Original Article

Safety culture in GolGohar Mine in Southeast Iran in 2014

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Abstract **Received**: September 2015, **Accepted**: November 2015

Background: Safety culture and attitude form an integral part of organizations' cultures and their improved levels are influential in the prevention of occupational accidents and injuries. The present study was conducted to assess the safety culture and attitude of workers in the mining industry in Iran.

Materials and Methods: The present cross-sectional study was conducted on 172 workers employed in GolGohar Mine in Southeast Iran. Data were collected using a standard safety culture questionnaire, and then, analyzed in SPSS software using ANOVA, independent t-test, and the linear regression model.

Results: Participants' mean age and mean length of work experience were 38.13 ± 7.11 and 9.95 ± 4.84 years, respectively. The level of education was found to be significantly related to management commitment (P = 0.003) and training (P = 0.001). Age was found to be significantly related to management commitment (P = 0.044), exchange of information (P = 0.020), and training (P = 0.047). In addition, work experience was found to be significantly related to training (P = 0.010) and safety prioritization (P = 0.002). However, employment and marital status had no significant relationships with the culture of safety (P > 0.050). Participants had experienced no occupational accidents during the course of their work.

Conclusions: The present study showed the effectiveness of the level of education, age, and work experience in promoting the culture of safety. Adopting measures to increase the employment of better educated individuals, providing safety training prior to recruitment, and using more experienced workers' recommendations can promote the culture of safety in the organization and reduce occupational accidents.

Keywords: Safety Culture, Attitude, Mining, Occupational Accidents.

Introduction

Safety culture is a collection of beliefs, norms, motives, roles, and social and technical functions that reduce the exposure of employees, managers, consumers, and the general population to harmful and dangerous situations (1, 2). Moreover, safety culture is the part of the organizational culture that is associated with human resources and safety within the organization, implying that anyone in any position in the organization should be concerned with safety issues (2, 3).

The term "safety culture" was first used in 1987 in the Chernobyl nuclear disaster report. This report was followed by questions about large accidents and defects in organizational structures and safety management systems, which highlighted the importance of a safety culture (4, 5).

Moreover, occupational hazards and accidents have always been regarded as critical problems

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encountered by workers in factories and workplaces (6) that can be associated with the level of safety culture maturity among the workers.

Occupational accidents have always been associated with extensive human injuries and huge financial losses (7). On average, the global rate of fatal occupational accidents is 14 per every 100,000 workers (8). According to the International Labor Organization reports, 129 million work-related accidents occur every year, leading to 219,000 deaths and millions of injured people (9). The rate of work-related accidents tends to be higher in developing countries than in developed countries (10). In Iran, work-related accidents expose thousands of workers to various dangers each year, and a large number of them either die or suffer varying degrees of disability (7). Taking into account the coefficients of errors and the necessary adjustments, 1.1 million fatal occupational accidents are estimated to occur throughout the world every year. In other words, 3000 work-related deaths occur every day (11). The safety culture should reach a turning point in which the rate of accidents becomes constant in organizations. To reach this ideal point, and to continue to improve the efficiency of safety measures, managers and employees should be mentally prepared and in harmony with each other. In other words, safety culture is an essential part of the culture of an organization (12). Addressing health and safety strategies such as promoting safety culture in organizations not only reduces the likelihood of accidents, but also entails economic and financial benefits. This is indicative of a return on capital investment in the long term for organizations (7, 13). The workers' perception of the overall attitudes and behaviors of the management in relation to safety, productivity, planning, and etc. is one of the most essential concepts for a successful assessment of the safety culture in an organization. In addition, a study has confirmed that the various aspects of health and safety records are manipulated at different managerial levels (14).

In a previous study on safety culture and safety rules and regulations adopted in a mine in Queensland, Australia, Laurence showed that the involvement of workers in safety decisions together with safety training can improve the workers' attitudes toward safety (15). In another study, Nordiof investigated safety culture in relation to the risk of accidents in steel factories in Sweden and revealed the parameters most effective in promoting safety culture among workers and subsequently in reducing the risk of accidents (16). These parameters included safety risk training in workers and the industry, training individuals about their responsibility toward safety, creating a balance between productivity and safety, emphasizing the importance of communication and interaction with colleagues, and clarifying the role of other conditions such as fatigue (16). A study was conducted by Maleki on safety culture in relation to accidents in the dam building industry in Iran. In this study, a significant relationship was found between the occurred accidents and the organization's level of safety culture maturity and also between the history of accidents and safety culture (17). Nevertheless, no significant relationships were found between the demographic characteristics of the workers (age, work experience, education, and marital status) and the level of safety culture maturity in the organization (17). Evidence suggests that creating a strong safety culture is equally beneficial and necessary in all levels of the job market, including in workers, clients, and governments. Preventive safety measures have a dramatic role in the prevention of accidents, and promoting safety culture is a definitive method for reducing accidents (18).

