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ORIGINAL ARTICLE

## Assessment of Risk Perception and Safety Behavior among Firefighters of Operational Units in Tehran

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### ABSTRACT

The purpose of this study was to determine the level of risk perception and assessment of the rate and factors of unsafe behavior among firefighters operating in Tehran.

The effect of education, awareness, personality capability, coordination in team work, environmental factors, neurological stresses, and systems motivational on the firefighters' risk perception and the rate of unsafe behavior in operational units were investigated. The data was collected using interview and an author's made risk perception questionnaire. The validity and reliability of questionnaire were investigated in this study and then used for data collection. The sample randomized allocation method was used to analyze among 510 operational personnel including district directors and deputies, station heads, commanders, caretakers and firefighters.

The results of this study showed that education, awareness, personality capability, coordination in teamwork and the motivational systems of firefighters operating units influence risk perception and the rate of unsafe behavior.

The results demonstrated that risk perception was played an important role on the rate of unsafe behavior among firefighters. Moreover, the results showed that some important organizational and individual characteristics which should be considered for high risk process and operations uninfluenced by risk perception.

**KEY WORDS:** *Risk Perception, Unsafe behavior, Firefighters, Tehran fire stations.*

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### BACKGROUND

Since the late 70s, the death probability in a fire has constantly decreased in the industrialized countries, but the material and human damage caused by fires worldwide is still enormous [1]. In Europe, closed to 2.5 million fires were reported each year, leading to 250 to

500 thousand injured people and 20,000 to 25,000 casualties. Approximately 80% of all fire deaths in Europe and the United States occur in domestic settings [2]. In a technical and mathematical context, risk is defined as the product of the probability of an incident and the extent of its consequences [3]. However, people seem to perceive and interpret risks differently.

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Sjöberg et al. defined risk perception as the subjective assessment of the probability of specific hazards and the extent to which people were concerned with their consequences [4]. Gierlach et al. focused mainly on the probability aspect using risk perception defining as “a subjective judgment about the felt likelihood of encountering hazards” [5]. Risk perception can play an important role concerning societal matters such as policy-making and public safety [6]. Moreover, researchers found a positive relationship between personal risk perceptions and the extent or probability of protective action with respect to risks [7] on a personal level, in the domain of health behavior [8] and taking protective actions [9]. Pertaining to fire-related incidents such as domestic fires, research findings are inconsistent [10].

In the other hand, a safety-based behavioral approach is a necessity to have a safe environment. Boholm et al in a study emphasized that a safety-based behavioral approach and reinforcing it may cause increase of positive attitude toward the safe behavior [11]. Safety solutions only based on the engineering and regulations approach, if the attitudes would be weak in relation to the safety and an efficient management system of safety isn't governing on the work place, would face with failure [12-14]. Safety of firefighters and rescuers requires proper performance of a series of activities such as identification, assessment, support, equipment, training, prevention and commanding of the operations and particularly providing guidelines on the operational procedure of firefighters and rescuers [15-17].

Nowadays, in case of any damage or endangering the health of firefighters, the first step is to identify causes, deficiencies and the indicator influencing on it. Firefighters' health protection equipment and methods can be divided into physical and psychological such as personal protection, chronic effects of chemical and physical effects, poisonous gases detectors, rehabilitation, operational protection equipment, training, identification of risks, etc. Although, there are inevitable cases such as natural events which is impossible to avoid or unpredictable during the operations, but managers,

commanders, firefighters should implement all protection instructions to avoid hazards to happen [18-21].

Having considered firefighters risk perception issues, this study was aimed to review Tehran firefighters' unsafe behavior factors rate and risk perception assessment among them. Firefighting job importance in the rescue operations is clear, therefore a necessity to reduce the unsafe behaviors and risk seems is remains. Consequently, the main objective of this research was to review to review Tehran firefighters' unsafe behavior factors rate and risk perception assessment among them.

## METHODS

This study was used a randomized controlled trial method in which the samples were collected from fire stations throughout Tehran. The sample size was consists of 510 operational personnel including district directors and deputies, station heads, commanders, caretakers and firefighters. The sample randomized allocation method was used to analyze sample.

