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RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

A Survey on Safety Culture: Firefighters

Güvenlik Kültürü Üzerine Bir Araştırma: İtfaiyeciler

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Abstract
This study aims to investigate the level of the safety culture of firefighters and the factors that affect the safety culture, and to find out the answers to the questions on which areas the safety of firefighters can be developed, and what can be done in these areas. In this study, the safety culture questionnaire developed by S. Williams in 2007 as a measurement tool is applied to 209 fire brigades, and the safety culture level of the participants is determined by statistical analysis. In order to determine the significance level of the relationship between the participants' responses to the safety culture questionnaire and the determined 11 hypotheses, the chi-square test is used, and the results are analyzed under three categories. As a result, a significant difference is found between the safety culture of firefighters, their education levels and occupational accidents. There is also a significant difference between the firefighters' accident situations and their ranks.
Keywords: Safety culture; Fire department; Occupational safety

Öz
Bu çalışmanın amacı, itfaiyecilerin güvenlik kültürünü ve güvenlik kültürü düzeyini etkileyen faktörleri araştırmak ve itfaiyecilerin güvenliğinin hangi alanlarda geliştirilebileceği ve bu alanlarda neler yapılabileceği sorularının cevaplarını bulmaktır. Bu çalışmada, 2007 yılında S. Williams tarafından bir ölçme aracı olarak geliştirilen güvenlik kültürü anketi, 209 itfaiyeciye uygulanmış ve katılımcıların güvenlik kültürü düzeyi istatistiksel olarak belirlenmiştir. Katılımcıların güvenlik kültürü anketine verdiği yanıtlar ile belirlenen 11 hipotez arasındaki ilişkinin önem düzeyini belirlemek için ki-kare testi kullanılmış ve sonuçlar üç kategori altında analiz edilmiştir. Sonuç olarak, itfaiyecilerin güvenlik kültürü ile eğitim düzeyleri ve iş kazaları arasında anlamlı bir fark olduğu bulunmuştur. İtfaiyecilerin kaza durumları ile rütbeleri arasında da önemli bir fark olduğu tespit edilmiştir.
Anahtar Kelimeler: Güvenlik Kültürü, İtfaiye Departmanı, İş Güvenliği

I. INTRODUCTION

There is a safety risk in every occupation, but firefighting is considered one of the most risky occupations [1]. The main purpose of fire brigades around worldwide is to create a safe and healthy environment for firefighters by eliminating fire and similar social risks while minimizing the occupational risks that arise during the intervention [2]. When the historical process of the fire brigade is examined, it is revealed that although the equipment and tools it possesses are technically advanced, the main dangers and vital risks faced by have not changed [1,3,4,5]. Although the help obtained from the technical developments in the fight against these dangers is important, it is seen that the approach of corporate culture, organizational commitment, sense of belonging, and safety culture gains importance [6,7,8,9,10].

Firefighters are exposed to uncontrolled environmental exposures, heavy physical workloads, chemical and toxic substances, and high levels of stress in the work environment [7]. Researchers [4,11,12,13,14] reported that firefighters were one of the most dangerous occupations according to job-related injury rates and the safety behaviors of firefighters, attitudes, norms and perceptions of security.

Safety culture is a sub-dimension of organizational culture, and reflects the behaviors and attitudes of the members of the organization about the maintenance of health and safety performance [15, 16, 17, 18]. The safety culture structure of an organization is examined as a pyramid consisting of four steps as basic security values, organizational factors, attitudes and ideas as well as safe behaviors [19].

The aim of this research is to examine the level of safety culture of firefighters and the factors that affect the safety culture, and to answer the questions about in which areas the firefighters' occupational safety can be improved, and what can be done in these fields. The purpose of this study is to reduce the risks of injuries and death among

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firefighters by analyzing the safety culture. Thus three main research questions are developed: i) Why the safety culture within the fire brigade is investigated? ii) Why the safety culture within the fire brigade is investigated? iii) Why the safety culture within the fire brigade is investigated? In order to answer the questions in detail, 11 hypotheses were developed and analyzed.

