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# Safety climate assessment: a survey in an electric power distribution company

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*Introduction.* This study aimed to investigate safety climate and its structural dimensions as well as establish a relationship between safety climate and demographic variables in a power distribution company. *Method.* This cross-sectional study included 200 workers. The safety climate questionnaire recommended by the UK Health and Safety Executive was applied containing 43 questions in 11 dimensions. Demographic information was also assessed. SPSS version 22.0 was applied to analyze the data. *Results.* In total, 179 workers participated in this survey. The response rate was high (89.5%). Safety climate had the highest correlation with the management commitment dimension ($r = 0.754$). The total score of safety climate in this company was 3.37 on a scale ranging from 1 to 5. Among safety climate factors, the highest score was for safety-related training (3.87) but work pressure had the lowest score (2.80). Among demographic variables, a significant relationship was observed between safety climate and age ($r = 0.180$). *Conclusions.* Management as an organizational power can exert great influence on the promotion of safety climate. Moreover, adopting efficient training programs and making a balance in workload for decreasing work pressure can improve safety climate.

**Keywords:** safety climate; management commitment; safety-related training; workload

## 1. Introduction

Safety climate describes employees' perception of the safety state or prevailing conditions in a workplace that impacts upon safety in a particular place at a definite time [1,2]. Safety climate is relatively unstable and subject to change the psychological phenomenon [3]. Nevertheless, if safety climate is accurately evaluated, it can be effective in identifying and assessing potential problems in the workplace, enhancing safety behavior and decreasing the frequency and severity of accidents [4].

While there is consensus on the definition of safety climate, there is no common agreement on safety climate dimensions [5], so, over the last 40 years of study in this field, the structural safety climate dimensions are still challenging issues between researchers. Common methods to study safety climate and its factors are designing psychometric measurement instruments and using questionnaires [6,7]. Zohar [8] developed a safety climate questionnaire structured with eight dimensions. He emphasized the importance of the safety management system in safety climate. He concluded that the employees' perception of the manager's attitudes toward safety is the most important factor in safety climate. Some researchers confirmed Zohar's findings and pointed out that management commitment is the core dimension of safety climate that plays a key role compared to other dimensions [9].

Other scholars emphasized other dimensions, e.g., Dedobbeleer and Béland [10] considered both individual characteristics and safety management's commitment as influencing dimensions in safety climate. Choudhry et al. [11] combined these two aforementioned dimensions into one dimension and emphasized it as the most important dimension of perceptual safety performance. Wu et al. [12] claimed that a favorable safety climate depends on management, the safety system, competence and the employee's participation. He concluded that 85% of researchers in safety climate pointed out that safety involvement was the main dimension in safety climate. Bosak et al. [13] emphasized the influence of priority setting of other objectives to safety as well as management commitment in safety climate. Risky behavior was positively related to the priority of production when employees were under pressure for increasing production that could result in offending the safety rules, thereby increasing the likelihood of accidents [13]. High work pressure and the absence of safety priority are quite common problems in many organizations. These problems have been consistently used for predicting unsafe behaviors [12,14]. Amponsah-Tawaih and Adu [15] declared that management commitment moderates the relationship between safety behavior and work pressure. Other researchers mentioned other dimensions of safety climate such as safety

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rules, procedures, safety communication, the status of a safety committee, safety training, the work permit system, individual responsibility, work conditions, the level of risk, safety encouragement and the supervisory environment [16–18].

Flin et al. [16] pointed out that divergence in the structural dimensions of safety climate is influenced not only by differences within countries and different industries but also by linguistic and cultural differences. These differences may also reflect differences in sample populations, question generation and labeling of constructs [7]. Consequently, while safety climate structures are important, each structure is unique for a specific population. The review of studies also shows that choosing the structures is related to the taste and opinion of the researchers.

Since safety climate is essential in organizations and is a leading indicator for safety performance and preventing accidents [19,20], we investigate the relationship between safety climate with 11 dimensions and variables like age, work experience, work shift and educational level in a power distribution company in the west part of Iran. Although occupational accidents caused by electricity do not have a high percentage of total work-related accidents, they are remarkably fatal [21]. For instance, in the USA [22] and Taiwan [23], electrocution was the fifth and the second major cause of occupational deaths, respectively. Electrical work-related accidents have increased in recent years in Iran. The Social Security Organization (SSO) in Iran reported 363 accidents during 2 years (2012–2013) in the three main sectors of the electric energy industry, which are production, transmission and distribution of electric energy [24,25].

