

# The Relationship between Safety Culture and Safety Behavior: An Approach to Occupational Accident and Injury Management

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## Abstract

**Background:** Safety culture can be a good indicator of safety performance which can contribute to the formation of the employee safety behaviors. Therefore, recognizing the dimensions of safety culture and their effect on the employee safety behaviors could be a useful step in the management of occupational accidents. As such, this study was conducted in order to investigate the relationship between safety culture dimensions with employee safety behaviors and accidents, in 2019.

**Methods:** This cross-sectional study was conducted on 315 employees in 19 different industries in one of the central provinces of Iran. Data collection tools included the safety culture and safety behavior questionnaires. Data were analyzed in IBM SPSS 22.0, using independent T-test, logistic regression, multiple linear regressions, and Factor Analysis.

**Results:** The results showed that safety culture had a multi-dimensional structure, and all of its dimensions had a positive and significant correlation with safety behaviors ( $P < 0.001$ ). In addition, safety culture had a significant inverse correlation with accidents ( $P < 0.05$ ).

**Conclusion:** Management commitment to safety is a key factor in the improvement of employee safety behavior. To reduce accidents and safety problems, it is recommended that the management should focus adequately on the safety policies and procedures.

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## Introduction

Safety culture is the result of values, attitudes, perceptions, efforts, and individual or collective behavioral patterns that determine commitment, success, and efficiency of a safety management system, resulting from multiple interactions targeted among the personnel (psychological dimension), jobs (behavioral dimension), and organizations (local or situational dimension).<sup>1-4</sup> Research on the safety culture and its dimensions is important because of two main reasons. The first reason is the advantage of safety culture as an appropriate leading indicator for evaluating the safety

performance of the organization. In fact, in recent years, in order to move away from the safety measurement methods based on lagging indicators, the movement has turned to leading indicators such as safety culture, safety climate, and safe behavior. This approach- for the success of safety management- focuses on the current safety activities. Therefore, measurement of safety culture was categorized in preventive safety performance indicators which provided the possibility of identifying weaknesses and deficiencies in the safety management system and paid more attention to issues before the accidents. The second reason is the role of safety culture in the formation of employee's safety behavior. Various safety

and health studies in this field have shown that attitude, behavior, and culture are the main causes of 85- 98% of occupational accidents.<sup>4,6</sup>

All the associated personal behaviors with the organization's safety have been perceived as safety behavior. The safety behavior includes safety compliance and safety participation that were considered to be components of individual safety performance.<sup>7</sup> Safety compliance involves activities that people must perform to maintain and expand their personal health and safety. These behaviors include following standard working instructions and using personal protective equipment. Safety participation explains the behaviors that do not have any direct roles in personal safety but contribute to the provision of a situation that increases safety and health levels in the organization; hence, the organization's safety targets are supplied. These behaviors include participating in voluntary safety activities and helping colleagues in issues that relate to safety and participation in meetings about safety. There are two different approaches for individual safety performance measurement. In the first approach, many of the studies have evaluated the safety performance based on accidents and micro-accidents indices and injuries. In the second approach, safe and unsafe behaviors were recorded and most of them selected safety behaviors for measuring the individual safety performance. Anyway, there is evidence that measuring safe/unsafe behaviors/acts and accidents/micro-accident/injuries supplementary indicate safety outcomes.<sup>8-10</sup>

Safety culture affects the attitude and behavior of employees about the safety performance of the organization. Promotion of a positive safety culture in any organization is an effective tool for developing safety. In a positive safety culture, employees are not only responsible for their own safety but also for the safety of their colleagues. In fact, when workers work in a workplace in which safety is a priority, they will follow safety instructions instead. This concept is completely in accordance with the social exchange theory which states that if employees perceive that the organization is interested in their welfare, they will have a commitment to behavior that would be useful for the organizations instead.<sup>11</sup> Some studies have shown that safety culture has a significant correlation with the rate of accidents occurrence.<sup>4</sup> However, Cooper also states that the relationship between three factors of safety climate, behavior and accident would not be clear as it is generally assumed.<sup>12</sup>

Safety culture has several dimensions, but the relationship between these dimensions and individual safety performance indicators has not been definitely confirmed, or at least it has not been confirmed in different countries and diverse industries with different cultural characteristics. Therefore, recognizing safety culture and its related factors in worker communities

and how each factor affects the employees' safety behavior could be a useful step in managing resources in order to reduce accidents. As such, this study was conducted to assess and analyze safety culture in the Iranian industry workers as well as survey the relationship between safety culture dimensions and employees' safety behaviors and accidents.