II. MATERIAL AND METHODS

In the research, Anne Arundel Safety Culture questionnaire [1] was applied to firefighters working in Istanbul in June 2017. The survey questions were prepared by Williams after examining many safety culture questionnaires in the literature to assess the safety culture within the firefighters [1]. In this study, the Anne Arundel Safety Culture questionnaire was used by being translated into Turkish. The questionnaire consists of 40 questions prepared on a 5-point Likert scale. On a Likert scale, participants are asked to choose one of the following responses for each notification: (a) strongly disagree; (b) disagree; (c) impartial; (d) agree; (e) strongly agree. Six additional questions are added to the questionnaire to determine the participants' demographic data, and whether they have had an occupational accident. It is assumed that the participants answer the questionnaire questions correctly, and are not affected by each other.

The population of the research consists of approximately 4000 firefighters working in Istanbul Metropolitan Municipality Fire Department. The survey is carried out within the scope of six fire brigade groups randomly selected among 32 fire brigade groups within the structure of Istanbul Metropolitan Municipality Fire Brigade Organization and the fire stations connected to these groups. The questionnaire is distributed to 236 (48.76%) firefighters who volunteered to participate in the survey among 484 firefighters working in these fire brigades and their fire stations. The selected fire stations are visited on three different days, and the firefighters working on different shifts are reached. Out of the 236 questionnaires, 209 (88.55%) questionnaires that filled completely are evaluated.

The data are analyzed using the SPSS (version 22) program. The chi-square test was used to test the relationship between the participants' ages, education, working positions, marital status, professional experience, answers to the safety culture questionnaire, and whether they had an occupational accident. In this study, the chi-square test for independence is used to compare two variables in a contingency table to see if they are related. The independent variables of the study were age, marital status, education level, professional experience, position, and occupational accident. The dependent variable is the occupational safety culture.

III. RESULTS AND DISCUSSION

According to the results of demographic questions, the findings related to rank, education and marital status, age, occupational experience and occupational accidents are given in Table 1. Cronbach's Alpha was found to be 0.949 when the reliability analysis of the safety culture questionnaire, which consisted of 40 questions prepared on a 5-point Likert scale, was conducted.

Table 1. Percentage distribution results of demographic questions

Rank distribution	N	Percentage (%)
Firefighter	169	%80.9
Fire Sergeant	40	%19.1
Education level		
High school and below	113	%54.1
University and above	96	%45.9
Marital status		
Married	174	%83.3
Single	35	%16.7
Age range		
18-25	64	%30.6
35-45	100	%47.8
45-55	45	%21.5
Professional experience		
0-10 years	63	%30.1
10-20 years	84	%40.2
20+ years	62	%29.7
Work accident		
Yes	85	%40.7
No	124	%59.3

When firefighter's view of safety culture is analyzed under three categories, 57 (27.27%) of them have negative, 52 (24.88%) firefighters have neutral, 100 (47.85%) firefighters have positive attitudes. Furthermore, 11 hypotheses are analysed, and three of them are found to be statistically significant.

H1: A significant difference was found between the education levels of the firefighters in terms of safety culture ($p = 0.027 < 0.05$). In terms of education level, the answers given by 113 firefighters having high school education level show 33.6% (38) negative, 26.5% (30) neutral and 39.8% (45) positive distribution. When the answers of 96 firefighters who graduated from the university are examined, 19.8% (19) show negative 22.9% (22) neutral and 57.3% (55) positive distribution. It is seen that the result of this research between the safety culture and education is in the same direction as the studies in the literature. In the literature, it was found that the level of education is closely related to the culture of safety, and that the level of safety culture increases as the level of education increases [20]. Another study is that employees have a more positive perception of safety culture as the

education level increases [21]. As explained in the literature, culture is a learned concept; culture is not the innate abilities but culture is psychosocial habits and various behavioral patterns that people later acquire [20, 21]. Culture is the result of behaviors that have been learned through education and shared by members of a particular community [21].

H2: There is no significant difference (p = 0.889> 0.05) between age groups in terms of safety culture of firefighters. When the percentage distribution of the answers given to the safety questionnaire was examined in terms of ages, the responses of 64 firefighters aged 18-35 showed 25% (16) negative, 21.9% (14) neutral and 53.1% (34) positive distribution. The responses of 100 firefighters between the ages of 35-45 showed 29% (29) negative, 26% (26) neutral and 45% (45) positive distribution. 45 firefighters in the 45-55 age range showed 26.7% (12) negative, 26.7% (12) neutral and 46.7% (21) positive distributions. The result between safety culture and age is in the same direction as the literature. Lee and Harrison [22] and Freaney [23] found no relationship between safety culture and age.

