

STRESS AS A RISK FACTOR IN THE FIREFIGHTER PROFESSION

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Abstract: Stress affecting humans over the long term can cause serious illnesses. It results from a lack of time, a lot of tasks, considerable responsibility and several other reasons that are perceived as a risk factor. In this paper, a method for assessing psychosocial risks was suggested. The suggested risk matrix method consists of two parameters: probability and consequence. To illustrate the assessment of the psychosocial risks of the firefighter profession, an activity was selected - the intervention of a firefighter in a traffic accident.

Almost every intervention puts their health and life at risk. For the purpose of health protection, all possibilities of risk situations that may arise in carrying out this work and may cause undesirable consequences are analysed.

Keywords: stress, firefighter, risk

1 Introduction

A human experiences stress when he feels an imbalance between the demands placed on him and the means at his disposal. Although stress is a psychological phenomenon, it affects a human psyche to a large extent. It is an organism response accompanied by adrenaline, other stress hormones, which manifest themselves as an increase in pulse and blood pressure, breathing, muscle tension, dry mouth, increased blood sugar and others.

There is no precise level of stress that is optimal for an individual because each person responds differently to different situations. Something that is a burden for one may be a joy for the other. Although it is not possible to clearly determine the optimum level of stress, in terms of the impact on human health, stress can be divided into negative and positive (OHS Framework Directive, 1989). Stress defined by Selye as a non-specific reaction of the body to every requirement it is exposed to. It is a condition when the organism is in an imbalance with itself and its surroundings (Macháč, Macháčová and Hoskovec, 1988).

The article analysed the stress at work of firefighters, burnout syndrome and more. The results revealed a relationship between stress and psychophysical exhaustion. In high-risk occupations, special attention should be paid to burnout prevention programs, health activities and psychotherapy (Makara-Studzińska, Golonka and Izdorzcyk, 2018).

Eustress (positive stress) is a reaction to a stress that is experienced as something pleasant. The stress reaction is accompanied by pleasant exciting feelings with pleasant expectations (Praško and Prašková, 1996).

Distress (negative stress) stress is a long-lasting negative burden, it appears where things cease to be handled, we feel overloaded, we lose confidence and detached view - workload (Praško and Prašková, 1996).

A stressor is a summary of events or circumstances leading to an individual's feeling that physical or psychological demands exceed his ability to cope with them (Marcinek, 2013).

The risks arising from the work of a rescue firefighter can be divided into two main groups, namely the workload and the working environment. The actual process of eliminating excessive psychological stress in firemen is divided into three

stages. The first stage consists of care and consistent removal of stressful situations from the work process. In this profession, a stressful situation cannot be avoided, but it is necessary to face it by preparedness and training, or by selecting those who are resistant to this type of stress. The essence of the second stage is to avoid the risk that acute stress reactions do not cause negative and long-term consequences on the health and working abilities of the firefighters involved. Here, social structures such as a psychologist and a work team are already intervening. Research results in Germany among 300 professional firefighters who reported having survived an extremely burdensome hit pointed to the fact that among stress management strategies, they use the interviews between firefighters themselves in practice. Reducing mental stress in common interviews can be more effective if the interview is conducted by a fire psychologist with a specific focus. The third stage of psychological care consists in psychological rescue. In cases where stress situations in the fireman persist for weeks, a so-called individual therapy starts (OHS Framework Directive, 1989). This article provides a review of the literature, where studies focus on workload and requirements for common firefighting tasks, the impact of health on the firefighting profession, and attempts to determine the minimum physiological capacity of the workload for successful performance firefighting. The existing literature provides information that firefighters are exposed to mental and physical stress during firefighting tasks. During their work, there is also physiological stress acting on the human body when wearing personal protective equipment when extinguishing a fire, which may affect the ability to withstand fire and the development of diseases as well as fire safety (Cody, Morris and Harish, 2018). Against the aggressiveness of the environment, it is necessary to protect the firefighter and ensure the important functions of his/her organism. Bodywork of firefighters, heat production multiplies, 90% involved muscles and skin, the rest shared with other organs 9% and the brain 1%. The skin surface contributes to the heat output. The expense is boosted when a heated layer of air is removed from the skin surface, e.g. by air flow, wind. The body's heat balance must be ensured by the fireman's personal protective equipment. In addition, these devices must protect the firefighter partially against environmental aggressions (heat flow, chemicals, sharp edges, bacteria, etc.). Significant factors that adversely affect the fireman are stress and mental stress at work. It should be emphasized that the aspect of mental demands is at the forefront.

