MSD

Medical Science and Discovery
ISSN: 2148-6832

# The relationship between occupational accidents and the safety climate of blue-collar workers in the metal industry

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## ABSTRACT

**Objective:** This study aims to reveal the ability of a safety climate assessment to make predictions regarding occupational accidents that occur in a metal sector workplace.

**Material and Methods:** This cross-sectional study was conducted with metal sector workers. Two sub-dimensions, the security climate scale, and an 18-question form, were used for data collection. The Chi-square, 'Student's t-test, and logistic regression tests were used to determine the relationships with occupational accidents. A correlation analysis was applied between the total scale score and its sub-dimensions.

**Results:** The questionnaire was completed by 289 workers (90.1%). In their current workplace, 28.4% had at least one work accident. The total score of the occupational safety climate was 61.11±6.90, and each unit was observed to increase the occupational safety climate score provided there was a 4.6% (95% CI: 0.6–8.4%) decrease in occupational accident reporting. There is a 1.10 (95% CI: 1.04–1.17) fold rise in reported work injuries for every additional year the workers work in this workplace (p = 0.001). Compared to unmarried people, married people recorded 3.24 times (95% CI 1.02–10.35) more workplace injuries.

**Conclusion:** According to the data, employee safety monitoring mediates the relationship between a safe environment and occupational accidents.

**Keywords:** Occupational health; metal industry; safety climate; occupational accidents

## INTRODUCTION

One thousand employees die every day due to workplace accidents and 2.3 million people per year due to unsafe workplace conditions (1). The economic burden caused by work-related diseases and deaths constitutes 4% of the gross domestic product (2). The 2016 cost of occupational injuries and occupational diseases in Turkey is estimated to be greater than 100 billion US $ (3). In 2016, the metal industry ranked fifth with 4.06% in terms of the activity groups with the highest number of deaths due to occupational injuries and diseases (4).

In Iran, an epidemiological study was investigating the rejection of preventive training for occupational accidents and the lack of widespread use of appropriate PPE in the metal sector, it pointed out the scarcity of occupational health and safety professionals as an element of safety culture (5). Occupational injuries in a metal factory in Ankara have been associated with the lack of vocational training and problems with the usage of personal protective equipment (PPE) (6). In addition, studies are suggesting that non-occupational factors and personal characteristics associated with occupational injuries should also be taken into account (7, 8).

There are hints of a complex, albeit negative, the relationship between the safety climate and occupational injuries (9–11). It has been determined that employees who perceive the workplace as safe have fewer occupational injuries (11–14). Safety climate is the perception of workers in the work environment towards job security (15).

**Research Article**

**Received** 09-06-2021

**Accepted** 23-06-2021

**Available Online:** 24-06-2021

**Published** 30-06-2021

Cooper and Phillips stated that the development and testing of theoretical models examining the relationship between the safety climate and occupational injuries is one of the essential stages in the development of the work safety climate literature (**16**).

This study aims to reveal the ability of a safety climate assessment to predict occupational accidents for blue-collar workers in a workplace operating in the metal sector in Ankara.

# MATERIAL and METHODS

There are 320 blue-collar employees in the workplace that has been operating in the metal sector for about 30 years in Ankara. The occupational health and safety service organisation is provided with an institutional infrastructure. This cross-sectional study aims to cover all blue-collar workers working in a workplace operating in the metal sector in Ankara and is not sampled.

**Data collection process and tools**

The participants were contacted by the workplace doctor, who is one of the researchers, through regular health checks between September and November 2019. Although the occupational accident experienced by the employees in this workplace are recorded, they were interviewed face to face in order to include any notifications that may not have been recorded. In addition, an 18-question questionnaire containing personal characteristics and working conditions was used.

The occupational safety perception was evaluated with the Safety Climate Scale consisting of 14 statements. The Turkish adaptation and validity of the scale developed by Choudhry, Fang and Lingard in 2009 were carried out by Türen et al. in 2014. Management's perspective and rules were examined with ten propositions, and colleagues and safety training with four propositions (**17**). Each statement was scored with a five-point Likert scale (1: strongly disagree, 5: strongly agree), and the total score was included in the analysis.

**Statistical Analysis :** SPSS (version 23.0) was used in the study's analysis. Descriptive data were analysed using frequency, mean, and median. The Chi-square test and Student's t-test were used to examine the relationships between work accident experiences and individual factors, demographic characteristics, working conditions, and the occupational safety climate. Logistic regression analysis was performed to determine the corrected relationships of all explanatory variables to the dependent variable. Correlation analysis was applied between the scale total score and its sub-dimensions. The suitability of the data for factor analysis was examined using the Kaiser Meyer Olkin (KMO) value. Exploratory factor analysis was used to determine the 'scale's success in measuring the predicted structure. In addition, the correlation between each item in the scale and the dimensions were examined. 'Cronbach's alpha coefficient was calculated for internal consistency. A possible 'Cronbach's alpha value above 0.7 was accepted as a good consistency criterion. The significance value of the analyses was accepted as $p<0.05$.