The safety climate questionnaire and its statistical analysis were carried out in an electrical power distribution (EPD) company in the west part of Iran to find answers for the following questions:

- What are the relationships between the structural dimensions of safety climate in this company?
- Which variables have correlations with safety climate in this case study?
- Which safety climate dimension is most essential in the improvement of safety climate?
- What is the relationship between demographic variables and safety climate?

## 2. Materials and methods

A survey study was carried out in an EPD company in the west part of Iran from December 2013 to February 2014. Various employees such as managers ($n = 23$), supervisors ($n = 55$), engineers ($n = 83$), technicians ($n = 102$), line workers ($n = 173$), administrative staff ($n = 97$) and services affairs ($n = 74$) work in this company. The Safety Climate Assessment Toolkit recommended by the UK Health and Safety Executive (HSE) [26] was applied to assess safety climate.

The questionnaire encompasses two sections: the first comprises demographic information such as age, job title, work experience, educational level and type of work shift. The second section is composed of 43 comprehensive questions on safety climate categorized into 11 dimensions including management commitment (MC), safety-related training (ST), safety communication (C), work pressure (WP), safety promotion (SP), employees' influence and involvement (EI&I), work permit system (PS), safety rules and procedures (SRP), safety encouragement (SE), safety committee (SC) and failure in safety rules (or rule-breaking) (RB). For the survey, first, 180 employees were chosen randomly as a sample size in this company [27]. Then, we added 10% to the sample size to cover the possibility of missing questionnaires, incorrect filling of the questionnaire and intent to leave the study. Finally, 200 employees were selected by utilizing the available sampling method.

The study commenced with an explanation of the purpose of the study. A lack of cooperation was understood as intent to leave the study. We expressed a confidentiality statement and reassured respondents that answers would be kept confidential and no data would be released in any form (printed, electronic, verbal, etc.) [28]. Then, in suitable time along with a tranquil atmosphere, the same persons were asked to fill in the safety climate questionnaires.

In total, 179 employees responded to questionnaires (89.5% response rate), which was high and did not need non-response analysis [28].

Questions in the questionnaire were scored based on a Likert scale. Persons gave their opinions for each positively keyed question in the form 5 = *strongly agree*, 4 = *agree*, 3 = *neutral*, 2 = *disagree* and 1 = *strongly disagree*. The negatively keyed items were scored reversely.

SPSS version 22.0 was applied for analyzing the data. To determine the external reliability in this study, 30 questionnaires were distributed among 30 respondents (excluding the sample studied); after 10 days, the questionnaires were distributed among the same respondents again. Spearman's correlation coefficient was used to determine the correlation between the results of the test and the retest. Furthermore, the Cronbach's $\alpha$ coefficient was used to assess internal consistency reliability for our case.

Descriptive statistics such as mean, standard deviation and frequency distribution were applied to determine employees' level of attitude toward the safety climate factors. The Mann–Whitney, Spearman and one-way analysis of variance (ANOVA) tests were utilized to analyze the relationship between employees' attitude toward safety climate factors and demographic variables.

## 3. Results

In this study, 179 completed questionnaires were collected with an 89.5% response rate. The average age