The mining industries are dangerous and have a high rate of accidents. On the other hand, safety culture has a critical role in accident prevention. It seems that relationship and cooperation between mine workers, especially in the issue of safety, is low. Therefore, the study of safety culture in different industries, especially in mining, is of grave importance.

Safety culture evaluation and its related factors could help health and safety executive engineers regarding effective planning to increase safety culture and eventually accident prevention.

The present study was conducted to investigate miners' attitudes toward safety culture and its associated factors in GolGohar Mine in Sirjan, Iran. The results should provide data on the safety culture among workers and the factors affecting this culture, which can then be adopted in plans for improving safety culture among workers.

Materials and Methods

The present cross-sectional study was conducted on 172 miners engaged in pelletizing, hematite, polycom, and condensing processes in GolGohar Mine. Sampling was conducted through census method. All workers of the studied GolGohar Mine participated in this study. Only 6 workers did not complete the questionnaire. The data were collected using a Nordic Occupational Safety Climate Questionnaire (NOSACQ), the validity and reliability of which had been confirmed in previous studies with a Cronbach's alpha of 0.96 (19). The content validity of the questionnaire was nevertheless reexamined through comments made by experts in the field and confirmed with a minimum content validity index of 0.85 for the items. The questionnaire's reliability was also confirmed with a Cronbach's alpha of 0.78 and a split-half reliability of 0.65. The questionnaire consists of two parts. The first part contains demographic characteristics and job details of the workers, including the type of job, age, work experience, gender, education, marital status, and frequency of accidents. The second part contains 61 items on safety culture standards designed and scored based on a Likert scale (totally disagree, disagree, no comments, agree, and totally agree). The second part of the questionnaire includes the dimensions of management commitment, exchange of information, supportive atmosphere, training, and safety prioritization. The following equation was used to assess the safety culture score:

$\mu = (5K + K)/2$

where μ is the mean score of safety culture and K the number of items in the questionnaire. Scores higher than 183 indicate a high level of safety culture maturity and scores below 183 indicate poor safety culture maturity (8). This study also assessed the quantitative and numerical scores obtained in the questionnaire through the calculation of the mean scores.

Prior arrangements were made with the factory manager, and the workers were briefed on the preservation of the confidentiality of their data and responses and the voluntary nature of participation. Questionnaires were then distributed among the workers to complete after they submitted their consent forms. The researcher was present in the questionnaire completion stage in order to eliminate any potential ambiguities in the questions. The researcher did not interfere with the workers' responses. The collected data were analyzed in SPSS software (version 16, SPSS Inc., Chicago, IL, USA) using descriptive statistics (tables of frequency distribution, diagrams, and central and dispersion indices), ANOVA [Fisher's least significant difference (LSD) test], t-test, and the linear regression model. Normal distribution of the data was assessed using the Kolmogorov-Smirnov test, which confirmed the overall normal distribution of the data and in every single dimension studied.

Results

Participants' mean age was found to be 38.13 ± 7.11 years and their mean length of work experience 9.95 ± 4.84 years. Moreover, 96.5% of the workers (n = 166) were married and only 32.6% of the workers (n = 56) had university education. In terms of the type of job, 32% of the workers (n = 55) were active in the field of production, 24.4% (n = 42) in cleaning and processing, 32.6% (n = 56) in repair and maintenance, and 11% (n = 19) were electricians.

In the present study, the scores for the workers' general attitude toward safety culture and the scores for the 5 separate dimensions of safety culture were calculated. Table 1 presents some of the central and dispersion indices of the different dimensions of safety culture, age, and work experience in the participants. ANOVA showed the level of education to be significantly related to management commitment (P = 0.003) and training (P = 0.001). It also showed age to be significantly related to management commitment (P = 0.044), exchange of information (P = 0.020), and training (P = 0.047), and work experience to training (P = 0.010) and safety prioritization (P = 0.002). Employment and marital status showed no significant relationships with safety culture (P > 0.050) (Table 2).

