational Health Journal 2011; 7(4):25-31.

23- Zaravshani V, Sheykhi S, Amini M, Mohamadizeydi E. Investigation of safety attitude among operating room staff of of educational hospital of Qazvin university of medical sciences. Paper presented at: 2nd Conference in Tehran Safe Community; 2009 October 7-8; Tahran, Iran.

24- Zohar D. The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. J Organ Behav 2002; 23(1):75-92.

25- Basen-Engquist K, Hudmon KS, Tripp M, Chamberlain R. Worksite health and safety climate: scale development and effects of a health promotion intervention. Prev Med 1998; 27(1):111-9.

26- Cooper MD, Phillips RA. Exploratory analysis of the safety climate and safety behavior relationship. J Safety Res 2004; 35(5):497-512.

27- Glendon AI, Litherland DK. Safety climate factors, group differences and safety behavior in road construction. Saf Sci 2001; 39(3):157-88.