Although firefighters are exposed to hard physical work during demanding actions, physical exhaustion is far from comparable to the psychological pressure that persists at different levels of consciousness, creating a kind of "pressurized mental vessel" and over the years can create an unmanageable problem (Cody, Morris and Chander, 2018).

2 Legislative regulations related to mental workload

Decree of the Ministry of Health of the Slovak Republic No. 542/2007 on details of health protection against physical workload, mental workload and sensory workload in Section 2 Paragraph 1 defines the mental stress.

Mental stress is a factor that represents the sum of all assessable impacts of work, working conditions and working environment affecting a person's cognitive, sensory and emotional processes that affect him and induce states of increased psychological tension and load of psychophysiological functions.

Mental stress is a factor that is burdensome for the organism and requires mental activity, mental processing and coping with environmental requirements and impacts, while:

1. The environment is understood as everything that surrounds a person, including the working environment, social ties, events, and behavioural requirements,

- The demands of the environment and work are greater than the individual's mental fitness, his/her work potential.

There are three forms of mental stress: sensory, mental and emotional. Sensory load results from the requirements for the activity of peripheral sensory organs and their corresponding structures of the central nervous system. Mental load arises from information processing requirements that impose demands on mental functions and mental processes, such as attention, imagination, memory, thinking and decision-making. Emotional load results from requirements triggering an effective response (Marcinek, 2013).

3 Algorithm of psychosocial risk assessment

Psychosocial risks at the workplace can be assessed according to the following seven steps:

- Preparation - data collection.
- Identification of stressors and intensity of their occurrence.
- Estimating the risk according to the severity of stressors (estimating the probability and severity of the stressors' effects on the health, error rate and performance of the employee and determining the magnitude of the risk).
- Reducing the effects of risk stressors at work, considering their severity, documenting risk assessments.
- Implementation of the proposed measures.
- Repetition of psychosocial risk assessment.
- Evaluation - there is proposed in the Figure 1 an algorithm for assessing of psychosocial risks causing stress to employees at work is proposed. After identifying the hazard (stress), the risk must be assessed by determining the risk parameters for each individual hazard.

The risk is derived from a combination of the following relevant parameters:

- severity of the damage and its consequences,
- likelihood of such damage occurring,
- likelihood of an adverse event,
- technical capabilities and human capabilities to prevent or to avoid risk.

To estimate the magnitude of psychosocial risk at work, a risk matrix needs to be developed. Categories of the probability of the occurrence of an adverse event - mental workload, expresses the intensity of the occurrence of stressors, which were evaluated based on the checklist as existing stressors - causing mental workload. The stressor intensity categories, express the severity of possible damage to health, the number of human errors/injuries, and the reduction in employee performance. The resulting risk matrix for the assessment of mental workload is in Table 1 and 2.

