



Association between Safety Self-Efficacy, Safety Perceived Control, and Safety Behavior in Employees of a Selected Steel Industry, Iran (2023)

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Abstract

Background: Individual factors influence safety behavior, especially personality and psychological variables. Self-efficacy and perceived control are among these psychological drivers that were less addressed in the industrial environments and work safety. In this regard, the present study was conducted to investigate the association between safety self-efficacy and safety perceived control with the dimensions of safety behaviors.

Methods and Materials: This cross-sectional study was conducted in a steel industry in Yazd province during the spring of 2023. 252 employees from different occupational groups (workers, supervisors, and production managers) were included in the study. Griffin and Neal's questionnaire was used to check the safety behavior dimensions (safety compliance and safety participation). Moreover, safety self-efficacy and safety perceived control were evaluated using Proactive-Safety Role Orientation Questionnaire (PRO-SAFE). To analyze the data, correlation, Mann-Whitney, Kruskal-Wallis test, and multiple linear regression model were used. SPSS-24 software was used to analyze data.

Results: We found a positive and significant association between psychological drivers and safety behavior. The regression model showed that with a unit increase in the safety self-efficacy score, the mean score of safety compliance, and safety participation increased by 0.36 and 0.36, respectively. Furthermore, with a unit increase in the safety perceived control score, the mean score of safety compliance and safety participation increased by 0.41 and 0.44, respectively.

Conclusion: Considering positive and significant association between psychological drivers and safety behavior, creating and promoting psychological drivers in the individuals can improve the level of safety in the workplace and reduce accidents.

Keywords: Safety, Behavior, Psychological Feedback, Self-Efficacy, Occupational Accidents

Introduction

One of the major problems of technological progress and industrial activities is occupational accidents [1]. An occupational accident is an unexpected work-related occurrence that results in injury, damage, or death to an

employee or employees [2]. Occupational accidents are of grave concern to health and safety in the workforce, which can result in significant financial burdens for organizations. Other consequences of occupational accidents include lost working days, loss of specialized

human resources, and loss of reputation of the organization [3]. Statistics show that every year in the world, occupational accidents or diseases caused by them are responsible for 2.3 million deaths. Moreover, about 317 million accidents occur annually, most of which result in long absences from the workplace [4]. The findings of a research in Iran showed that the frequency of occupational accidents in 2007 and 2017 was 24,152 and 18,523, respectively, of which 0.4 to 0.6 percent of accidents resulted in death [5].

Considering the unfortunate and irreparable consequences of accidents, safety in workplaces was followed more seriously. There are different approaches and measures to improve the safety level of organizations and prevent accidents. The retrospective approach analyzes data related to accidents and injuries that are not effective enough to prevent accidents [6]. On the other hand, there are prospective and preventive actions that can help organizations before events occur [7]. In past studies, the cause of most accidents was reported to be unsafe behavior. Today, factors affecting unsafe behavior are important [8]. Examining the factors affecting safety behaviors to improve employees' safety behavior can reduce occupational accidents in workplaces [9]. In general, safety behavior refers to actions that are performed based on safety instructions. In usual, safety behavior is divided into two dimensions: safety participation and safety compliance. The distinction between these two aspects of safety is important because they may have different associations with other safety variables or personality variables [10]. Griffin and Neal suggested safety compliance and participation as important preventive measures.

Safety compliance includes the behaviors that employees should perform to maintain the safety of the workplace. Also, safety participation refers to manners performed voluntarily by a person and indirectly enhance the working environment's safety [11]. Considering the effect of employee behaviors on safety and accidents in the workplace, identifying and analyzing factors affecting safe behaviors is of great importance [12].

A review of studies shows that various organizational and individual factors are related to safety behaviors. The role of personality and psychological variables is significant. Different psychological factors have been considered for employees' involvement in expanding and enhancing workplace safety. The results of studies show that psychological characteristics have a significant effect on the safety performance, and ultimately the safety level of the organization [13, 14]. The findings of Rafiei et al.'s study showed that conscientiousness has a direct and positive effect on nurses' safety behaviors. Also, their findings showed that safety motivation in nurses has a significant effect on their performance and safety behavior [15]. The results of Subramaniam et al.'s study showed that safety

motivation can directly and significantly predict nurses' safety behavior [16]. Neissi et al. believe that personality traits, such as neuroticism, extroversion, agreement-seeking, and conscientiousness are related to people's insecure behaviors, and people's insecure behavior can be predicted based on mentioned personality traits [17].