The data collection starts after filling informed consent form for each participant. The respondents in operation unit with minimum one year job experience were selected whereas executive managers, illness and accident were eliminated to assess in this study. The self-administered questionnaire was applied to collect data that initially its indicators was codified by library studies and survey from experts then its validity was obtained through heuristic factorial analysis. The reliability of questionnaire was obtained using Cronbach alpha as .867. Content validity index (CVI) was used to validate questionnaire. The results showed 94% validity. Content validity ratio (CVR) also was used to examine results. The results showed 71 % CVR for author made risk perception questionnaire. Statistical population of this research was selected among 510 operational personnel of operational units of Tehran Firefighting Organization (districts 1 to 8 of Firefighting Organization) including district directors and deputies, station heads, commanders, caretakers and firefighters and randomized sampling

allocation method was used to analyze factors. The SPSS Ver. 23 statistical software was used to process data. The regression test was used in the inferential statistics section.

## RESULTS

Table 1 Indicators of central tendency, average and standard deviation, risk perception affecting factors, unsafe behaviors reducing in firefighters.

The average results for firefighters risk perception affecting factors, unsafe behaviors reducing incidence and personality capabilities were calculated (1.2271), motivation (1.1583), coordination and commanding (1.1560), environmental factors and stress (0.9583) and training (0.9537), respectively.

**Table 1.** Indicators of central tendency, average and standard deviation, risk perception affecting factors, unsafe behaviors reducing in firefighters.

Variables of research	number	Average	Standard deviation
Training	510	.9537	.60782
Personality capabilities	510	1.2271	.47364
Coordination and commanding	510	1.1560	.75284
Environmental factors and Stress	510	.9583	.66490
Motivation	510	1.1583	.78567
Risk perception	510	1.1113	.78727
Unsafe behaviors reducing	510	.9291	.58792

**Table 2.** Correlation coefficient among research variables

Correlation coefficient	Motivation	Environmental factors and stress	Coordination and commanding	Personality capabilities	Training
Risk perception	0.956	0.930	0.949	0.906	0.934
P-value	0.000	0.000	0.000	0.000	0.000
Number	510	510	510	510	510