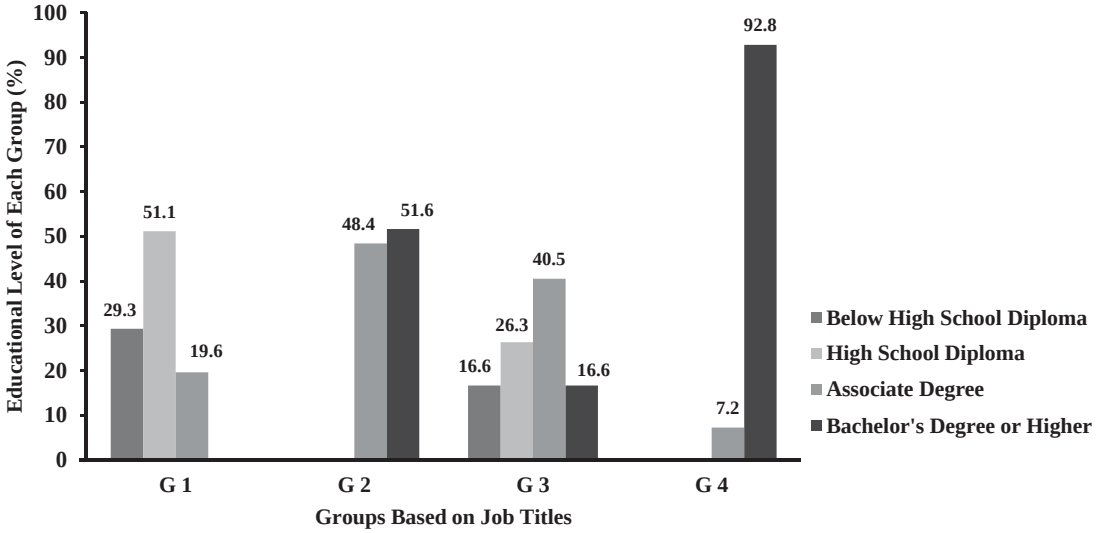


Figure 1. Frequency distribution of educational level in different job titles.
Note: G1 = line workers; G2 = supervisors; G3 = administrative staff; G4 = managers.

of participants was 38 years, and the age range was between 20 and 63 years. The average work experience was 132 months, ranging from 6 months to 30 years. This company had two different types of work shifts, either an 8-h daily work shift or a 12-h work shift with 1 day off. In the studied population, 116 (64.8%) persons worked in the 8-h daily shift and 63 (35.2%) persons worked the 12-h work shift.

For the convenience of the analysis, job titles were divided into four groups based on the similarity of their tasks. The groups included line workers (G1), supervisors (G2), administrative staff (G3) and managers (G4). Likewise, the education level was divided into four groups: below diploma, diploma, a college degree and a bachelor's degree or higher. Figure 1 shows the clustered bar graph for the frequency distribution of educational level for different job titles. As can be seen, the majority of line workers hold a diploma; however, the administrative staff and managers all had a university education.

### 3.1. *Reliability analysis*

The results of the reliability analysis showed that Cronbach's $\alpha$ coefficient, which is an index of reliability, ranged from 0.689 to 0.868. Spearman's correlation coefficient, used for measuring validity, was more than 0.691 for all dimensions of safety climate (Table 1). This indicates a high positive correlation of safety climate factors in the EPD company.

### 3.2. *The relation between safety climate dimensions*

In order to analyze the relationship between safety climate dimensions, Spearman's correlation coefficient was applied. The results are presented in Table 2.

Table 1. Spearman's correlation coefficient for the test and retest with Cronbach's $\alpha$ coefficient for each dimension of safety climate.

| Dimension of safety climate | Cronbach's $\alpha$ coefficient | Spearman's correlation coefficient for test and retest |
|---|---|---|
| Management commitment | 0.818 | 0.872 |
| Safety-related training | 0.706 | 0.751 |
| Safety communication | 0.722 | 0.713 |
| Work pressure | 0.689 | 0.743 |
| Safety promotion | 0.868 | 0.727 |
| Employees' influence and involvement | 0.848 | 0.762 |
| Work permit system | 0.740 | 0.816 |
| Safety rules and procedures | 0.795 | 0.738 |
| Safety encouragement | 0.713 | 0.691 |
| Safety committee | 0.697 | 0.748 |
| Rule-breaking | 0.738 | 0.702 |

According to Table 2, there is a positive, significant and strong correlation between safety climate and all of its dimensions. Safety climate has the highest correlation with management commitment ($r = 0.754$) and employees' influence and involvement ($r = 0.716$). There is a significant correlation among all safety climate dimensions with the exception of safety-related training, which has no significant correlation with the three dimensions of work pressure, safety promotion and rule-breaking. Furthermore, there is no significant correlation between safety rules and procedures with work pressure.

Figure 2 shows the scores for safety climate factors. The total score of safety climate was 3.37. The lowest score was for work pressure among safety climate dimensions (2.80) but safety-related training had the highest score (3.87).