## Methods

This cross-sectional study was conducted on the industrial employees of one of the central provinces in Iran in 2019. Given the first type of error being equal to 5%, the study power of 90%, and the maximum correlation difference (study accuracy) being equal to 0.2, the minimum number of required samples was estimated to be 268. Furthermore, with regard to 15% loss, the minimum number of final samples was estimated to be 309. (Equation1). In the data collection step, 315 employees participated in the study.

$$n = \left[ \frac{Z_1 - \frac{\alpha}{2} + Z_1 - \beta}{|Z'_{r0} - Z'_{r1}|} \right]^2 + 3 \quad \text{Equation 1}$$

The participants were selected from 19 industries with more than 25 production line employees who had a total of 1654 production line personnel. The number of participants from each industry was selected due to the number of employees working in that industry in relation to 1654. Participants were selected from each industry in a simple random manner. In case of the selected person's unwillingness, a new person was replaced. Participants had to have at least one year of work experience in their current job.

Data collection tools included a questionnaire with three parts including safety culture, safety behavior as well as the demographics questionnaire

### *Safety Culture Questionnaire*

Safety culture was assessed using a 61-item questionnaire that was designed and validated to be used among Iranian industrial employees.<sup>13</sup> To assess its validity, we used Cronbach's alpha coefficient, exploratory factor analysis, and confirmatory factor analysis. The Cronbach's alpha coefficient and Guttman Split-Half coefficient of this questionnaire was obtained to be 0.97 and 0.95, respectively. In the items in this questionnaire were scored in five-point Likert scale (5 strongly agree, 4 favor, 3 no idea, 2 disagree and 1 strongly disagree), with higher scores indicating better safety culture.

### *Safety Behavior Questionnaire*

According to the above-mentioned description regarding this study, two methods were utilized for safety performance measurement. The first method was the occurrence of accidents to a person

through self-report of involvement in accidents. This is a reliable method for measuring individual safety performance.<sup>14</sup> Therefore, in a part of the questionnaire, the participants were asked if they had had any accidents during the previous year leading up to the study. Another method used in many studies for assessing the safety behavior is the use of safety behavior questionnaire.<sup>4, 15</sup> Therefore, a 23-item safety behavior questionnaire was used consisting of 12 items in terms of safety compliance and 11 items in the field of safety participation.<sup>7</sup> The items were scored using a five-point Likert scale (5 always, 4 often, 3 sometimes, 2 rarely and 1 never), with higher scores indicating safer behavior. Cronbach's Alpha coefficient for safety behavior questionnaire was obtained to be 0.902. In addition, Cronbach's alpha coefficient for safety compliance and safety participation were obtained to be 0.86 and 0.87, respectively.

In this study, the data were collected by referring to relevant industries, delivering questionnaires, and providing explanations on how to complete them. Finally, participants in the study completed questionnaires through semi-supervised self-reporting. Wherever an ambiguity arose, the necessary explanations were provided. Each participant was given 35 minutes to answer all the items.

#### Data Analysis

Data analysis was done using SPSS V.22 software. To assess the structural validity and determine the different factors of safety culture, we utilized exploratory factor analysis and confirmatory factor analysis. To determine the relationship between structural factors of safety culture and also that between the total score of safety culture and safety performance, we used Pearson's correlation coefficient. In addition, independent T-test was used to compare the mean scores of safety culture and safety behavior in workers with and without accident. To investigate

the association between independent variables with the occurrence of accidents as well as safety behavior, we respectively used binary logistic regression and multiple linear regression.

## Results

Analysis of demographic and occupational data showed that the mean and standard deviation of the participants' age were  $34.83 \pm 7.96$  with the average work experience being  $12.43 \pm 7.85$  and mean working hours per day being  $9.7 \pm 2.54$ . Other demographic and work-related variables are presented in Table 1.

#### Safety Culture Dimensions

The value of KMO (0.955) and Bartlett's test ( $X^2=11016.967$ ,  $P \geq 0.001$ ) for this set of variables implied that the requirements for Explanatory Factor Analysis (EFA) have been met. EFA results estimated 5 dimensions including "Management Commitment", "Safety Priority", "training", "safety Cooperation", and "preventive factors". These five dimensions totally have explained 59.12% of the total variance. Varimax rotation showed that all questions in the questionnaire were loaded on the five factors obtained. Confirmatory factor analysis confirmed these results (Table 2).

In Table 3 presents the correlation coefficients between different dimensions of safety culture. There was a significant positive correlation between all dimensions of safety culture.

#### Relationship of Safety Culture and Safety Behaviors

The results showed a significant positive correlation between all dimensions of safety culture and safety behavior ( $P > 0.01$ ) (Table 4). It was determined that among the different dimensions of safety culture, Management Commitment had the strongest relationship with safety behavior. The lowest relationship was observed in preventive factors.