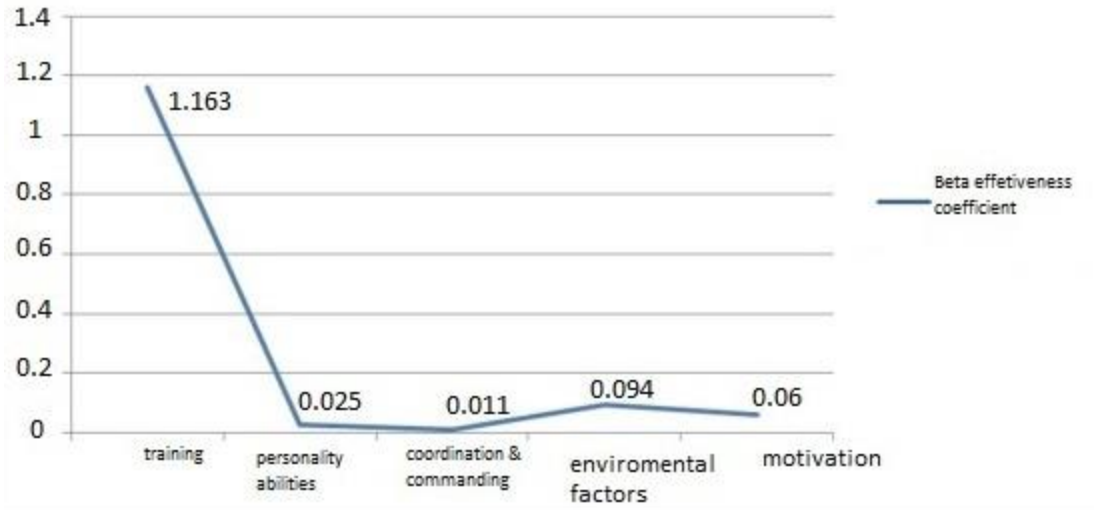


Fig. 1. Research variables correlation coefficient

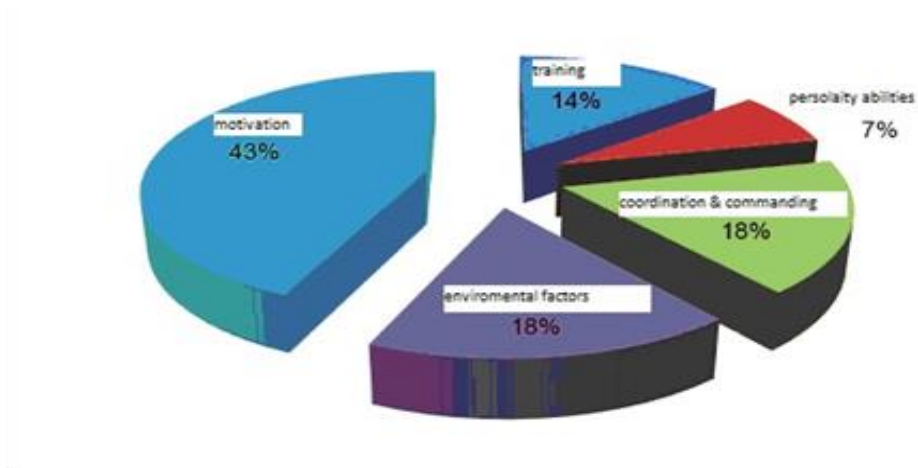
Table 3. Beta coefficients and the firefighters risk perception coefficients variables influence.

	sig	t	Standardized coefficient Beta	Non-standard coefficients Standard error	B
Constant	0.000	6.268		0.039	0.247
training	0.000	3.613	0.462	0.166	0.598
Personality capabilities	0.000	6.189	0.237	0.064	0.394
Coordination and commanding	0.000	4.073	0.573	0.147	0.599
Environmental factors and stress	0.000	4.560	0.570	0.148	0.675
Motivation	0.000	10.132	1.417	0.140	1.420

Firefighters risk perception based on the research variables influence results were calculated as follow: motivation ( $\beta= 1.417$ ,  $t= 10.132$ ,  $sig<0.05$ ), coordination and commanding ( $\beta= 0.573$ ,  $t= 4.560$ ,  $sig<0.05$ ), environmental factors ( $\beta= .570$ ,  $t= 4.560$ ,  $sig<0.05$ ), training ( $\beta=$

$0.462$ ,  $t= 3.613$ ,  $sig<0.05$ ), personality abilities ( $\beta= 0.237$ ,  $t= 6.189$ ,  $sig<0.05$ ), respectively.

**Regression equation:** Training (0.462) + personality ability (0.237) + coordination and commanding (0.573) + environmental factors and stress (0.570) + motivation (1.417) = risk perception



*Fig. 2.* Beta coefficients, the firefighters risk perception impact variables rate.

*Table 4.* Correlation coefficient between research variables

Correlation coefficient	Motivation	Environmental	Coordination	Personality	Training
Unsafe behaviors	0.961	0.992	0.963	0.945	0.999
P-value	0.000	0.000	0.000	0.000	0.000
Number	510	510	510	510	510

Correlation coefficient for the training risk perception was presented in Table 4 as follow: (0.999), personality capabilities (0.906), coordination and commanding team work unit

(.963), environmental and stress (0.992), and motivation (0.961). Whereas, the correlation coefficient was statistically significant,  $\text{sig} < 0.05$ .

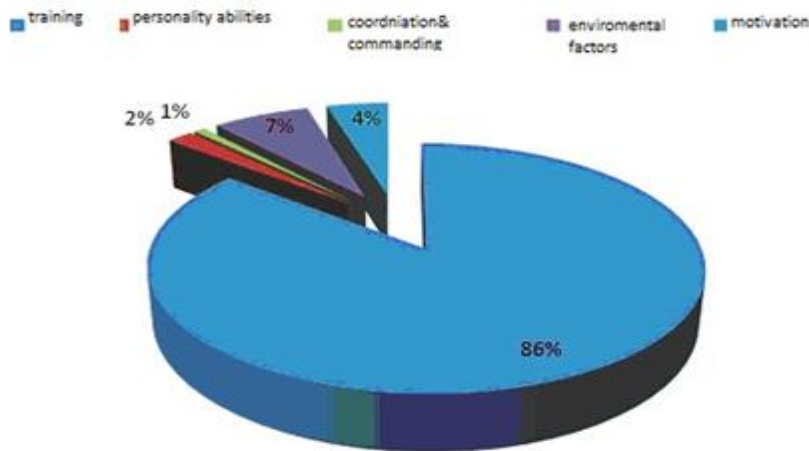
**Table 5.** Beta coefficients and the coefficients of variables influence on the firefighters unsafe behaviors.