Table 2. Spearman's correlation coefficient among safety climate dimensions.

| Dimension | MC | ST | C | WP | SP | EI&I | PS | SRP | SE | SC | RB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Management commitment (MC) | 1 | 0.244** | 0.532** | 0.499** | 0.582** | 0.509** | 0.345** | 0.187* | 0.385** | 0.487** | **0.282**** |
| Safety-related training (ST) | | **1** | **0.233**** | **0.128** | **0.143** | **0.499**** | **0.510**** | **0.187*** | **0.303**** | **0.421**** | **0.132** |
| Safety communication (C) | | | 1 | 0.465** | 0.326** | 0.495** | 0.381** | 0.215** | 0.307** | 0.390** | **0.212**** |
| Work pressure (WP) | | | | **1** | **0.475**** | **0.256**** | **0.391**** | **0.070** | **0.304**** | **0.338**** | **0.359**** |
| Safety promotion (SP) | | | | | 1 | 0.330** | 0.302** | 0.188* | 0.301** | 0.334** | **0.430**** |
| Employees' influence and involvement (EI&I) | | | | | | **1** | **0.448**** | **0.204*** | **0.512**** | **0.589**** | **0.238**** |
| Work permit system (PS) | | | | | | | 1 | 0.270** | 0.420** | 0.497** | **0.269**** |
| Safety rules and procedures (SRP) | | | | | | | | **1** | **0.197*** | **0.265**** | **0.312**** |
| Safety encouragement (SE) | | | | | | | | | 1 | 0.529** | **0.208**** |
| Safety committee (SC) | | | | | | | | | | **1** | **0.159*** |
| Rule breaking (RB) | | | | | | | | | | | **1** |
| Safety climate | **0.754**** | **0.503**** | **0.644**** | **0.575**** | **0.642**** | **0.716**** | **0.642**** | **0.393**** | **0.593**** | **0.638**** | **0.495**** |

*Correlation significant at the 0.05 (5%) level.
**Correlation significant at the 0.01 (1%) level.
Note: Bold numbers indicate significant correlation among safety climate factors.

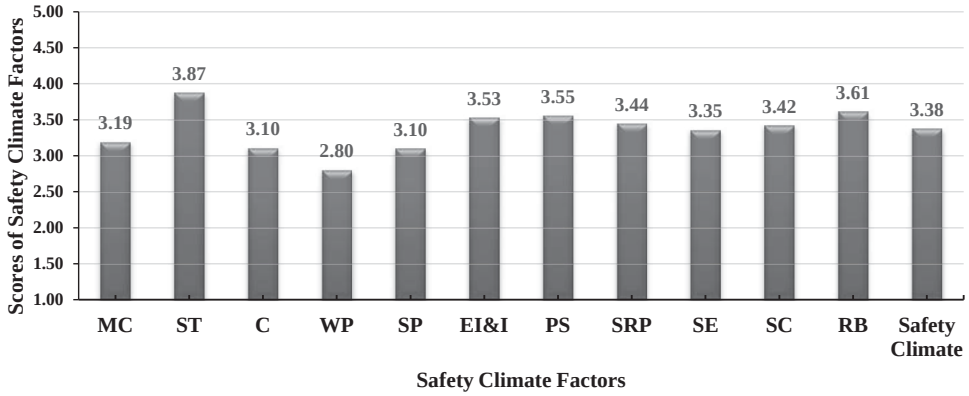


Figure 2. Factors of safety climate in the electrical power distribution company.
Note: C = safety communication; EI&I = employees' influence and involvement; MC = management commitment; PS = work permit system; RB = rule-breaking; SC = safety committee; SE = safety encouragement; SP = safety promotion; SRP = safety rules and procedures; ST = safety-related training; WP = work pressure.

### *3.3. Relation between safety climate dimensions and demographic variables*

The relation between safety climate dimensions and job title was determined by means of descriptive statistics on a scale of 1–5 and one-way ANOVA. As can be seen in Table 3, there is no significant association between job titles and safety climate dimensions.

Analyzing the $p$ value and Spearman's correlation coefficient between three demographic factors (age, work experience and educational level) and safety climate dimensions indicates that there were significant relationships and positive correlations between age and several safety climate factors such as work pressure, employees' influence and involvement, work permit system, safety encouragement and safety committee (Table 4). The educational level had a positive and significant relationship with safety rules and procedures. Finally, work experience had a significant association with the safety committee. In total, the results demonstrate that there was no significant relationship between safety climate and work experience as well as education level. For safety climate and work experience, the correlation coefficient is $r = 0.111$ ($p = 0.141$), and for safety climate and education $r = 0.007$ ($p = 0.923$), indicating no significant linear association between the two variables. By contrast, there is a weak but significant correlation between work experience and safety committee ($r = 0.184$, $p = 0.029$) and between education level and rule-breaking ($r = 0.152$, $p = 0.048$) as well as between education level and safety rules and procedures ($r = 0.168$, $p = 0.029$).

