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SAFETY AND DANGER DURING FIREFIGHTER'S WORK

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ABSTRACT

In Hungary in the event of disasters and technical rescue, the interventions and rescue services of fire protection are carried out by the fire department and the firefighters within the system of disaster management. The circumstances and the tasks that await them cannot be predicted. Although there are regular trainings and drills, the annual statistics clearly show that accidents do occur during interventions despite their caution and protective equipment.

One of the aims of the research was increasing the safety of firefighters. The statistics about deployment and injuries of firefighters with a span of 11 years (between 2000 and 2010) were collected and analysed, then a conclusion was drew. The currently available protective equipment and methods which are the most suitable and in accordance with the current potentials were identified. The negative effects on fire fighters working - especially in closed space - resulting from the use of protective equipment as well as the ways of reducing risks of interventions was studied too. Based on one of the research findings, there are more ways to increase safety of both the fire fighter and the rescuee, thus the safety of the intervention. These ways include finding a more modern alternative of protective equipment, preparing firefighters for the circumstances in confined space is drilling in as life-like circumstances as possible and the use of devices which are currently not standard in firefighting.

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INTRODUCTION

This article is based on a study on the dangers of firefighting interventions and the possible methods of enhancing safety. The purpose of the article is to increase the safety of the intervention team and the quality of their activities. We can gain an overall view of the rescue activities of fire protection in Hungary with the help of a few figures. During technical rescues the primary intervention tasks of the fire service will be presented as well, which shows that the range of responsibilities is quite wide. The representation of the issue of safety was selected out of the whole research material along with adding recent results. The typical injuries of fire fighters and their usual forms are described. Minor risks caused by the current protective equipment worn by the intervention crew must also be mentioned.

MAIN PART

In Hungary the rescue activities of fire protection in road accidents or in the immediate interventions of technical rescues in building damages are conducted by the fire service within the organisation of disaster

management. Almost two thousand fire fighters are on duty to carry out these activities at all hours to be able to leave for the fire or damage within 120 seconds after the alarm. The exact circumstances and the tasks waiting for them cannot be predicted. [1] The definitions of a flat fire, a road accident or a technical rescue are the same in a course material, but the actual interventions are almost totally different in each fire or damage. There are no two cases alike. The settings are different, the sources of danger are diverse, the set of instruments available might be dissimilar, the number, age and health status of the people in danger may differ, etc. [2] The data in a year's interventions, alarms in Hungary:

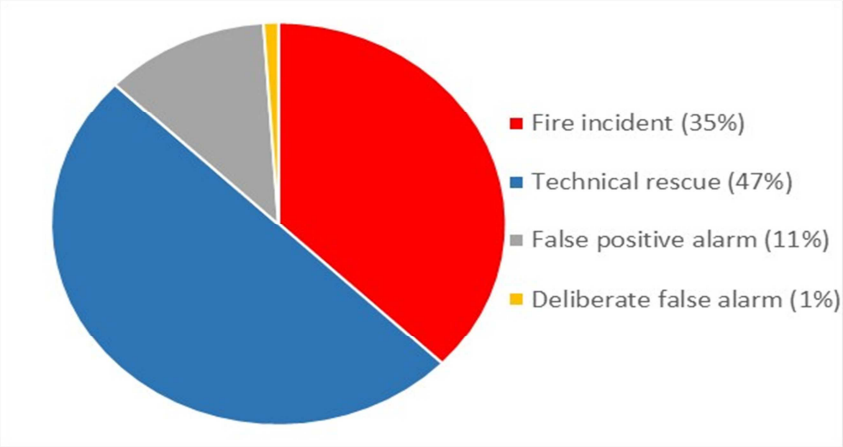

Figure 1 the distribution of intervention in 2013 based on NDGDM statistics

There are basic differences between the two main tasks of fire services, firefighting and technical rescue. During firefighting time is more limited, so there is more time pressure and it is essential to wear heat protective clothing as well as to extinguish fire, glowing as soon as possible by applying fire extinguisher. [3] In the case of technical rescues, generally there is more time available to find the best solution possible. However, wearing protective clothing slightly hinders or makes it more difficult to carry out the tasks and strains the intervention crew. In addition, access to special protective and intervention equipment is constrained. As the chart and even recent statements illustrate, technical rescue activities of fire services remarkably outnumber firefighting duties.