**Ethical approval:** Ethical approval of the study was given by the Medical Research Ethics Committee of the Ege University Faculty of Medicine (with decision number 19-8.IT/11, dated 21.08.2019). Permission was obtained from the workplace managers for the participation of the occupational physician. All participants were informed about the purpose of this study, the duration of the interview, and their right to decline or withdraw; then, verbal and written consent was obtained.

# RESULTS

Two hundred eighty-nine (90.1%) of 320 employees invited to the study answered the questionnaire. Eighty-two of the workers included in the study (28.4%) declared that they had an occupational accident at the current workplace. Two hundred eighty-eight of the participants were male, average age 36.6±7.9, 84.8% were married, 88.6% have had a minimum of a high school education. Only 12.5% of participants had an income that was higher than their expenses, only 29 (10.0%) of the employees stated that they received training on the job. The average number of years of experience in the workplace where participants are currently working is 7.6±7.6 (**Table 1**).

**Table 1:** The distribution of the characteristics of the employees according to their responses

| Features | | n* | %** |
|---|---|---|---|
| Age (36,6±7,9) | ≤40 | 209 | 76.8 |
| | >40 | 63 | 23.2 |
| Gender | Female | 1 | 0.3 |
| | Male | 288 | 99.7 |
| Marital status | Single | 40 | 13.8 |
| | Divorced | 3 | 1.0 |
| | Widow | 1 | 0.3 |
| | Married | 245 | 84.8 |
| Education | Primary school and below | 10 | 3.4 |
| | Secondary school | 23 | 8.0 |
| | High school | 196 | 67.8 |
| | University and above | 60 | 20.8 |
| Alcohol use | Yes | 43 | 14.9 |
| | No | 177 | 61,2 |
| Smoking | Yes | 169 | 58.5 |
| | No | 120 | 41.5 |
| Accident at the current workplace | Yes | 82 | 28.4 |
| | No | 207 | 71.6 |
| Income and expenditure perception | Income <Expense | 68 | 23.5 |
| | Income = Expense | 183 | 63.3 |
| | Income> Expense | 36 | 12.5 |
| Occupational educated | Yes | 260 | 90.0 |
| | No | 29 | 10.0 |
| Workplace experience (years) (7,6±7,6) | 0-5 | 149 | 51.7 |
| | 6-10 | 76 | 26.4 |
| | >11 | 63 | 21.9 |