Table 2 presents the results of the Fisher's LSD test and the difference between the groups in terms of the mean scores of the different dimensions of safety culture. The independent t-test showed no significant relationships between marital status and the different dimensions of safety culture. Participants were divided into a group with high safety culture maturity and attitude, and a group with low safety culture maturity and attitude according to the cut-point used. Table 2 presents the frequency distribution of the various dimensions of the positive attitude to safety culture in the subgroups of the demographic characteristics.

According to table 2, single workers had better attitudes toward safety culture compared to their married counterparts, but the difference between the two groups was not significant. A better attitude toward safety culture was observed in workers with higher levels of education compared to those with lower levels of education. A better attitude was also observed in workers in the 30-39 years age group compared to other age groups, and in the more experienced workers. The workers examined in this study had not been involved in any accidents during the course of their work.

In the assessment of the relationship between safety culture and the independent variables altogether, the linear regression model showed work experience and level of education to be the main variables affecting attitude toward safety culture among the workers. It also showed that as work experience ($\beta = 3.3$, P = 0.035) and the level of education increased ($\beta = 1.62$, P = 0.021), the attitude toward safety culture and its score also improved significantly.

Table 1: Central and dispersion indices of the various dimensions of safety culture, age, and work experience in participants

	Age	Work experience	Total Score	Commitment dimension	Exchange of information dimension	Training dimension	Supportive atmosphere dimension	Safety prioritization dimension
Mean	38.13	9.95	19.7	47.75	48.75	50.48	66.98	75.94
Median	39.00	10.00	19.5	43.47	47.91	52.27	69.44	75.00
Mode	29.00	5.00	17.9	29.35	47.92	54.55	69.44	75.00
SD	7.11	4.84	25.7	17.48	7.30	20.34	11.93	10.34
Minimum	25.00	1.00	14.2	13.04	22.92	2.27	30.56	45.83
Maximum	55.00	20.00	25.8	88.04	64.58	100.00	91.67	100.00

Table 2: The mean and standard deviation of the various dimensions of safety culture by the type of job, work experience, employment status, age, and education