As mentioned, personality traits and psychological drivers can affect people's safe behavior in the workplace. The most significant psychological factors influencing people's conduct are discussed in the research by Curcuruto et al. They looked at pertinent psychological factors that influence job safety in their research. Self-efficacy and perceived control are among these psychological drivers. Self-efficacy is defined as a person's degree of confidence in his ability to participate in a task. Thus, perceived control is defined as a person's belief to influence a certain process or environment [18]. So far, some of these psychological drivers such as felt responsibility were examined in various studies and their association with safety behavior has been confirmed [19, 20]. Until now, the association among various psychological characteristics with safety behaviors was studied, but safety self-efficacy and safety perceived control were investigated less. For this reason, this study aimed at examining a association between safety self-efficacy and safety perceived control with dimensions of safety behaviors in employees of a selected steel industry in Yazd province.

Materials and Methods

The current study consists of a cross-sectional study which was carried out in 2023. The study took place in a selected steel plant in the province of Yazd, Iran. The current research took into account workers, supervisors, and production managers who are employed in the steel sector. Every eligible employee received an invitation to take part in the research. Therefore, work experience of at least one year was considered inclusion criteria. Finally, 283 employees volunteered to participate in the study (Response rate: 89%). Finally, the questionnaire was delivered to the participants. Completed questionnaires were examined and finally, after removing incomplete questionnaires, 252 complete questionnaires were collected.

Demographic information questionnaire: The demographic characteristics of employees, including age, work experience, marital status, shift work status, occupational accident experience, education, and occupational group of employees (worker, supervisor, and production manager) were collected.

Safety behavior questionnaire: An employee's safety behavior was measured using the Griffin and Neal questionnaire. Two aspects of safety participation and safety compliance are looked at in this questionnaire.

Three questions are used to assess each dimension. The scoring method of questionnaire is Likert (1=completely disagree to 5=completely agree) [11]. The content validity of the Persian version of questionnaire was approved. Also, Cronbach's alpha coefficient of safety participation and safety compliance dimensions were obtained as 0.86 and 0.83, respectively [21].

Proactive-Safety Role Orientation Questionnaire (PRO-SAFE): Curcuruto et al. have presented this questionnaire. In this questionnaire, six stable motivational states were identified and related to the safety of workplace, which can be effective in terms of behavior, tendency, and motivation of workers in a specific field. The safety perceived control and safety self-efficacy are dimensions of this questionnaire. The safety self-efficacy dimension examines individual's confidence in their ability to participate in workplace safety programs. The safety perceived control dimensions, examines the individual's belief in influencing safety programs. Each of the safety perceived control and safety self-efficacy dimensions is checked with 4 items. Its scoring method is Likert (1 completely disagree = 1, I completely agree = 5) [18]. Research and verification were carried out into the psychometric properties of a Persian version of this questionnaire. Face and content validity has been

confirmed. Also, cronbach's alpha for safety self-efficacy and safety perceived control dimensions was 0.85 and 0.76, repetitively [22].

To describe the information of qualitative variables, frequency, and percentage indicators were used, and to describe the information of quantitative variables, if they were normal, the mean and standard deviation were used, and if they were not normal, the median and interquartile range indicators were used. Kolmogorov Smirnov test was used to check the normality of the distribution of variables. The data was further analyzed using correlation tests, Mann-Whitney, Kruskal-Wallis, and multiple linear regression models. The data was analyzed using SPSS 24 software. In all tests, a 5% significance threshold was used.

Results

The mean age and work experience of the employees was 37.17 ± 6.02 and 12.26 ± 5.65 years, respectively. The results of the survey showed that 221 of the employees (87.7%) were workers. Also, the number of supervisors was 24 (9.5%), and the number of production managers was 7 (2.8%). The results of the demographic information of employees are presented in Table 1.