**Table 1:** Demographic and work-related result

Variable	Category	Frequency	Percentage
Gender	Male	292	92.6%
	Female	23	7.4%
Marital status	Single	42	13.2%
	Married	273	87.1%
Job Type	Employees	25	8.2%
	Production worker	290	91.8%
Smoking	Yes	80	25.4%
	No	235	74.6%
Chronic disease	Yes	31	9.8%
	No	284	90.2%
Taking medicine	Yes	23	7.4%
	No	292	92.6%
Second jobs	Yes	54	17.1%
	No	261	82.9%
Accident(in one last year)	Yes	82	26%
	No	233	74%

**Table 2:** Fit indices of the confirmatory factor analysis models for safety culture dimension

Model fit index	Measurement model of safety culture	Acceptable level
$\chi^2/df$	2.12	<3
RMSEA	0.051	<0.08
CFI	0.958	>0.9

CFI=Comparative fit index; RMSEA=Root mean square error of approximation

**Table 3:** Correlation coefficient between dimensions of safety culture\*

	Mean	SD	1	2	3	4	5
Management Commitment	3.29	0.83	1				
Safety Priority	3.06	0.86	0.78	1			
Training	3.40	0.98	0.86	0.62	1		
Safety Cooperation	3.53	0.45	0.63	0.50	0.60	1	
Preventive Factors	3.17	0.85	0.59	0.79	0.49	0.41	1
Safety Culture	3.28	0.73	0.98	0.86	0.86	0.67	0.67

\*Correlation is significant at the 0.01 level (P value<0.001)

**Table 4:** Correlation coefficient between safety culture and safety behavior\*

	Management Commitment	Safety Priority	Training	Safety Cooperation	Preventive Factors	Safety Culture
Safety compliance	0.61*	0.63*	0.51*	0.57*	0.50*	0.65*
Safety participation	0.50*	0.28*	0.48*	0.40*	0.18*	0.47*
Safety Behavior	0.65*	0.53*	0.58*	0.57*	0.40*	0.66*

\*Correlation is significant at the 0.01 level (P value<0.001)

**Table 5:** Linear regression analysis of the relationship between safety culture and occupational and personal variables with the safety behavior

Model	B	Std. Error	Standard Beta	t	P	95% C.I. for B	
						Lower	Upper
Marital status	0.38	0.15	0.13	2.50	0.01	0.08	0.68
Chronic disease	0.27	0.13	0.11	2.12	0.03	0.01	0.52
Working hours per day	0.03	0.02	0.09	1.67	0.09	-0.00	0.06
Safety Culture	0.64	0.05	0.74	13.19	0.00	0.54	0.73

The Linear regression model shows that two individual variables including marital status and chronic disease beside safety culture have remained in the output of the model as predictor variables of safety behavior. The results show that the proposed regression model could explain 55% of the data (Table 5).

*Relationship between Safety Culture and Accidents*

Based on the results, safety culture score and its 5 dimensions, among workers that had an accident, were lower than those workers who experienced no accident (Table 6). Although the mean score of “safety Cooperation” in workers with accident was lower, the difference was not significant.

As shown in Table 7, the results of regression analysis showed that safety culture had a significant effect on the accidents and by increasing scores of safety culture, the probability of accidents decreased. It should be noted that Hosmer and Lemeshow’s test showed that regression analysis was appropriate to examine the relationship between safety culture and accident (P=0.82), and acceptable data was obtained by the model.

**Discussion**

*Safety Culture Dimension*

The results showed that all dimensions of safety culture have a strong direct and significant correlation with one another. The results obtained in this section are in line with those of previous studies carried out in Iran and other countries.<sup>16, 17</sup> According to the results of this study and other similar studies, management commitment to establish and comply with safety policies has the highest impact on the improvement of safety culture, and the organization management has a critical role in creating a positive and effective safety culture among employees of the organization. Therefore, if management of an organization intends to reduce the accidents and safety problems, there should be adequate focus and attention paid to the formation and implementation of safety policies and procedures as well as production, sales, and quality control.<sup>18, 19</sup>

*Relationship between Safety Culture and Safety Behavior*

A significant positive correlation was abtained

**Table 6:** Comparison of the safety culture in the participants with and without accident

	Accident History	Mean	SD	P value
Management Commitment	No	3.39	0.85	0.03
	Yes	3.15	0.75	
Safety Priority	No	3.17	0.89	0.01
	Yes	2.87	0.77	
Training	No	3.53	1.01	0.01
	Yes	3.20	0.88	
Safety Cooperation	No	3.56	0.46	0.10
	Yes	3.46	0.39	
Preventive Factors	No	3.22	0.90	0.04
	Yes	3.00	0.79	
Safety Culture	No	3.37	0.75	0.01
	Yes	3.13	0.66	