H3: There is no significant difference between the marital situations in terms of safety culture of firefighters (p = 0.832> 0.05). When the percentage distribution of the answers given to the safety questionnaire is examined in terms of marital status, the answers given by 174 married firefighters are 26.4% (46) negative, 24.7% (43) neutral and 48.9% (85) positive. When the responses of 35 single firefighters are examined, 31.4% (11) are negative, 22.9% (8) were neutral and 45.7% (16) is positive. In the literature, Freaney [23] found no relationship between safety culture and marital status. In another study conducted by Dursun [21], no meaningful relationship was detected between married and single people in the perception of safety culture [21]. As a result, this study supports the literature.

H4: A significant difference is found between fire accidents in terms of safety culture (p = 0.005 <0.05). In case of occupational accident status, the responses of 85 firefighters who had an occupational accident show 37.6% (32) negative, 27.1% (23) neutral and 35.3% (30) positive distribution. When the responses of 124 firefighters who did not experience occupational accidents are examined, it is observed that 20.2% (25) are negative 23.4% (29) are neutral and 56.5% (70) are positive. It is seen that there is a significant difference between the workers who have not had an occupational accident, and those who have had an occupational accident. In addition, it is seen that employees who have not had an accident before have a higher safety culture average than those who have had an accident. In this study, it has been investigated whether occupational accident status is an indicator of individual safety performance. With the assumption that our perception and attitude towards dangers will also be an indicator of the safety culture, this hypothesis was created in order to evaluate the relationship between the accidents and safety culture. The literature supports the conclusion that there is a relationship between safety culture and occupational accidents obtained from this study.

In a study conducted on 456 people using the NOSACQ-50 safety culture scale to determine the safety culture in Norwegian construction and construction works, it was found that the perceptions of the safety culture of workers injured as a result of work accidents have lower average values compared to the perceptions of the safety culture of those not injured in a work accident [24]. In another study conducted by Smith and Wardsworth [25], 1752 people working in different sectors in the UK also found that non-accident workers had a more positive perception of security than those who were involved in the accident. According to the results obtained from the studies conducted in the Indian steel processing sector, a significant relationship was found between the change in employee behavior, and the decrease in work accidents and injury rates as a result of positive safety culture [26,27].

H5: There is no significant difference between the levels of occupational experience of firefighting personnel in terms of safety culture (p = 0.986> 0.05). In terms of professional experience, the responses of 63 firefighters between 0-10 years show 25.4% (16) negative, 23.8% (15) neutral, 50.8% (32) positive distribution. 84 firefighters who are between 10-20 years have 28.6% (24) negative, 25% (21) neutral, 46.4% (39) positive distribution. The responses of 62 firefighters who are 20 years and over show 27.4% (17) negative, 25.8% (16) neutral and 46.8% (29) positive distribution. Similar to the results obtained from this study and the safety culture and professional experience, Freaney [23] found no relationship between safety culture and professional experience.

H6: There is no significant difference between the ranks in terms of safety culture of firefighters (p = 0.626> 0.05). According to the rank, the answers given by 169 firefighters show 28.4% (48) negative, 23.7% (40) neutral and 47.9% (81) positive distributions. When the responses of 40 firefighters in the rank of sergeant are examined, 22.5% (9) were negative, 30% (12) are neutral and 47.5% (19) are positive. Similar to the results obtained in this study, the relationship between safety culture and rank was not found in the study conducted by Freaney [23].

H7: There is no significant difference between the education levels of firefighters in terms of occupational accidents (p = 0.787> 0.05). When the percentage distribution of the firefighters' accidents was examined in terms of education level, it was observed that 113 firefighters in high school education have 39.8% (45) occupational accidents and 60.2%

(68) not occupational accidents. It is observed that 96 firefighters at the university education level have 41.7% (40) occupational accidents and 58.3% (56) have no occupational accidents. In a study conducted by Budakoğlu [28] on workers working in the State Railways Factory, no significant relationship was found between the occupational accident status and education status of the workers. Although a significant difference was found between education and culture in H_1 hypothesis, and between work accident and safety culture in H_4 hypothesis, there was no significant difference between occupational accident and education in H_7 hypothesis, and a significant difference between occupational accident and rank in H_{10} hypothesis. These results show that many factors are effective on individual safety performance.