Considering the economic performance of Hungary, it can maintain only a limited number of professional fire departments, rescue teams (e.g. subregional, county, HUNOR), the number of standby vehicles is limited, the special equipment loaded on them and, of course, the provision for trained fire fighters in the crew have budget constraints.

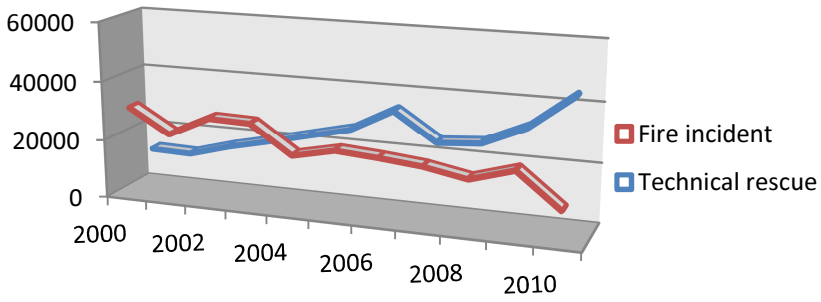

Figure 2 The rate of fire incidents and technical rescues based on NDGDM statistics

The authorised number and location of fire departments, the firefighting equipment allowed to be kept there and the various ranks of fire fighters working there are laid down in the relevant legislation. Given the above limitations, the vehicles used for firefighting and technical rescue are supposed to be as versatile as possible loaded with the widest range of special equipment in addition to the protective clothing offering the strongest protection against most forms of dangers. According to the National Director General's measure in effect (29/2012 currently in effect), the protective clothing of the crew of professional fire departments is the following:

- 1 breathing mask
- 1 pair gauntlet
- 1 firefighet coveralls
- 1 firefighter helmet
- 1 cowl
- 1 pair firefighter protective boots
- 1 climbing safety belt

Since failures, replacements, shortages might occur, 20% spare equipment of the above items must be stored.

Picture 1 Mosaic of standardised personal protective equipment at the Hungarian disaster management, own and catalogue pictures from websites of distributors, 2013

In order to maintain and enhance the performance of the firefighters, there are regular trainings and drills. However, in spite of their caution and the use of protective equipment, accidents do happen during interventions. When saving lives, fire fighters are in heightened emotional state and they are under more pressure. It becomes more difficult to concentrate on their duty and easier to make mistakes with this heavy emotional burden. There is an increased risk of injury when fire fighters take part in interventions involving people even if their task is to remove a victim. [4] [5]