*There are missing data for some variables. ** Percentage of columns

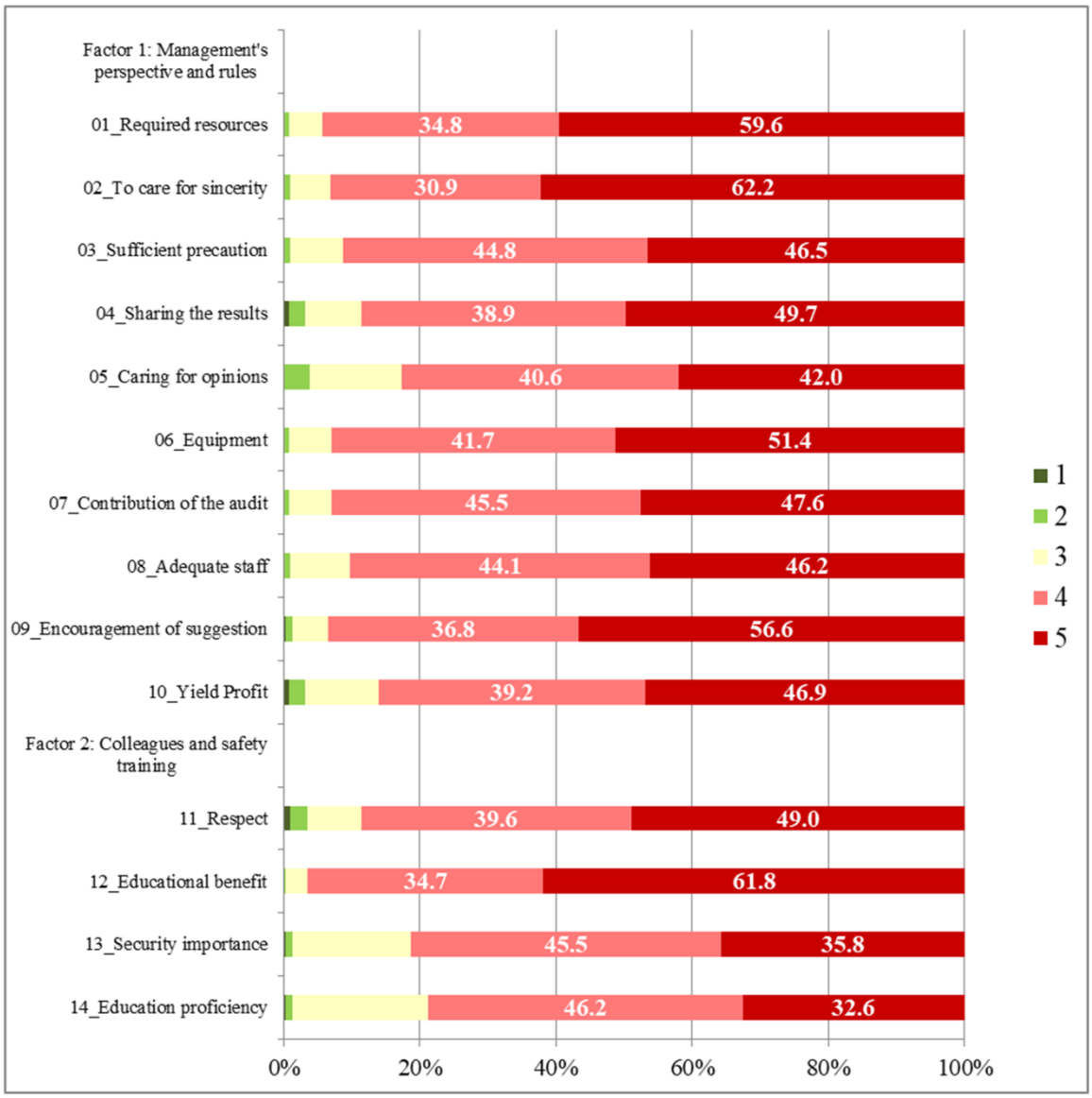
The total score of the participants for the occupational safety climate was 61.11±6.90, the dimension of the managers' commitment to the security issue was 43.94±5.20 and the dimension of the colleagues and safety training was 17.16±2.25, shown in **Table 2**.

A high positive correlation was found between the total score of the scale and the sub-dimensions of the scale (Pearson Correlation, 0.970 and 0.827, respectively, $p <0.005$). There is a high positive correlation between scale sub-dimensions (0.666, $p <0.005$). When the correlation of the items in the scale with their dimensions was examined, it was seen that each item showed a higher correlation with its own dimension.

http://dx.doi.org/10.36472/msd.v8i6.558

**Table 2:** Employees' Occupational Safety Climate Scale scores

| | Mean | Sd | Median | Q1 | Q3 |
|---|---|---|---|---|---|
| **Total Score** | 61.11 | 6.90 | 62 | 56 | 67 |
| **Factor 1: Management's perspective and rules** | 43.94 | 5.20 | 45 | 40 | 48 |
| **Factor 2: Colleagues and safety training** | 17.16 | 2.25 | 17 | 16 | 19 |




(1: strongly disagree, 5: strongly agree)

**Figure 1:** Percentage distribution of the responses given to the propositions

**Table 3:** Logistic regression assessment of factors associated with occupational injuries.

| Features | Mean ± SD | Crude OR | 95% CI | | Adjusted OR* | 95% CI | |
|---|---|---|---|---|---|---|---|
| Safety Climate | 59.74±6.62 | 0.962 | 0.927 | 0.998 | 0.954 | 0.916 | 0.994 |
| Age (years) | 39.79±7.77 | 1.072 | 1.036 | 1.109 | 0.982 | 0.923 | 1.044 |
| Workplace experience (years) | 11.82±8.43 | 1.100 | 1.063 | 1.1439 | 1.103 | 1.039 | 1.170 |
| Married | 78 (31.8%) | 4.671 | 1.614 | 13.513 | 3.244 | 1.017 | 10.348 |
| Not married (ref) | 4 (9.1%) | | 1.000 | | | 1.000 | |

KMO values of the data were 0.929 and 0.704 for the dimensions, respectively, while this value was 0.929 for the whole scale. The factor loads of the items varied between 0.536 and 0.819 for the sub-dimension of the managers' commitment to the security issue, while the only proposition for the coworkers and security dimension remained at 0.474, while the others varied between 0.709 and 0.879. The Cronbach's alpha values were 0.909 and 0.775 for the two factors, respectively. It was found to be 0.919 for the occupational safety climate scale. The percentage distribution of the responses of the employees to the items of the scale is shown in Figure 1. While the 12th item (96.3%) in the second sub-dimension (colleagues and safety training) had the highest positive (Strongly Agree + Agree) percentage of the items, the lowest percentage was the 14th item (78.8%) in the same dimension. For the first sub-dimension, the first item had the highest percentage (94.4%), while the fifth item had the lowest rate (82.6%)