Figure 1 Proposed algorithm for psychosocial risk assessment

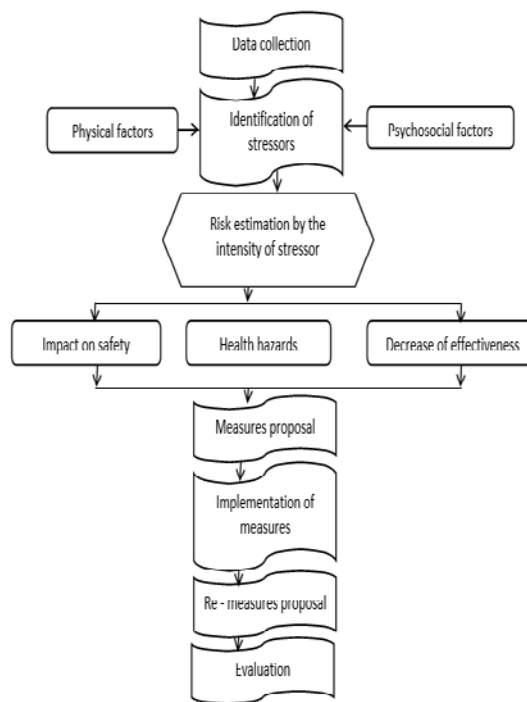


Table 1 Risk matrix for mental workload assessment

		Probability			
I.		Rarely, unlikely			
II.		Occurs regularly, probable			
III.		Permanent occurrence during activity, very likely			
		Consequence			
		Health hazard	Human error/injury	Decrease of effectivity	
A		Short-term increase of tension in the organism without health damage	Sporadic occurrence of errors (almost accident)	Short-term decrease of effectivity	
B		Explosiveness, aggression, possible disease	Increased number of errors (sick leave over 3 days)	Prolonged decrease of effectivity	
C		Depression, severe mental health conditions, possible long-term health damage	High error rates (sick leave more than 42 days or death)	Permanent work disability	
Risk matrix for mental workload assessment					
		A	B	C	Low risk - no action required Medium risk - measures must be taken to eliminate psychological threats High risk - it is not possible to work in these conditions, immediate corrective action is required
I.		Low risk	Low risk	Medium risk	
II.		Low risk	Medium risk	High risk	
III.		Medium risk	High risk	High risk	

Source: own calculation of Balážiková

Table 2 Form for psychosocial risk at work assessment

Mental workload assessment											
Job positions:				Assessed by:							
				Date:							
No.	Threat-stressor	Health threat			Human error/injury			Decrease in performance			Measures
		P	D	R	P	D	R	P	D	R	

Source: STN EN ISO 12100:2011

4 The effect of stress on the psyche of firefighters

Table 3 describes the traumatic events, in which the post-traumatic interventional care is provided (Marcinek, 2013). The analysis shows how the environmental, physical and emotional stresses to which firefighters are exposed in their work activities can lead to occupational hazards, accidents or even fatalities. Psychological reactions can be caused by fatigue and could endanger the health and the safety of firefighters. It is recognized that an increase in body temperature leads to a decrease in physical and mental performance. In addition, a physiological decline related to age could be expected during the working period of firefighters. Adequate physical fitness programs and regular physical fitness assessments are needed to ensure that physically fit personnel perform this profession. Adequate financial investment to assess and increase the physical abilities of firefighters could effectively reduce the health risks associated with emergencies (Perroni, Guidetti, Cignitti and Baldari, 2014).

Table 3 Traumatic events

Fireman experiences:	Firefighter suffers:	Firefighter causes:
Death or serious injury to others as a direct witness to the event (especially to children, colleagues, or family members)	Severe threat to life or physical integrity	Death or serious injury to someone else
Especially tragic events, accidents involving many victims, disasters, Suicide witness	Serious road accident, burial under something irradiation, intoxication	Wrong decision, rescue mission failure, car accident

Source: author (Tomašková, 2012)

How to help the affected colleague or the victim of an accident?
There are applied the following rules (Marcinek, 2013):

- to talk: find the courage to address the victim,
- to support: the victim is taken from the exposed area, sitting down, leaning against the wall,
- to recall the reality: ask for name, calm breathing, recall inhale, exhale,
- to encourage: encourage the victim saying that his/her symptoms are normal in such a situation,
- to help: ask what he/she needs, offer a blanket, water, sensitively provide body contact,
- to move: no one can handle everything completely, if there is no strength to help the victim, you must let the colleagues, health professionals or other persons to do it.

How should superiors, affected persons, colleagues and life partners behave in a stressful extraordinary event? (Perroni, Guidetti, Cignitti and Baldari, 2014).

1. Firefighter's superior: should provide some protection to the affected fireman first. This includes a gentle approach immediately after the event. In a confidential interview, the superior can create a picture of his/her mental state, inform him/her of the upcoming possibilities of help and consult him/her on further steps.
2. Affected firefighter: the psychic situation of the affected firefighter is marked mainly by deep uncertainty and growing doubts or feelings of guilt. Many times, the firefighter had to act in a time of distress, in a highly dangerous situation.

He/she is thinking about how his relatives, his superiors, his colleagues will treat him/her now, and how they will deal with potentially controversial events. It is helpful from him/her if he/she talks to a person who understands him.