H8: There is no significant difference between age groups in terms of occupational accidents among firefighters (p = 0.602> 0.05). When the percentage distribution of the firefighters' accidents is examined in terms of their ages, it is observed that 64 firefighters between the ages of 18-35 have 39.1% (25) occupational accidents and 60.9% (39) not occupational accidents. It is observed that 100 firefighters between the ages of 35-45 have 44% (44) occupational accidents, and 56% (56) have no occupational accidents. It is observed that 45 firefighters between the ages of 45-55 have 35.6% (16) occupational accidents, and 64.4% (29) have no occupational accidents. In a survey of 1200 workers in a copper factory in India, it was found that the average age of 29 workers was higher than the other workers with an average age of 41 (29).

H9: There is no significant difference between the marital status of firefighters in terms of occupational accidents (p = 0.773> 0.05). In terms of marital status was examined, it is observed that married firefighters have 40.2% (70) occupational accidents, and 59.8% (104) have no occupational accidents. It is observed that 35 firefighters who are single had 42.9% (15) occupational accidents, and 57.1% (20) have no occupational accidents. The results obtained from the literature and the results obtained from this study are in the same direction. In a study conducted by Budakoğlu [28] on workers working in State Railways Factories, no significant relationship was found between the employee's occupational accident status and marital status.

H10: There is a significant difference between the ranks of firefighters in terms of occupational accidents (p = 0.016 <0.05). When the firefighters were examined in terms of their percentage distribution of occupational accidents, it is observed that 169 firefighters have 36.7% (62) occupational accidents, and 63.3% (107) have no occupational accidents. It is observed that 40 firefighters in the rank of sergeant have 57.5% (23) occupational accidents, and 42.5% (17) have no occupational accidents. There is a conflict between the literature and the results obtained from this study. Although the result of the relationship between firefighters' accident situations and their ranks is the same as the literature, the direction of the relationship is different. Studies have shown that firefighters in the rank of private suffer more injuries than other ranks [9]. In this study, unlike Moore-Merrell [9] the party who had more accidents was a fire sergeant rank. The difference may be due to differences in social culture and differences in business practice.

H11: There is no significant difference between the levels of occupational experience of firefighters in terms of occupational accidents (p = 0.704> 0.05). When the percentage distribution of the firefighters' accidents is examined in terms of their professional experience, it is observed that 63 firefighters between 0-10 years have 44.4% (28) occupational accidents, and 55.6% (35) do not have occupational accidents. It is observed that 84 firefighters between 10-20 years have 40.5% (34) occupational accidents, and 59.5% (50) have no occupational accidents. It is observed that 62 firefighters with 20 years, and over have 37.1% (23) occupational accidents, and 62.9% (39) have not. In a study on workers working in a construction site in Sakarya province, a significant relationship was found between the occupational experience of the workers and their accident situations [30]. Although there is an expectation of a positive relationship between occupational experience and occupational accidents in many sectors, the reason for the failure of such a relationship for the fire brigade workers is that each incident that the fire brigade intervenes may have different risks and hazards in itself**.**

IV. CONCLUSION

Within the scope of this study, the concept of safety culture is evaluated generally without considering the sub-dimensions of the safety culture (situational awareness, management participation etc.). Investigating the relationship between sub-dimensions of safety culture and variables will be useful to identify in which aspects of an existing security culture need to be improved. It is recommended to use these parameters when designing a safety culture measurement tool in future researches.

The study's universe and sample area are selected as the city of Istanbul, which has the highest population among cities in Turkey. Future studies to be conducted on higher populations will be compared with the results of this study, which will contribute a better understanding of the relationship between demographic characteristics and occupational accidents and safety culture.

The research problem of this study was that although there exists high rate of injuries and death among firefighters, as far as our knowledge, the fire departments had never been an assessment of the safety culture in Istanbul. When the results are evaluated, the

relationship between the safety culture and the fire brigade is answered with three basic questions:

(i) Why the safety culture within the fire brigade is investigated? In most workplaces, the hazard is typically handled and eliminated to create a safe working environment. However, there is no way to eliminate all hazards in firefighting. Since hazards cannot be removed, the firefighter must be a safe person [10]. Consequently, developing a safety culture is an important way to make the firefighting profession as safe as possible for firefighters.