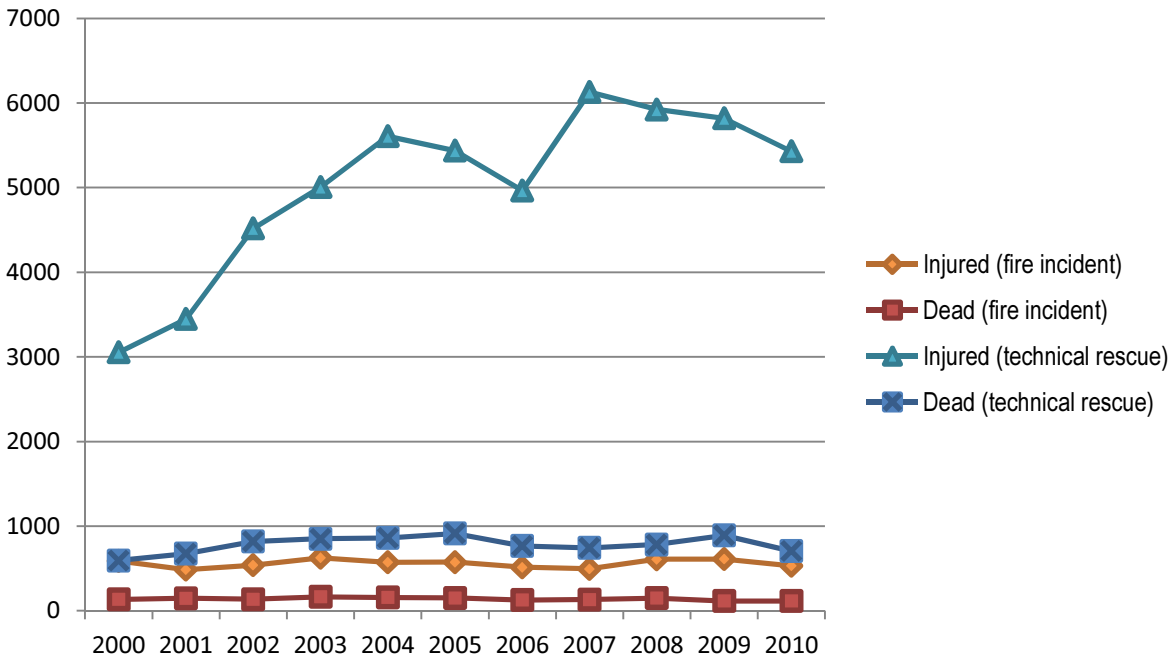

Figure 3 The number of injured or dead citizens in the incidents between 2000 and 2010, own figure, 2012.

Figures clearly show that Hungarian fire fighters participate in thousands of interventions annually in which they have to deal with injured people at the site of fire or damage. The number of interventions when they deal with dead people or work in their surrounding is also high.

In my research whose aim is to increase the safety of firefighters in confined space interventions I identified the following dangers compared to open space interventions:

- greater thermal load
- explosion
- limited visibility and difficult lighting conditions
- greater chance of obstructions
- dangerous substances of unknown ingredients
- substances of unknown ingredients, which can react have dangerous reactions when exposed to water or other substances
- unknown places
- limited escape routes
- limited movement
- limited ventilation
- limited possibility to save lives and escape in heights (floors), from underground (cellars, caves), through doors and windows
- time span is shorter when using breathing apparatus [6]

To sum up, the following harms may affect fire fighters besides the strain protective equipment causes: excessive heat, restricted visibility, breathing difficulty or shortness of breath, risk of explosion, increased stress. Several circumstances might increase the level of stress: the presence of hazardous materials, being aware of the shortness of breath, restricted escape routes, increased responsibility when saving lives and searching for survivors, exhaustion and excessive heat. [7]

Apart from these effects posing dangers on fire fighters, general fire interventions and disaster management task obviously entail further risks based on the character of the given case. In accordance with the Decree of the Minister of Interior on the general rules of firefighting and technical rescue, firefighting tasks may emerge in the following situations especially to save lives and property:

a) structure fires
b) road accidents
c) accidents in natural waters
d) in sewers, wells and other water storage systems
e) malfunctions of public utilities
f) high-rise accidents or accidents in underground holes (caves, cliffs)
g) hazardous substances, nuclear accident
h) natural disasters

Combining the items with further risks, collapse and fall hazard, contact with unknown dangerous materials, drowning, the effects of electricity and nuclear radiation hazard are present, too. The list is still not complete with these items. Unfortunately, fire fighters have had serious accidents related to these sources of dangers in the last few years. In point f), the fire fighter who died a hero's death deserves to be mentioned and point g) should include fire fighters who got injured in the red sludge flood.

Pictures 2 and 3 Rescue at Rám-szakadék and firefighter intervention at the red sludge flood, source of picture 2: Márton Kovács, the Hungarian Cave Rescue Service, picture 3: kisalfold.hu

INJURIES AND ACCIDENTS OF FIRE FIGHTERS

Quite a lot of accidents happen after the alarm before fire fighters get into the engine, and even more during deployment, which include fatal ones, too. It can be stated that the number of fire fighter accidents are related to the changing number of technical rescues or firefighting from year to year. There are noticeable changes in the tendencies as well, changes in the rate of firefighting/technical rescue are reflected in the types of related accidents. The most severe accidents - which involve death – happened mostly at the fireground or as a result of activities carried out there. [8]

- According to the statistics of Work Safety Centre of NDGDM[1], the six most common injuries are the following:
- Trips, falls, slips
- Hits, bruises

[1] Until 2011.

- Falls, jumps
- Stab wounds, cuts
- Falling objects
- Burns, scalds, explosion

Data on accidents reveal that the rate of injury types remained constant between 2000 and 2010. Injuries caused by trips, falls and slips are by far the most frequent, followed by hits and bruises, whose number is still remarkably significant. The annual frequency of more severe injuries is much lower (in decreasing order of frequency: stab wounds, cuts, falling objects, burns and explosion).

To compare data, it is worth contrasting the annual number of accidents and the number of accidents which happened in the line of duty. They include accidents that happened after the alarm and before returning from the incident. More detailed reports on the distribution of injuries occurring in the line of duty cover only certain periods of the given year. A detailed report on the accidents happening in the line of duty in 2006 suggests that the rate may be similar in the whole period under examination. The following graph shows 2006 figures.