Table 1. Demographic characteristics of the employees of a selected steel industry

| Variables | Classification | Frequency | Percentage |
|----------------------------------|--------------------|-----------|------------|
| Marital status | Single | 13 | 5.2 |
| | Married | 239 | 94.8 |
| Age | ≤30 | 44 | 17.5 |
| | 31-40 | 134 | 53.2 |
| | 41≥ | 74 | 29.4 |
| Education | High school | 35 | 13.9 |
| | Diploma | 91 | 36.1 |
| | Associate Degree | 33 | 13.1 |
| | Bachelor and above | 93 | 36.9 |
| Work experience | 10≤ | 93 | 36.9 |
| | 11-15 | 71 | 28.2 |
| | 16≥ | 88 | 34.9 |
| Occupational accident experience | Yes | 78 | 31 |
| | No | 174 | 69 |
| Shift work status | One-shift | 60 | 23.8 |
| | Three-shift | 192 | 76.2 |

As shown in Table 1, 31% of employees had an experience of occupational accidents. Also, the majority of employees (76.2%) work three shifts. The median (interquartile range) of the safety behavior score of all

employees was 3.83 (0.96). The results of examining the dimensions of safety participation, safety compliance, safety perceived control, and safety self-efficacy are presented in Table 2.

Table 2. The median score of safety compliance, safety participation, safety perceived control, and safety self-efficacy

| Variables | Dimensions | Median | Interquartile range | Minimum | Maximum |
|-----------------------|--------------------------|--------|---------------------|---------|---------|
| Safety behavior | Safety compliance | 4 | 1.33 | 1 | 5 |
| | Safety participation | 3.66 | 1 | 1 | 5 |
| Psychological drivers | Safety perceived control | 3.75 | 1 | 1 | 5 |
| | Safety self-efficacy | 3.62 | 1 | 1 | 5 |

The association between demographic variables and psychological drivers was studied using Mann Whitney and Kruskal Wallis tests. The results of Mann-Whitney test showed that there is no significant association between safety self-efficacy and safety perceived control with occupational accident experience and shift work status ($P>0.05$). The Kruskal Wallis test showed a significant association between education and safety self-efficacy ($P=0.03$). Also, a significant association was found between age, and safety perceived control ($P=0.003$). No significant association was found

between work experience, safety self-efficacy, and safety perceived control ($P>0.05$). The data analysis findings indicated that there was no statistically significant difference in the mean scores of safety self-efficacy and safety perceived control among workers, supervisors, and production managers ($P>0.05$). The association of demographic variables with safety compliance and safety participation was investigated. The results of this investigation are presented in Table 3.

Table 3. Comparison of safety compliance and safety participation scores in the classification of demographic variables

| Variables | Classification | Safety compliance | | | Safety participation | | |
|----------------------------------|---------------------|-------------------|---------------------|---------|----------------------|---------------------|---------|
| | | Media n | Interquartile range | P-value | Median | Interquartile range | P-value |
| Age | ≤ 30 | 3.5 | 1 | 0.01 | 3.66 | 1 | 0.14 |
| | 31-40 | 4 | 1.33 | | 3.66 | 1 | |
| | $41 \geq$ | 4 | 1 | | 4 | 1.33 | |
| Shift work status | One-shift | 4 | 1 | 0.89 | 4 | 0.67 | 0.34 |
| | Three-shift | 4 | 1.33 | | 3.66 | 1 | |
| Occupational accident experience | Yes | 4 | 1.33 | 0.88 | 3.66 | 1 | 0.86 |
| | No | 4 | 1.33 | | 3.66 | 1 | |
| Work experience | $10 \leq$ | 3.66 | 1.17 | 0.13 | 3.66 | 1 | 0.27 |
| | 11-15 | 4 | 1.33 | | 4 | 1.33 | |
| | $16 \geq$ | 4 | 0.67 | | 4 | 1.25 | |
| Marital status | Single | 4 | 0.67 | 0.95 | 4 | 0.83 | 0.51 |
| | Married | 4 | 1.33 | | 3.66 | 1 | |
| Education | High school | 3.66 | 1 | 0.06 | 3.33 | 1.33 | 0.11 |
| | Diploma | 4 | 0.67 | | 4 | 1 | |
| | Associate degree | 4 | 1.33 | | 4 | 1.67 | |
| | Bachelor and above | 4 | 1 | | 4 | 1 | |
| Occupational groups | Workers | 4 | 1.33 | 0.37 | 3.66 | 1 | 0.24 |
| | Supervisors | 4 | 1 | | 3.83 | 1 | |
| | Production managers | 4 | 1 | | 4 | 1 | |

A positive and significant association was found between age and safety compliance ($P=0.01$). Also, mean score of safety compliance and safety participation had no significant difference in the groups of workers, supervisors, and production managers (Table 3).