**Table 3** shows the factors associated with occupational injuries. According to the corrected logistic regression analysis, the score increase in the perception of occupational safety has a significant relationship with the decrease in work accident reporting. Each unit increase in the work safety culture score provides a 4.6% (95% CI: 0.6-8.4%) decrease in work accident reporting (p = 0.025). Each extra year that employees work in this workplace provides a 1.10 (95% CI: 1.04-1.17) fold increase in work accident reporting (p = 0.001). 3.24 times (95% CI 1.02-10.35) occupational accident reporting was realised in married people compared to unmarried ones. The relationship between age, which was determined in univariate analyses, and the state of having an occupational accident, lost its significance in the multivariate analyses (p> 00.5).

## DISCUSSION

This study, which aims to reveal the relationship between work injuries and safety climate by making an assessment of the safety climate for blue-collar workers in a workplace operating in the metal sector in Ankara, has shown that; each point increase in the occupational safety climate provides a 5% reduction in occupational accident reporting. Increased safety measures contributed to the decrease in work accident indicators in the metal industry, as in all fields of work (**8, 14).** In workplaces where the occupational safety climate has increased, it is more common for employees to report risky situations before a work accident occurs (**18**). This provides opportunities for occupational health and safety professionals charged with managing risk, to provide safe work environments. For workplaces where a safe climate cannot be provided, the risk of occupational injuries becomes more pronounced. For example, in a cohort study conducted in Denmark, the OR 2.22 (95% CI 1.60–3.09) for reporting at least one accident in 2014 was found to be higher in those who reported three or more safety climate problems in 2012 than those who did not identify any safety climate problems in 2012 (**19**). Where the workplace safety climate is improved through cooperation between managers and employees, there is a positive effect on occupational safety performance (18).

As workplace safety has received increased attention (**8**) less-experienced workers are considered a higher risk for occupational accidents. However, in this study, there was a 1.1- fold increase, per year worked, in accident reporting for blue-collar workers. In the study carried out by Çınar et al. (2018) in the metal sector in Konya, it was reported that accident reporting of experienced employees was high, with more than half (56.37%) of those reports associated with employees with five or more 'years' experience (**20**). It is possible that as occupational accidents are unusual cases, those with more extended work experience will remember them more vividly.

In this study, the notification of an occupational accident in the metal sector was 3.2 times higher for married blue-collar workers than for those who were not married. This was found to be one of the variables associated with occupational accident reporting in Iran between 2008 and 2012, where married people reported more work accidents. The significance of this result was ascribed to married people working harder and taking dangerous duties because of increased responsibilities in the workplace (**21**).

In this study, 84.8% of the participants were married, with an average age of 36.6. Of this group, 88.6% had a minimum of a high school education, professional experience of 16.5 years, and current workplace experience of 7.6 years. In a similar study conducted by Gülhan et al. in a metal factory in Ankara in 2011, the average age was 35.4 ± 8.1, 88.0% of the group were married and had 15.5 ± 8.7 years of professional experience. However, the level of education shows a distinct difference (**6**). In a similar study conducted in India, the average age of island metal workers was 35.7 ± 7.4 years, 85% of the workers were married, 35% had a postgraduate education, and the average working time was 5.7 ± 1.9 years (**8**). However, as in the example for Addis Ababa, there were different profiles of participants conducting accident research in the metal sector, with less work experience and a lower educational profile (**22**).

There was a high positive correlation between the total score of the Occupational Safety Climate Scale, the sub-dimensions of the scale, and each item on the scale. This made it possible to discuss the relationship between the numbers of occupational accidents at work with the total score on the scale. However, the safety climate is a temporary phenomenon and subject to change. As a result, there are some variables that cannot be accommodated in this type of study.

## CONCLUSIONS

According to this study, each point improvement in the occupational safety environment results in a 5% reduction in occupational injury reporting for blue-collar workers in a workplace working in the metal sector in Ankara. According to the data, employee safety monitoring mediates the relationship between the safety environment and occupational injury. In the metal sector, as in all fields of employment, increased safety measures lead to a decline in work injury indicators. These findings emphasise the importance of using organisational variables and employee characteristics to improve organisational safety performance.

**Author Contributions: SD, SA:** Literature Search, Study design, Data collection, and Statistical Analyzes, **SD:** Article writing and revisions. Final approval for publication.

**Financial & competing interest's disclosure**: The authors have no relevant affiliations or financial involvement with any organisation or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

**Ethical approval:** The study was conducted according to the guidelines of the Declaration of Helsinki and approved by Local Ethical Committee.

**Conflict of interest:** The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. This research did not receive and specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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