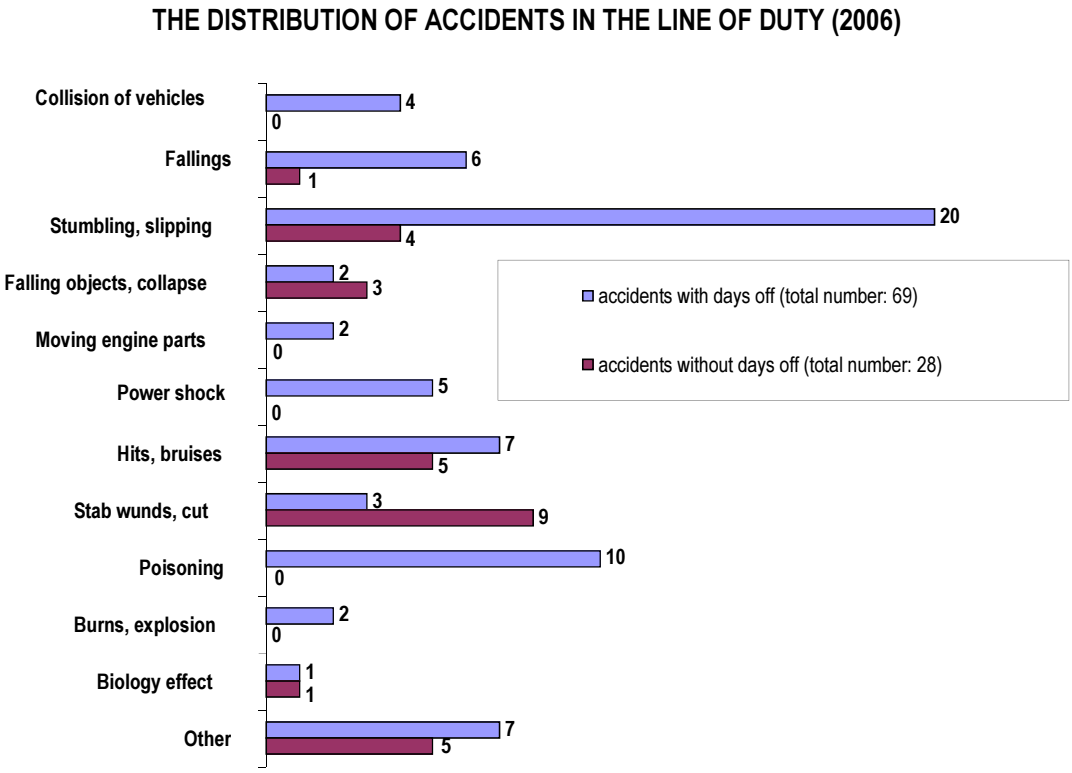

Figure 4 The distribution of accidents in the line of duty in 2006

It can be clearly seen that the high number of injuries are owing to the wide range of activities of the fire service within disaster management instead of the harmful effects of fire. Burns and explosions are treated separately in the statistics of the Work Safety Centre of NDGDM, however, they can only be demonstrated if they are shown together. All things considered, graph 3 shows a slow, uneven, but moderate decrease after the peak values in 2002 till 2007. The slight increase starting in 2008 can be explained by the staff increase of almost 1000 and the fluctuation caused by the retirement wave.

Law enforcement bodies, professional fire departments experienced a relatively sudden generational change because of the many new recruits and the retirement of the bulk of the most experienced employees. The less experienced fire fighters are more likely to make mistakes, while senior colleagues who they could turn to help for have already left. These statements are only true if we examine the overall statistics on accidents in the line of duty instead of just emergency activities. [9]