Due to the non-normal distribution of the variables as determined by the data analysis, the association between safety behavior dimensions and safety self-efficacy and safety perceived control was examined using Spearman's correlation test. The results of this investigation are presented in Table 4.

Table 4. Correlations of safety behavior dimensions and safety self-efficacy and safety perceived control

| Variables | Safety compliance | | Safety participation | |
|--------------------------|-------------------------|-----------|-------------------------|-----------|
| | Correlation coefficient | P-value | Correlation coefficient | P-value |
| Safety self-efficacy | 0.56 | < 0.001 | 0.58 | < 0.001 |
| Safety perceived control | 0.57 | < 0.001 | 0.58 | < 0.001 |

As presented in Table 4, there is a positive and significant association between psychological drivers and dimensions of safety behavior. The association between psychological drivers and dimensions of safety behavior in occupational groups was studied. The results showed that there is a positive and significant association between psychological drivers and

dimensions of safety behavior in occupational groups ($P<0.05$).

A multiple linear regression model was used to predict safety behavior dimensions. In this regard, univariate analyses were performed first, and significant demographic variables ($P<0.3$) were included in the final model. Age and occupational accident experience

were significant predictors of safety compliance in the multiple linear regression analysis; therefore, they were included in the final model. In multiple linear regression analysis to predict safety participation, marital status

was significant, and entered in the final model. Tables 5 and 6 show the results of multiple linear regression models.

Table 5. Results of multiple linear regression analysis to predict safety compliance

| Models | Variables | β | SE | P-value |
|-----------|--------------------------|---------|------|---------|
| *Model 1 | Safety self-efficacy and | 0.36 | 0.07 | < 0.001 |
| | Safety perceived control | 0.43 | 0.07 | < 0.001 |
| **Model 2 | Safety self-efficacy and | 0.36 | 0.07 | < 0.001 |
| | Safety perceived control | 0.41 | 0.07 | < 0.001 |

* Model fitting without considering demographic variables

** Model fitting by adjusting the effect of significant demographic variables

As shown in Tables 5 and 6, psychological drivers (by adjusting the effect of demographic variables) could significantly predict safety behavior dimensions. The regression model's findings demonstrated that the mean scores for safety compliance and safety participation

improved by 0.36 and 0.36, respectively, for every unit rise in the safety self-efficacy score. Also, a unit increase in the safety perceived control score, the mean score of safety compliance and safety participation increased by 0.41 and 0.44, respectively.

Table 6. Results of multiple linear regression analysis to predict safety participation

| Models | Variables | β | SE | P.value |
|-----------|--------------------------|---------|------|---------|
| *Model 1 | Safety self-efficacy and | 0.35 | 0.07 | < 0.001 |
| | Safety perceived control | 0.45 | 0.07 | < 0.001 |
| **Model 2 | Safety self-efficacy and | 0.36 | 0.07 | < 0.001 |
| | Safety perceived control | 0.44 | 0.07 | < 0.001 |

* Model fitting without considering demographic variables

** Model fitting by adjusting the effect of significant demographic variables

Discussion

A review of literature shows that psychological drivers are effective on safety behaviors and proactive partnership of employees in safety programs. The association between safety self-efficacy and safety perceived control with safety behaviors was investigated.

A positive and significant association was found between safety self-efficacy and safety behavior dimensions including safety compliance and safety participation. A favorable and substantial correlation was discovered between felt control over safety and several variables of safety behavior. The association between age and safety compliance was found to be positive and significant.

Participation in preventive safety actions and safety programs can be risky and challenging. So, researchers believe that psychological and motivational drivers are useful and necessary to create safe behavior and participation in safety programs [18]. The results of Homayounfar et al.'s study showed that self-efficacy is significantly related to safety behavior dimensions (safety compliance and safety participation), which is consistent with the results of this research. It is necessary to mention that in the current study, the self-efficacy of individual in the field of safety was investigated, which is different from the study of

Homayounfar et al [21]. Ma et al. conducted a study to examine the correlation between self-efficacy and safety behavior among hospital nurses in China. By enhancing self-efficacy, it is possible to enhance the nurse's safety behavior and thus ensure the patient's safety, according to the findings of their study [23]. In the study of He et al., the association of self-efficacy, hope, resilience, and optimism with dimensions of safety behaviors (safety compliance and safety participation) was studied in construction workers in China. The results of their study showed that the self-efficacy dimension had a positive effect on safety compliance and safety participation, while the resilience dimension had a positive effect on safety participation. Thus, the dimension of optimism had a negative association with safety participation [24].