	sig	t	Standardized coefficient Beta	Non-standard coefficients Standard error	B
Constant	0.001	3.388		0.005	0.016
training	0.000	58.256	1.163	0.019	1.125
Personality capabilities	0.000	4.164	0.025	0.007	0.031
Coordination and commanding	0.021	0.494	0.011	0.017	0.008
Environmental factors and stress	0.000	4.787	0.094	0.017	0.083
Motivation	0.006	2.756	0.060	0.016	0.045

Firefighters’ unsafe behaviors based on the research variables influence results were calculated as follow: training ( $\beta= 1.163$ ,  $t= 58.256$ ,  $sig<0.05$ ), environmental factors and stress ( $\beta= 0.094$ ,  $t= 4.787$ ,  $sig<0.05$ ), motivation ( $\beta= 0.060$ ,  $t= 2.756$ ,  $sig<0.05$ ), personality abilities ( $\beta= 0.025$ ,  $t= 4.164$ ,  $sig<0.05$ ),

coordination and commanding ( $\beta= 0.011$ ,  $t=.494$ ,  $sig<0.05$ ), respectively.

**Regression equation:** Training (1.163) + personality ability (0.025) + coordination and commanding (0.011) + environmental factors and stress (0.094) + motivation (0.060) = unsafe behaviors



**Fig.3.** Beta coefficients, the firefighter’s unsafe behaviors reducing impact variables.

## Discussion

According to the obtained results, (33.3%) of firefighters were 31-35 years old, (6.1%) were 46-50 years old, (24.1%) have worked 11-15 years and (0.8%) have worked 26-30 years. 40.2% of firefighters were single and 59.8% were married. Firefighters with Bachelor degree consist of (42.9%) of respondents and (2%) of them with a Master or higher education degree. A firefighting station includes head of station (6.9%), commander (10.4%), commander's assistant (11.6%), technician (19.2%), and firefighter (52%). Given the obtained results, firefighters risk perception based on the research variables influence results were calculated as follow: motivation ( $\beta = 1.417$ ,  $t = 10.132$ ,  $\text{sig} < 0.05$ ), coordination and commanding ( $\beta = .573$ ,  $t = 4.560$ ,  $\text{sig} < 0.05$ ), environmental factors ( $\beta = 0.570$ ,  $t = 4.560$ ,  $\text{sig} < 0.05$ ), training ( $\beta = .462$ ,  $t = 3.613$ ,  $\text{sig} < 0.05$ ), personality abilities ( $\beta = 0.237$ ,  $t = 6.189$ ,  $\text{sig} < 0.05$ ), respectively. The unsafe behaviors correlation coefficient for training was calculated (0.999), personality capabilities (0.906), coordination and commanding team work unit (0.963), environmental and stress (0.992), and motivation (0.961). The rate of research variables impact on the firefighters unsafe behaviors were calculated as follow: training ( $\beta = 1.163$ ,  $t = 58.256$ ,  $\text{sig} < 0.05$ ), environmental factors and stress ( $\beta = .094$ ,  $t = 4.787$ ,  $\text{sig} < 0.05$ ), motivation ( $\beta = 0.060$ ,  $t = 2.756$ ,  $\text{sig} < 0.05$ ), personality abilities ( $\beta = 0.025$ ,  $t = 4.164$ ,  $\text{sig} < 0.05$ ), coordination and commanding ( $\beta = 0.011$ ,  $t = 0.494$ ,  $\text{sig} < 0.05$ ), respectively. Similarly, Carey et al. were assessed view of the stressful nature of the firefighting and officers who work in this organization are exposed to high levels of job burnout and low mental health [25]. These individuals were faced with many physical and psychological and job stress, so they are more vulnerable to psychological disorders and job burnout. Kimbrel's studies (2011) showed that the implementation of the occupational safety and health management program is generally beneficial for improving health and safety, and its effectiveness evidence was proved [27]. In a study implemented in United Kingdom based on