**Table 7:** Logistic regression analysis of the relationship between the safety culture and occupational and personal variables with the occurrence of the accidents

	B	S.E.	Wald	df	P	Odds Ratio	95% C.I. for OR	
							Lower	Upper
Working hours per day	0.17	0.08	3.96	1	0.04	1.19	1.00	1.40
Smoking	-0.76	0.43	3.09	1	0.08	0.47	0.20	1.09
Job Type (employee)	1.79	1.09	2.70	1	0.10	6.01	0.71	51.08
Work Experience	0.05	0.03	2.87	1	0.09	1.05	0.99	1.10
Safety Culture	-0.65	0.28	5.22	1	0.02	0.52	0.30	0.91

between all dimension of safety culture and safety behavior. Safety culture is one of the most important predictors of safety behavior, and by increasing safety culture by one point, 0.64 points are added to the score of safety behavior. These results are in line with those of other studies.<sup>20-23</sup> Dwomoh concluded that measures taken by the organization in the field of safety and health had positively affected the improvement of safety performance; however this relationship was weak.<sup>22</sup> The results of Hadjimanolis's study revealed that health and safety policies, safety climate, and organizational commitment had a statistically significant relationship with safety performance.<sup>23</sup>

Among the various dimensions of safety culture, the strongest correlation was seen between "Management Commitment" and safety behavior ( $r=0.65$ ). In this regard, some studies concluded that performance of management commitment in the field of safety was the most important determinant of the employees' safety performance.<sup>24</sup> Amponsah also concluded that employees' positive perception about attitudes and behaviors of the senior management towards safety was the basis for employees' safety behavior. This improves the safety performance of the organization, and negative perception of employees about management's commitment to safety can reduce the employees' safety behaviors.<sup>25</sup> Appropriate and effective implementation of safety policies and procedures is the main sign of management commitment to safety.<sup>26-28</sup> These policies affect the employees' organizational culture, occupational attitudes, organizational commitment, and job satisfaction which, in turn, positively affect the safety

climate of the organization. Organizational health and safety policies have a positive impact on the employees' organizational commitment. In addition, positive working attitudes lead to employees' stimulation for their performance of better safety behaviors. When a positive attitude has a positive effect on the employees' perceptions of safety climate, then safety climate helps to improve safety performance. On the other hand, safety policies increase job satisfaction and organizational commitment. Thus, companies are recommended to establish clear safety policies with the aim of producing a positive safety climate and risk prevention culture, with an emphasis on management commitment to safety.<sup>23, 29, 30</sup>

Based on the obtained results, the safety culture of the organization and employees' safety behaviors have relevant and coherent structures that are designed to improve the employees' safety performance level. It is necessary to invest the efforts of the whole organization in safety culture and improve it. However, according to the limited resources available for improving safety behaviors, there is a need to focus on areas where it is more efficient. According to the results of this study and other similar studies, the management commitment to safety had the strongest relationship with its employees' safety behavior; hence, management commitment is a key factor in the improvement of safety conditions. On the other hand, management commitment has a strong and positive impact on other safety culture dimensions; therefore, management commitment both directly and indirectly has a positive effect on improving safety behaviors.

### *The Effect of Safety Culture on Accidents*

It was revealed that safety culture and its 4 dimensions were significantly lower among people that had an accident. The results showed that safety culture had a significant and inverse correlation with accident. The probability of the occurrence accident for people who have a more positive perception of safety culture was significantly lower than those who have a negative perception about it. The results of this study are in line with those of other studies in this regard.<sup>31</sup> In his study, Amini found a significant and inverse relationship between safety culture and the frequency of accidents.<sup>32</sup> Shuen concluded that there was a significant negative correlation between safety culture and accident.<sup>33</sup> Contrary to these results, Morrow concluded that accident rate, as compared to other safety performance indicators, is a measure that is not much relevant to safety culture and has no significant correlation with safety culture.<sup>20</sup>

One potential limitation of this study is that employees' safety behavior is reported by participants themselves, which might have created bias in the study. The second limitation is the use of self-report involvement in the accidents that might have led to lack of reporting or recalling accidents by the subjects. Other methods such as investigation records events, safety sampling or supervisor ratings on safety behavior for measures of safety performance are suggested for future studies.

### Conclusion

The results of this study and other similar studies reveal that the safety culture of the organization has a significant impact on the employees' safety behavior and that an increase in safety culture in the organization subsequently improves the individual and corporate safety behaviors of the employees. As a result, by improving safety culture in the workplace, significant reductions in accidents can be expected. Among various dimensions of safety culture, "Management Commitment" had the highest effect on the individuals' safety performance. In addition, it was revealed that besides safety culture and safety behavior, a number of demographic and occupational variables affected the work-related accidents.

**Conflicts of interest:** None declared.

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