By contrast, the positive attitude toward safety climate rises by increasing the age. Moreover, analyzing the relationship between dimensions of safety climate and type of work shift by means of the Mann–Whitney $U$ test indicates that there were no significant relations between these dimensions and the type of work shift.

Table 3. Relation between the safety climate score and demographic variables.

| Feature | *N* (%) | Safety climate score | Minimum | Maximum |
|---|---|---|---|---|
| Type of work shift | | | | |
| Day worker | 116 (64.8%) | 3.381 ± 0.48 | 2.11 | 4.78 |
| Shift worker | 63 (35.2%) | 3.358 ± 0.48 | 2.16 | 4.67 |
| Education level | | | | |
| Below diploma | 36 (20.12%) | 3.301 ± 0.54 | 2.16 | 4.67 |
| Diploma | 56 (31.28%) | 3.403 ± 0.50 | 2.23 | 4.71 |
| Associate degree | 50 (27.93%) | 3.401 ± 0.47 | 2.43 | 4.78 |
| Bachelor's degree or higher | 37 (20.67%) | 3.341 ± 0.39 | 2.11 | 4.13 |
| Job title | | | | |
| Manager | 14 (7.8%) | 3.358 ± 0.31 | 2.73 | 3.89 |
| Supervisor | 31 (17.3%) | 3.392 ± 0.34 | 2.66 | 4.33 |
| Administrative staff | 42 (23.5%) | 3.377 ± 0.57 | 2.11 | 4.78 |
| Line worker | 92 (51.4%) | 3.367 ± 0.50 | 2.23 | 4.71 |

## 4. Discussion

The results of this study indicate the good validity and reliability of the safety climate questionnaire for application to the EPD industry in Iran. The validity and reliability of this questionnaire in other Iranian industries such as oil and gas companies and mines had been verified by Jafari et al. [29], Zare et al. [30] and Arghami et al. [31]. For instance, the questionnaire had proper validity and reliability in Iran's uranium mines because Cronbach's $\alpha$ for most factors was more than 0.7 and the Spearman coefficient was significant [32]. The results revealed that there was a positive and significant correlation among the majority of safety climate dimensions. Moreover, this positive and significant correlation observed between all dimensions and safety climate indicates a close and strong relationship among the 11 dimensions of safety climate; consequently, any changes either positive or negative in one dimension can influence other dimensions of safety climate.

Among all dimensions, safety climate had the highest positive correlation with the management commitment dimension, which is congruent with the study by Flin [33] which concluded that management commitment is the key element in safety climate. Management commitment to safety improvement influences workforce commitment, consequently developing real safety performance [34]. Furthermore, according to Dov [35], managerial commitment is the core factor in safety climate, with an important role in both the theoretical and empirical development of safety climate, which supports our findings in this study. The result of this study demonstrates that to create a positive safety climate in the organization it is indispensable that management develops policies in the field of safety, causing employees' attitudes toward a priority setting of safety for other strategic objectives of the company and resulting in safety rules being considered as values. Likewise, by making effective contact with personnel, safety communication, employees' influence and involvement in decision-making and attaching significance to their solutions or suggestions, management can give employees a sense of responsibility.

The lack of significant association between safety climate and the four demographic variables of work experience, educational level, type of work shift and job title demonstrates the approximately equal employees' attitudes toward safety climate as a result of the shared perception of safety climate.

It is noteworthy that the difference in educational level has not influenced the employees' attitudes toward safety. Nevertheless, there is a significant relationship between educational level and safety rules and procedures. Individuals with higher-level education obeyed the safety rules and procedures more than individuals with a lower educational level, which shows the influence of employees' awareness and perception of safety rules.

Based on the results, there is a significant relationship between age and safety climate demonstrating that age can positively influence employees' attitudes toward safety climate. Studies such as those by Siu et al. [36] and Lee and Harrison [37] concerning the relationship between age and positive safety attitudes, and safety consciousness, support our findings. By contrast, this result is not congruent with the studies by Hahn and Murphy [38] and Zare et al. [30] which could not find any relationship between age and safety climate.

The EPD company acquired a safety climate score of 3.37 on a scale of 1–5, which is a moderate safety climate. It seems that approaches such as balancing the workload, active support of managers in the field of safety and improvement of training programs can promote safety climate in this company.