3. Firefighters: Action after a traumatic event may result in failure to address the surviving adverse event that may lead to remorse. It helps here if colleagues and professionals (psychologists) communicate with the affected firefighter and help him mitigate the consequences of a negative event.

Firefighter's partner in life: he/she is also shocked and confused. The partner in life should listen if he/she does not want to talk, should not force the firefighter, urge, or inquire. After some time, there may be a need to talk about everything, and then it is important to be an attentive and responsive listener (Pačaiová, Markulík, Turisová and Nagyová, 2018).

5 Evaluation of the workload of firefighters according to the characteristics of the subjective reaction of the employee to the load

The questionnaire method is used for subjective evaluation of the impact of work on the psyche of employees. It is suitable for screening evaluation of various work activities or professions. Based on ten items: time pressure, low job satisfaction, high responsibilities at work, numbing work, workplace problems and conflicts, monotony, nervousness, supersaturation, fatigue, long-term exceeding of maximum load capacity, and more. The method evaluates both the individual and group mental load at work in characteristics: psychological overload, monotonous load (monotony) and non-specific load. It also evaluates individual experience, subjective perceived mental load at work. The criteria for excessive psychological workload for the purposes of this Government Order include the third degree of psychological overload, the third degree of monotonous workload or the third degree of non-specific workload achieved in this method, see Table 4.

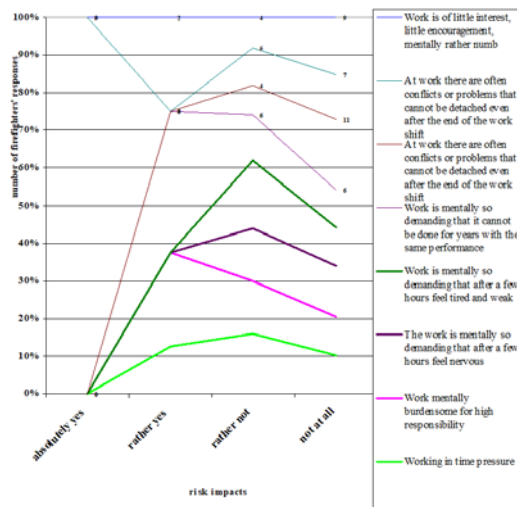
The method serves for subjective evaluation of the impact of work activity on the psyche of employees (OHS Framework Directive, 1989). It is suitable for screening evaluation of various work activities or professions. A sample of 15 firefighters of fire and rescue brigade (HAZZ) in Košice was evaluated.

Table 4 Questionnaire method form

Questions in the questionnaire	absolutely yes	rather yes	rather not	not at all
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Source: Perroni, Guidetti, Cignitti and Baldari (2014).

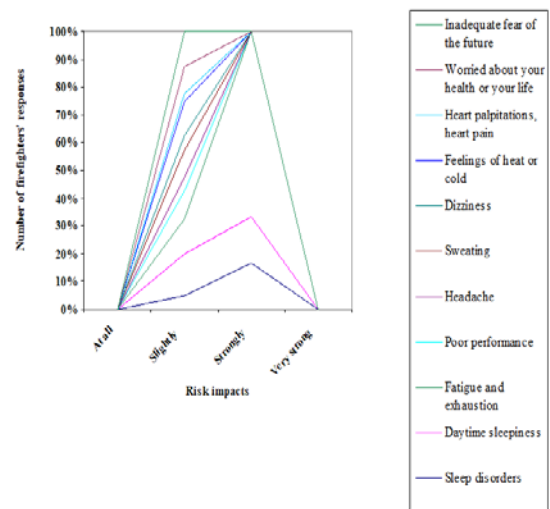
Figure 2 Evaluation of mental workload according to the characteristics of subjective response of employees to load



Source: authors' own graph based on a questionnaire

Graphical presentation of evaluation for mental workload according to the characteristics of subjective response of employees to load is visible on Figure 2. Firefighters have selected those items that have bothered them in the last three months and have indicated the intensity. In each item they

Figure 3 Questionnaire for evaluation of neurotic tendencies



Source: authors' own graph based on a questionnaire

circled one option, which most closely matched their opinion, Figure 3.