(ii) What variables should be analyzed to understand the safety culture within the fire brigade? In this study, the variables that are compared with the safety culture are education, age, rank, marital status, occupational status and accident status. In many studies in the literature [31, 21, 32, 33, 34, 35, 36], while examining the safety culture structure of organizations, it was found that socio-demographic factors and occupational accidents are the most frequently compared variables with the safety culture. In addition, the occupational accident was used as an indicator of safety performance in a study by Smith and Wardsworth [25].

(iii) What are the effects of the dependent and independent components of the study on the safety culture within the fire department? According to the results, it is found that there is a significant relationship between the variables of education level safety culture. In addition, there is a significant relationship between the status of occupational accidents and rank variable. There is no significant relationship between marital status, age, professional experience and rank variables and safety culture. There is also no significant relationship between occupational accident status and education, marital status, age, professional experience and rank variables.

The main contribution of this study to literature is that the study supports the need to improve the safety culture within Istanbul fire departments. Furthermore, firefighters are working more safely and experiencing fewer occupational accidents as the level of positive safety culture increases. In the firefighting organizations, a strategic plan should be designed by the administrations to develop the current safety culture and implement in a way that encourages the positive safety culture. It is recommended to identify the current safety culture situation, and which areas need to be improved.

Based on the findings of this study, it has been observed that the level of safety culture increases as the education level of the employees increases. In this context, an encouraging plan should be developed and implemented to increase the level of education of firefighters within the fire brigades.

CONFLICT OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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APPENDIX A

Anne Arundel Safety Culture Questionnaire:
1.The department is genuinely concerned about safety.
2.Leadership provides a positive climate that promotes reasonably safe Fire/EMS operations.
3.The number of local and national firefighter deaths and injuries is unacceptable.
4.Firefighting has been made about as safe as it can be.
5.The department is doing more now to promote safety than in the past.
6.Leadership conducts adequate reviews and updates of safety standards and operating procedures.
7.The department has a defined process to set training goals and to review performance.
8.Leadership closely monitors proficiency and currency standards to ensure firefighters are qualified to function.
9.Leadership is actively involved in the safety program and management of safety matte
10.Our Health/Safety Policies and Procedures are adequate in communicating standards needed for conducting safe operations.
11.Supervisors encourage reporting safety discrepancies without the fear of negative repercussions.
12.Co-Workers are willing to report safety violations, unsafe behaviors or hazardous conditions
13. Peer influence is effective at discouraging violations of standard operating procedures, or safety rules.
14. Violations of safety operating procedures are rare.
15. My department has a reputation for high-quality performance.
16. My supervisors closely monitor quality and correct any deviations from established quality standards.
17. Supervisors permit cutting corners to get a job done.
18. I have sometimes felt too fatigued to do my job safely.

19. Lack of experienced personnel has adversely affected my station/assignment's ability to operate safely.
20. Safety decisions are made at the proper levels, by the most qualified people in my command.
21. Leadership takes the time to identify and assess risks associated with its Fire/EMS operations.
22. Supervisors do a good job managing risks associated with its operations.
23. I am provided adequate resources to accomplish my job.
24. Equipment and facilities are designed with safety in mind.
25. Operational Risk Management processes are incorporated into decision-making at all levels.
26. My department would rather lose a building than unnecessarily risk my personal safety.
27. My supervisor can be relied on to keep his/her word.
28. Leadership is successful in communicating its safety goals to unit personnel.
29. Leadership communicates the lessons learned from collision/injury investigations.
30. Mistakes have actually led to positive changes.
31. Leadership sets the example for compliance with standards.
32. Leadership reacts well to unexpected changes to its plans.
33. My supervisor does not hesitate to temporarily restrict individuals from functioning who are under high personal stress.
34. I am adequately trained to safely conduct all of my duties.
35. Morale and motivation at my station/assignment is high.
36. Leadership provides adequate safety backups to catch possible human errors during high-risk operations.
37. Good communications flow exists up and down the chain of command.
38. Safety education and training are adequate in my command.
39. The Health/Safety Division is well-respected.
40. I am kept informed of important safety information.