The significant correlation between safety climate and safety-related training factor demonstrates that safety-related training is one of the most significant and influential dimensions in safety climate. Indeed, in other studies such as study, safety-related training was emphasized as a factor that can considerably improve safety behavior of an employee, or similarly Zohar [8] accentuated safety-related training as a significant dimension of safety climate. Likewise, the significance of sufficient safety training was identified as a central theme

Table 4. Statistical analyses between safety climate dimensions and demographic factors.

| | Age | | Work experience | | Education level | | Type of work shift | |
|---|---|---|---|---|---|---|---|---|
| Dimension | *r* | *p* | *r* | *p* | *r* | *p* | Mann–Whitney *U* | *p* |
| Management commitment | 0.114 | 0.140 | 0.056 | 0.470 | 0.038 | 0.627 | 3098.5 | 0.62 |
| Safety-related training | 0.148 | 0.051 | 0.136 | 0.073 | −0.029 | 0.708 | 3297 | 0.62 |
| Safety communication | 0.144 | 0.060 | 0.030 | 0.703 | −0.041 | 0.594 | 2950 | 0.32 |
| Work pressure | **0.163*** | **0.031*** | 0.104 | 0.174 | −0.043 | 0.574 | 3000 | 0.17 |
| Safety promotion | 0.050 | 0.515 | 0.037 | 0.634 | 0.091 | 0.232 | 3088 | 0.25 |
| Employees' influence and involvement | **0.177*** | **0.023*** | 0.140 | 0.075 | −0.077 | 0.325 | 2761 | 0.33 |
| Work permit system | **0.198**** | **0.010*** | 0.078 | 0.316 | −0.077 | 0.322 | 2687 | 0.08 |
| Safety rules and procedures | −0.018 | 0.816 | −0.071 | 0.359 | **0.168*** | **0.029*** | 2732 | 0.32 |
| Safety encouragement | **0.192*** | **0.011*** | 0.046 | 0.549 | 0.020 | 0.792 | 3391.5 | 0.78 |
| Safety committee | **0.150*** | **0.047*** | **0.184*** | **0.015*** | −0.089 | 0.240 | 3162 | 0.24 |
| Rule-breaking | 0.077 | 0.318 | −0.072 | 0.352 | **0.152*** | **0.048*** | 3163 | 0.70 |
| Safety climate | **0.180*** | **0.016*** | 0.111 | 0.141 | 0.007 | 0.923 | 3516.5 | 0.67 |

*Correlation significant at the 5% level.
**Correlation significant at the 1% level.
Note: Bold numbers indicate significant correlation among safety climate factors.

by Flin et al. [16] in their review of 18 safety climate scales.

The high correlation between safety-related training and the work permit system indicates that the training programs work efficiently in relation to the work permit; additionally, increasing the age can lead to increasing adherence to the work permit system.

Work pressure has the lowest score in our study. The lack of a significant relationship between work pressure and safety rules and procedures demonstrates the negligence in carrying out safety procedures in a high workload as a result of time and financial pressure in this company. Flin et al. [16] mentioned that work pressure is the most likely influential factor on safety climate in a workplace when time and resources become limited. Moreover, work pressure has no significant correlation with the safety-related training dimension, which can indicate that high work pressure negatively influences an employee's preferences in safety training programs.

Safety climate also has a strong correlation with the safety encouragement factor. Safety climate is a powerful incentive for leading workers to employ safe work methods. Besides, it can exert a positive influence on occupational accident prevention. Giving regular feedback as well as active support and encouragement by managers, supervisors and co-workers can give employees a sense of responsibility and commitment [39]. Furthermore, the safety encouragement factor had the highest correlation with the safety committee, indicating the essential role of such a committee. The committee can develop the reward system, attach significance to employees' motivation, encourage employees, lead supervisors to observe employees' behavior, emphasize the importance of training programs and submit a suitable report of all employees in order to reinforce safe behavior as well as attention to safety [39].

## 5. Conclusion

The present study analyzed safety climate and influencing factors in one EPD company. The results showed that the management's commitment was the most important dimension in this company. Factors such as the positive attitudes of management and employees toward safety, clear policy, the right budgetary decisions, the active role of safety committees and balance of the workload should be attached significance so as to ameliorate safety climate.

There was a positive and significant relationship between age and the majority of safety climate dimensions, which are work pressure, employees' influence and involvement, work permit system, safety committee and safety encouragement.

It is noteworthy to mention that this company requires adopting effective programs to promote safety climate and to increase safe behaviors along with a decline in the frequency and severity of accidents.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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