Table 5 Form for evaluation of mental workload

		at all	slightly	strongly	very strongly
1	Sleep disorders	0	1	2	3
2	Daytime sleepiness	0	1	2	3
3	Fatigue and exhaustion	0	1	2	3
4	Poor performance	0	1	2	3
5	Headache	0	1	2	3
6	Sweating	0	1	2	3
7	Dizziness	0	1	2	3
8	Fainting feelings	0	1	2	3
9	Vomiting and nausea	0	1	2	3
10	Feelings of heat and cold	0	1	2	3
11	Shaking, internal shaking	0	1	2	3
12	Restlessness and lack of concentration	0	1	2	3
13	Irritability and anger	0	1	2	3
14	Poor memory	0	1	2	3
15	Tingling and contraction pain	0	1	2	3
16	Heart palpitations, heart pain	0	1	2	3
17	Breathing difficulties	0	1	2	3
18	Lack of appetite	0	1	2	3
19	Diarrhoea or constipation	0	1	2	3
20	Flushing or fading	0	1	2	3
21	Pessimism	0	1	2	3
22	Pity or hypersensitivity	0	1	2	3
23	Sad or bad mood	0	1	2	3
24	I don't want to do anything	0	1	2	3
25	Indefinite anxiety or tension	0	1	2	3
26	Worried about health and your life	0	1	2	3
27	Unjustified fear tied to a certain situation	0	1	2	3
28	Inadequate fear of the future	0	1	2	3
29	Doubts about yourself	0	1	2	3
30	Feelings of insecurity in front of people	0	1	2	3
31	Feeling uncomfortable like in a dream	0	1	2	3
32	Intrusive thoughts or urge to act	0	1	2	3
33	Feeling stupefied	0	1	2	3

Source: own calculation of Tomašková and Balážiková (2012)

6 Assessment of the psychosocial risks of the firefighter profession

To illustrate the assessment of the psychosocial risks of the firefighter profession, an activity was selected - the intervention of a firefighter in a traffic accident, see Table 6. Firefighters carry out many activities in which they are at risk, but the most common interventions are different types of road accidents. A road accident is an event in road traffic in which people are killed or injured, or property is damaged in direct connection with motor vehicle traffic. Traffic accidents can be simple, mass or accident involving dangerous substances. The following table defines the threats to a firefighter in a road accident and a risk assessment. Risk analysis is the process of identifying hazards and assessing risk for individuals or groups of the population, objects, the environment and other objects under investigation. Risk analysis is usually a subjective process input indicator of which are not only quantitative ones, but also the possibility of compromise solutions, expert evaluations, etc. The risk analysis identifies the probability and scope of the consequences of a negative event resulting from a given work or other activity of the equipment or system. Based on hazard identification, it reveals the magnitude of the risk. A peculiarity of the risk analysis is that potential negative consequences are examined at

its beginning. The results of the analysis are of great importance for the adoption of justified and preventive solutions.

The risk assessment of the firefighter during the intervention was performed by the proposed risk matrix, see Table 1. The assessment of the risks of a firefighter in a traffic accident is in Table 6. The consequences of threat to health, human error and decrease of performance were taken into account in the risk assessment. In terms of the impact on human error, the highest risk is dangerous: the chaotic arrangement of the scene (inaccessible terrain). In terms of the impact on the health of the firefighter, the highest risk is in danger: the external environment. From the point of view of the consequence on the performance of the firefighter, the highest risk is in case of danger: chaotic arrangement of the place of intervention (inaccessible terrain) and the possibility of another accident.