	Marital Status			Education				Age (Year)				Occupation					Work experience			
	Single	Married	P	Elementary school	High school and Diploma	Academic education	P*	< 29	30-39	> 40	P*	Line Worker (assembler)	Janitor	Maintenance worker	Power worker and wirer	P	Less than 5 years (1)	6-15 Years (2)	More than 15 Year (3)	P*
	n (%) Mean score (SD)			n (%) Mean score (SD)				n (%) Mean score (SD				n (%) Mean score (SD)					n (%) Mean score (SD)			
Commitment of management Positive attitude	1(16.7) 48(22.5)	16(9.6) 47(17.3)	0.57	6(10.7) 47(18.9)	1(1.8) 40(11.7)	10(17.9) 56(17.4)	0.034 0.003 0.02	1(3.2) 39(14.2)	9(15.5) 53(17.8)	7(8.4) 46(16.9)	0.001 0.044 0.011	7(12.7) 47(19.6)	3(7.1) 45(16.2)	5(8.9) 47(16.2)	2(10.5) 53(16.9)	0.43	4(8.9) 45(17.3)	8(9.6) 50(17.05)	5(11.4) 44(17.9)	0.13 0.75 0.66
Exchange of information Positive attitude	2(33.3) 49(8.1)	54(32.5) 48(7.2)	0.57	9(16.1) 47(7.7)	10(18) 48(7.5)	10(17.9) 49(6.2)	0.514 0.11 0.342	2(6.5) 46(7.02)	9(15.5) 49(7.5)	10(12) 49(7.1)	0.023 0.057 0.538	7(12.7) 47(8.3)	6(14.3) 49(7.6)	5(8.9) 49(5.9)	2(10.5) 50(6.8)	0.25	6(13.4) 49(7.27)	8(9.6) 48(7.94)	6(13.7) 49(5.98)	0.51 0.7 0.28
Training Positive attitude)	1(16.7) 59(26.04)	22(13.3) 50(20.1)	0.80	9(16.1) 50(22.2)	1(1.8) 43(14.4)	13(23.2) 57(21.5)	0.07 0.06 0.01	2(6.5) 46(19.7)	11(19) 55(22.06)	10(12) 48(18.8)	0.047 0.512 0.075	9(16.4) 46(22.9)	6(14.3) 49(19.3)	6(10.7) 54(17.7)	2(10.5) 50(20.8)	0.22	5(11.1) 49(21.9)	14(16.9) 54(18.3)	4(9.1) 44(21.1)	0.25 0.19 0.01
Supportive Atmosphere Positive attitude	2(33.3) 65(16.3)	54(32.5) 67(11.8)	0.96	14(25) 66(10.9)	20(35.7) 68(10.5)	22(39.3) 66(14.4)	0.53 0.89 0.44	7(22.6) 66(10.4)	15(25.9) 65(12.2)	34(41) 68(12.1)	0.76 0.39 0.15	14(25.5) 66(11.6)	11(26.2) 65(9.08)	21(37.5) 67(13.4)	10(52.6) 69(13.7)	0.59	10(22.2) 65(12.1)	33(39.8) 68(12.6)	13(29.5) 66(10.1)	0.19 0.64 0.44
Safety prioritization Positive attitude	4(66.7) 71(10)	107(64.5) 76(10.3)	0.91	41(73.2) 76(11.2)	29(51.8) 73(10.3)	39(69.6) 77(8.6)	0.12 0.61 0.041	18(58.1) 72(10.7)	37(63.8) 76(8.6)	56(67.5) 76(11.07)	0.067 0.065 0.91	38(69.1) 76(10.9)	23(54.8) 74(10.8)	35(62.5) 75(10.1)	15(78.9) 78(7.8)	0.45	30(66.7) 75(9.1)	46(55.4) 73(11.05)	35(79.5) 80(9.05)	0.4 0.35 0.002
Total score Positive attitude	1(16.7) 2(313)	8(4.8) 1(25.6)	0.20	3(5.4) 1(28.4)	0(0) 1(17.2)	6(10.7) 2(25.3)	0.55 0.001 0.003	0(0) 1(21.4)	5(8.6) 2(26.1)	4(4.8) 1(25)	0.002 0.028 0.023	4(7.3) 1(29.2)	1(2.4) 1(24.2)	3(5.4) 2(23.2)	1(5.3) 2(23.1)	0.15	2(4.4) 1(25.5)	4(4.8) 2(25.2)	3(6.8) 1(26.1)	0.13 0.73 0.059

***The ANOVA to compare the groups; the level of significance for the differences between groups 1 and 2, groups 1 and 3, and groups 2 and 3**

Discussion

Many studies have been conducted to date on safety culture in various industries; however, very few studies have monitored and assessed the attitude of miners toward safety culture given the difficult and hazardous nature of their job. The present study was conducted on 4 different job titles, including production workers, general service men and cleaners, repair and maintenance workers, and electricians. The various dimensions of safety culture, including management commitment, exchange of information, training, work atmosphere, and safety prioritization were assessed. The present study showed safety culture to be significantly related to the level of education and work experience, as high levels of safety culture maturity were observed in workers with high levels of education and work experience. The workers' commitment to safety issues also increased with their level of education, especially in management. These results are consistent with the results obtained by Lee et al. on safety culture in the nuclear industry (20). Further studies should therefore be conducted on administrative and management system workers to assess safety culture and the attitude toward safety in all mining industry workers and employees. A study conducted on safety culture in the Atomic Energy Organization of Iran showed that a high safety culture maturity is effective in increasing the workers' work spirit and reducing human errors in the workplace (21). Further studies on the level of safety culture among mine workers before and after safety training are recommended, so that the effect of training can be assessed on the workers' attitudes toward safety.