The felt safety responsibility is one of the psychological drivers that can affect people's safety behaviors [18]. The results of Wang et al.'s study showed that the Felt safety responsibility and affective commitment have a positive effect on the safety behavior of employees [19]. The results of another study showed that the felt responsibility is one of the factors influencing safety behavior [25]. Numerous studies have underscored the significance of perceived safety responsibility in relation to safety behavior, as personnel who hold a greater sense of felt safety responsibility are more

motivated to accomplish the collective objectives of the organization. Therefore, employees who feel less responsible for safety under the conditions of the organization, do not want to change their safety behavior [20]. In fact, psychological drivers can make individuals understand their role to achieve the organization's safety goals, such as reducing incidents and injuries. Psychological drivers such as felt safety responsibility can determine the reason for the individual to help improve safety by proactive safety behavior [18, 19]. Besides, psychological drivers can affect proactive safety behavior through individual's motivation. In a study, the association between safety behavior and safety motivation in nurses was confirmed [16]. Many researchers emphasized the need to motivate and involve individuals in raising safety levels, based on a review of studies. In improving the level of safety and reducing occupational accidents, it is possible to focus attention on factors that increase employee motivation and engagement [18, 26].

Considering the important role of psychological drivers to promote proactive safety behaviors, paying attention to factors that affecting on promotion of drivers is very important. So far, some effective factors on psychological drivers were studied in various studies [20, 27]. People's safety self-efficacy significantly increases when they participate in safety interventions, according to the findings of Nykänen et al.'s research. Thus, people's participation in safety interventions brings a significant increase in safety motivation [28]. Wang et al. found that the felt safety responsibility has a negative and significant association with the safety-role ambiguity and safety-role conflict [19]. A review of studies showed that psychological drivers can be affected by organizational, individual, and background factors. So, some psychoactive drivers are more effective and relevant in different conditions. This issue needs further investigation.

The safety behavior can be affected by organizational, individual, and background factors. In this regard, people's safety behavior can be affected by some organizational factors. The research conducted by Naji et al. revealed a noteworthy correlation between the safety performance of personnel in the oil and gas sector and the safety culture. Additionally, as a mediator, the psychological aspects of the workplace have a big impact on safety performance [29]. Also, organization's safety climate can predict the safety behavior of employees, so safety behavior plays the role of a mediator between safety climate and occupational accidents [9]. The results of Kaynak et al.'s study showed that the implementation of health and safety programs, such as safety guidelines, risk management programs, training, etc. directly affects the organizational commitment of employees, and indirectly affects their job performance [30]. The results of various studies showed that organizational support in

the field of safety and necessary measures to improve safety make workers believe the importance of safety issues in the organization, and for this reason, the probability of changing workers' safety behavior increases [31, 32].

There are limits to this study which could influence the results. This study is a cross sectional research which has been carried out at the steel industry of Yazd province. Thus, the effect of organizational and individual variables was not studied. Using self-report scales is another limitation of the research. Further research is recommended in various industrial and mining settings, as exhaustive investigations in these environments can reveal the precise associations between the variables. It is suggested that the role of variables, such as safety knowledge, risk perception and organizational support for proactive safety should be investigated in future studies.

Conclusion

In general, the results of this study showed that psychological drivers, such as safety self-efficacy and safety perceived control have a positive association with the dimensions of safety behaviors. Considering significant association between psychological drivers and safety behavior, creating and promoting psychological drivers in people can improve the safety level of the workplace and reduce accidents. In this regard, it is proposed to undertake measures such as enhancing people's engagement in safety interventions and managers' commitment to safety. It is also recommended to provide psychological therapies and training in this subject. It is suggested to study the role of variables, such as organizational safety culture, management's commitment to safety, and safety training in future studies.

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Ethical Considerations

The participants were informed about the objectives of the study, and a written consent was obtained. Also, the managers and officials in the HSE ward were informed of these objectives and methods. They've been assured that all information will be kept secret.

Code of Ethics

The research was endorsed by the Ethics Committee of Yazd Shahid Sadoughi University of Medical Sciences (Ethics Code: IR.SSU.SPH.REC.1401.169).

Authors' Contributions

MJN, RJN, and GHH contributed to the Project administration, Conceptualization, Formal analysis and Writing—original draft. RS, and HM contributed to the Methodology and Writing – review & editing.

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