HSG150 (Health & Safety Executive, 2016) showed that health and safety management at work have considered necessary need to planning, control, organization, supervising and reviewing work (UK Standard Institution, 2016) [28-29]. Leiter in a study evaluated the lack of investigation on the effectiveness of organizational interventions to reduce the risks of unsafe behaviors in the 17 projects and concluded that 50% of organizations have reached to success by training interventions [30]. Different studies showed that fire risk analysis through the process of understanding and identifying the risk of fire help to find the consequences and unintended outcomes that may result from a fire for individuals and properties [15-20, 22, 28]. Although, the costs of protection against fire almost are known and can be calculated like the other costs [29-31]. But calculating its benefit is very difficult. Seo in a study argued that the professional firefighting is so dangerous, with high damage, disease and mortality rate compared to other jobs which capable to implement a risk management program and largely is effective in the improvement of the safety and health of firefighters [32]. Slimak et al. found that environmental uncertainty, company complexity and board's supervision have a significant impact on fire risk management [7]. Similarly, there is a positive relationship between the mentioned variables and risk management. Slimak et al also showed that the 75 to 80 percent of fires are predictable and preventable [7]. Hence, proper procedures implication to assess fire risk through identification of existing dangers and to control or reduce the probability of events occurrence and their necessary technical and management measures application effects may reduce the different damages resulting from fire to a significant level. Carey et al. examined the relationship between the risk management and performance of fire safety in Indonesian industrial companies [25]. Results of this study showed that there is a positive relation between companies' structure, leadership and management of fire risk.

The results of this study showed that firefighter's higher perceived risk associated with higher perceived training and practical experience [23]. Firefighters' job experiences, previous accidents and hazardous situations influence on each risk perceived and risk approach. Hazardous situations survivors assessment showed a positive relationship between risk perception and perceived awareness about first aid and participation in firefighting operation [33]. In addition, a study showed that risk perception can be influenced by specific personality characteristics [34]. Furthermore, according to the self-selection principles [35] inter-person differences regards to level of perceived risks may be caused by underlying personality characteristics due to psychological effects, that have originally lead the participants to follow their career, such as fearlessness [36]. Firefighters often confronted with adverse conditions and high risky situation (e.g., extremely high temperatures, low oxygen levels, and danger of building collapse), but they have to be able to manage their fear irrespective of their amount of training.

In the current study the results indicated that the experience of acute stress reaction should be considered in the explanation of why exposure to hazardous activities can result in higher risk perception. It depends on the approach of firefighters to the hazardous situation, and also type of knowledge-based experience achieved from each of these situations [37]. It is likely that the attenuation of risk perception following exposure to the hazardous situation and risks may apply only to voluntary hazardous activities [38- 39]. Since firefighting commanders' perception of training is a part of the psychological safety climate [31-40], it can be emphasized that the perception of training is negatively associated with risk perception. On the other hand, this study was found significant relationships between risk perception and training. Literature and other related research results showed that firefighter's culture (as well as culture of each country) may stimulate risk acceptance and risk normalization [41]. In other arguments, certain operational risks may become so commonplace that their

perception of dangerousness is diminished. Therefore, firefighters before training may have underestimated the related risk in specific emergency situations. Training may have resulted in an increment of risk perception to compensate the effect of the firefighting culture. Second, Leiter et al [30] controllability estimate model was used to determine the risk perceptions [42]. The impact of training on risk perception was mediated by perception of control. Therefore, it is possible that the training did not increase firefighters' efficacy in managing risks. The validity of these explanations may be determined in the future studies.

## CONCLUSION

This study was aimed to investigate Tehran operational units firefighters risk perception affecting factors. Some important affecting parameters on level of perceived risk among firefighters were investigated. Safety performance and safety behavior also were investigated and the results were demonstrated that both of risk perception and safety behavior influenced by some physiological parameters such as personality and level of job experiences among firefighters. Both risk perception and safety behavior can affect safety performance during firefighting operation. These are very important issues to reduce injuries and mortality in firefighting as a high risk job. This study also was demonstrated that the level of perceived risk in different dangerous situations and safety behavior of firefighters can be improved by continuous training regards safety at work in operational units of firefighting departments.

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## COMPETING INTERESTS

The authors declare that they have no competing interest.

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