No relationships were observed between safety culture and marital status or the type of job in the present study, which is consistent with the results of a previous study conducted in Iran (17). This finding confirms that personal factors are less likely to have an effect on attitude toward safety and safety culture, and reveals that the workers' attitudes must be affected by their training and level of education. It can be concluded that, in all job categories, the workers' attitudes toward various issues can be independent of their marital status and type of job. Almost all the parameters measured in the safety culture questionnaire (management commitment, exchange of information, training, work atmosphere, and safety prioritization) are related to the management system. This indicates the importance of managerial policy-making in relation to safety, the management's attention to safety at work, the management's relationship with employees regarding safety, and the management's treatment of safety issues in the mine. Kines et al. studied the effect of the management system on promoting safety culture and the attitude toward safety among workers (22). They concluded that an increased level of safety culture maturity in the management in relation to commitment to safety issues and exchanging positive and constructive information with the workers improves safety culture dramatically among the workers (22). Grote claims that the managers' positive attitudes toward safety issues and efficient safety management strategies boost the workers' work spirits in complying with safety issues from the perspective of organizational safety culture (23). According to the results of the present study, workers' level of education is significantly related to safety prioritization. In other words, workers' and employees' attitudes toward the prioritization of safety as an effective strategy for the prevention of accidents increase with their level of education.

Management commitment is considered as one of the main parameters in establishing a culture of safety. With the management system's increasing commitment to safety

issues at work, workers' spirit of complying with safety rules will be strengthened. In the present study, management commitment was found to have a direct significant relationship with the level of education. In other words, highly educated managers feel a greater commitment to safety issues compared to poorly educated managers. In another study, Ruchlin showed a significant relationship between managers' level of education and their commitment to safety issues (24).

In the present study, a significant relationship was found between the workers' age groups and safety training; that is, younger workers and employees are more inclined to learn about safety. Nevertheless, workers with more work experience showed a positive attitude toward in-service safety training. This may be due to their better understanding of the need for safety training and their acknowledgement of the outcomes of training and compliance with safety rules over the years. In another study, O'Toole reported that long work experience and being young had a positive relationship with fully acquiring safety training, which is consistent with the results of the present study (25). To achieve the system's safety demands and requirements, especially a safety culture and attitude, an appropriate structure should first be planned and cultural and behavioral changes be simultaneously pursued to place the workers within the framework of this structure. Behavioral changes are more quickly achieved and tend to require a lower investment of time compared to cultural changes, and their benefits also emerge faster in the society. However, these qualities should not be taken to trivialize cultural programs. A review of literature shows a significant correlation between the safety atmosphere and the level of safety in industries. As shown in this study and in others, the management commitment to safety issues is an influential factor in establishing a positive attitude toward safety and a strong safety culture among industrial workers. Therefore, given the priority of this factor, organizational commitment to a safety culture and its establishment in such a way that is accessible to the workers can be claimed to be among the main factors involved in promoting a culture of safety in any industry or organization (23, 26, 27).

To create a positive atmosphere of safety in an industry or organization and incorporate safe working practices into the personnel's routine, management policies and commitment to safety and relevant issues should be directed toward generating a positive attitude in the workers. This will then allow individuals to have faith in the management's commitment to safety and to believe that safety is truly a priority for them. Furthermore, creating positive relationships, exchanging information, involving workers in decision-making, and demanding solutions from them further create a sense of ownership in workers. All these strategies can in turn lead to safer behaviors and a more positive atmosphere and culture of safety. Nevertheless, these strategies cannot be claimed to be the only factors affecting people's behaviors and attitudes. The dominant culture of the individual's family, society, and previous organizations can also have a role in this issue. Moreover, the personal attributes of individuals can also be responsible for their different attitudes and beliefs. The management cannot have control over these factors in any organization or industry (24-26).

A limitation of the present study was the lack of a systematic management system to assess safety culture maturity among the managers. In addition, the safety culture and attitude of the very few individuals in

managerial positions could not be compared with the workers' safety culture and attitude. Similar studies in different mines of the country are recommended to assess the industry's general safety culture and the attitude of its workers and managers toward safety, especially before and after training and the systematic implementation of a safety culture in all the units and processes of the organization.

Conclusion

As the establishment of a culture of safety has a major role in preventing accidents among workers, changing and promoting workers' attitudes toward safety is essential. Considering the existing relationship between education and safety culture and attitude, providing safety training for workers and improving their awareness of all the dimensions of safety culture will be effective in modifying their attitudes and ultimately reducing the rate of accidents. Although workers' safety culture and attitudes improve with an increased work experience, it is better to promote safety culture among workers in their early years of employment when the rate of accidents is high. Assessing new workers' and employees' safety culture and attitudes upon recruitment helps identify those with poor safety cultures in any dimension and arrange safety training courses to promptly improve their safety attitudes.

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