Table 6 Specific assessment of psychosocial risks at work

Evaluation of mental workload											
Threat - Stressor	Consequence	Threat to health			Human error/injury			Decrease of performance			Measures
		P	D	R	P	D	R	P	D	R	
Road traffic density	Injury of a firefighter due to collision with other motor-car	II	A	Low risk	III	A	Medium risk	II	A	Low risk	Adherence to Tactical-methodical procedures of performing interventions, respecting the instructions of the commander of the intervention in traffic accidents, use of PPE.
Sharp objects at the scene of an accident	Cutting with the possibility of infection	III	A	Medium risk	III	A	Medium risk	II	A	Low risk	
Fragments of glass	Cutting	III	A	Medium risk	III	A	Medium risk	II	A	Low risk	
Occurrence of dangerous substances of different character	Health damage related to the properties of a dangerous substance	II	B	Medium risk	II	B	Medium risk	II	B	Medium risk	
Dangerous driving of drivers	Injury of a firefighter due to collision with the surrounding motor vehicle	II	A	Low risk	III	A	Medium risk	II	A	Low risk	
Chaotic arrangement of the place of intervention	Damage to health during the intervention in an unknown terrain	III	B	Medium risk	III	C	High risk	III	C	High risk	
Unavailability of getting to the place of intervention	Mental load from time stress	III	B	Medium risk	II	A	Low risk	II	A	Low risk	
Impossibility of battery disconnection	Possibility of fire or explosion	I	A	Low risk	I	A	Low risk	II	A	Low risk	
Complicated communication with injured persons	Damage to the fireman's health by an injured person who is in shock	III	A	Medium risk	II	B	Medium risk	I	A	Low risk	
Unpredictable behaviour of affected persons	Damage to the fireman's health by an injured person	III	A	Medium risk	II	C	High risk	I	B	Low risk	
Danger of threat by animals	Damage to firefighters' health by transported animal	I	B	Low risk	I	B	Low risk	I	B	Low risk	
Insufficient means to carry out rescue work	Mental load due to impossibility to help	II	A	Low risk	I	B	Low risk	II	A	Low risk	
Possibility of another accident	Mental load	II	B	Medium risk	II	B	Medium risk	II	C	High risk	
Dangerous substance with many dangerous properties	Damage to health	II	A	Low risk	I	A	Low risk	I	B	Low risk	
Adverse effect of weather conditions	Damage to health	III	A	Medium risk	II	B	Medium risk	I	B	Low risk	
Threat from the outer environment	Damage to health	III	B	High risk	II	B	Medium risk	II	A	Low risk	

Source: own calculation of Tomašková and Balážiková

7 Conclusion

As a result of the assessment of psychosocial risks in the profession of a firefighter, it was found out that their activity in performing the work task has an impact on human error or injury that may occur as a result of a stressful situation during work.

Also, working conditions significantly affect the performance of his/her activity, e.g. if the firefighter knows that there is a possibility of another accident, the risk of a decrease in performance is high. Activity in repressive intervention, which is characterized by a combination of high, often marginal, physical and mental load, necessarily requires adequate full competence. Each firefighter must be adapted so that he/she can cope with a specific physical and mental load in extreme conditions of intervention without risking his/her own health. Directly related to the effectiveness and success of the action, on which many people's health and lives depend, the possible failure of an individual means breaking the balance of the entire intervention group that leads into the success rate of liquidation of emergency but can result in a direct threat to other firefighters' life. (Vysocký, 2007). The results of the studies show that stress has an adverse effect on the ability of a person to work. The age category, which is most affected by the stress, is from 25-44 years. It is the most productive group of people, with 50-60 % of missed working hours related to stress. To solve the question of how to eliminate stress is important e.g. in terms of a greater satisfaction of people with their work. In severe traffic accidents, only seconds can decide on life or death, and whether a person will recover completely or have to live with a disability all his life. Rescuers must be able to act quickly. Heart rate, rectal temperature, blood pressure, changes in temperature and relative humidity inside the garment were measured on 18 professional firefighters wearing firefighting uniforms, protective clothing and breathing apparatus. Subjects trained on a cycling ergometer with a working load of 1.5 W. kg⁻¹, at 39 ° +/- 1 °C and at 70% +/- 5% of relative humidity. They stopped training at the point of subjective fatigue and overheating, which they judged would cause them to stop working during the actual extinguishing of the fire (Faff and Tutak, 1989). In order to ensure safety, health, comfort and long-term productivity it is necessary to regulate the requirements for tasks, so as not to burden or overburden the individual. Nevertheless, the risks of overload have been known for a long time, many professions are exposed to stress. Psychology has been trying to find it for a long time answers to questions and thus make a significant contribution to the study and assessment of mental workload (Wickens, 1992).

However, new technologies are being developed at high speed in the field of motor vehicle construction. Thanks to these technologies, the chance to survive an accident without serious injuries has improved significantly. However, this has also led to rescuers making their work in traffic accidents difficult.

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