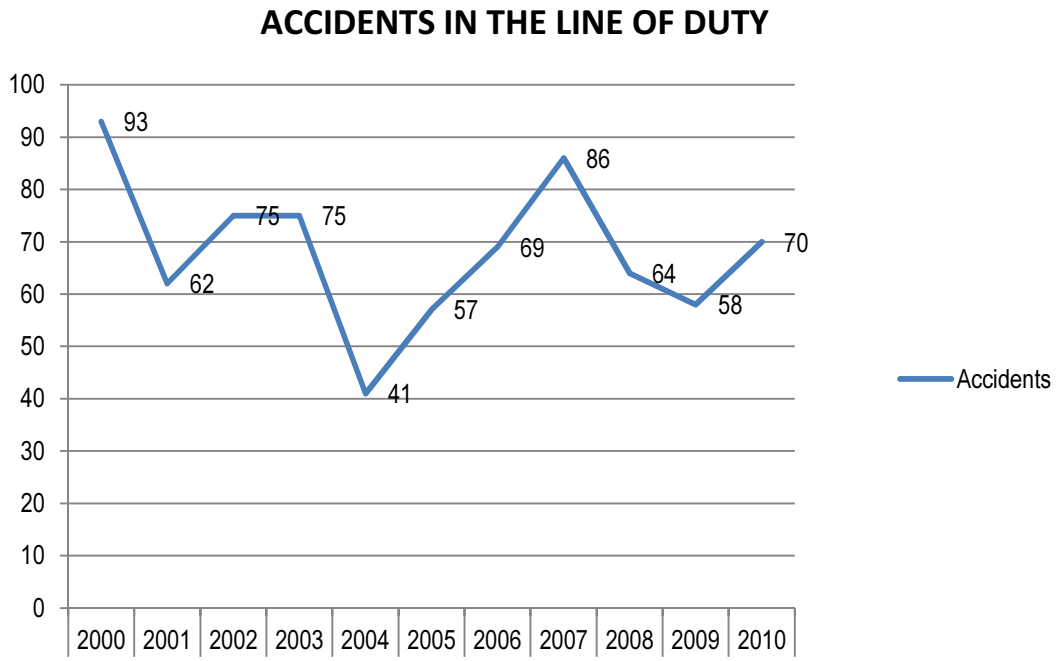

Figure 5 Accidents in the line of duty between 2000 and 2010

Between 2004 and 2008 there was a significant increase, which then dropped slightly. In 2010 a moderate growth started again. My assumption is that due to the high crew turnover, injuries of various types were more common at the fire brigade (trips, slips and falls), while at the fire ground and during technical rescues fire fighters were more careful and considerate, probably due to the higher level of supervision.

Dangers resulting from the use of protective equipment need to be addressed as well. Wearing protective clothing itself hinders the body's thermoregulation as radiation of heat is considerably reduced. Heat stress is the leading cause of death on the fire ground, which is justified by international researches. Protective clothing and its parts can easily get in contact with objects. Breathing apparatus means excessive

weight and limits movement. Hearing is reduced, speaking is not articulate enough owing to the mask and visibility is limited. Wearing full gas clothing further increases the risks and limits movement.
Protective equipment and its disadvantages:

turnout gear: limits movement, additional weight, hinders thermoregulation

helmet (with face mask): reduced hearing, additional weight, may get stuck in narrow passages. In these cases it needs to be removed, thus the head is no longer protected.

cowl (hood): in case of poor quality, heat insulation is not satisfactory in extreme weather. In explosive environments, the material of the cowl needs to be considered.

protective boots: heavy and relatively big, limits fine movements.

gauntlet: it hinders fine movements of fingers and hands. The hand loses sensitive tactile perception.

climbing safety belt: it can get stuck in objects. Not proper size or use may lead to danger of falling, just what it is meant to protect fire fighters from.

breathing mask: limits visibility because of distortion and decreased sight degree. Hearing and speech volume is greatly reduced. Combined with the breathing apparatus significantly increases weight and limits movement.

There are several ways to increase safety of both the fire fighter and the rescuee, thus the safety of the intervention. One of these ways is to find more modern alternatives of protective clothing and equipment, improving active and passive visibility, more modern respirators with more functions, remote sensing, remote reconnaissance, basic thermographic cameras, multifunctional respirators which allow longer intervention period and telemetry systems.

Another way to prepare firefighters for the circumstances in confined space is drilling in as life-like circumstances as possible. The higher education has to be ready for these methods. [10] At the local branches of disaster management, methods are available to conduct multi-purpose, varied drills with low financial, infrastructure and personnel costs. The training of the future's firefighter officers and the researches must focus on preparing the parts of intervention teams for the circumstances. [11] [12]

Picture 4, Students of disaster management wearing a breathing apparatus during a visit to a fire department, own picture, 2013

A third way is the use of devices which are currently not standard in firefighting, although they can either make circumstances safer or reduce the degree of personal intervention (standardising firefighting through the exterior walls, overpressure ventilation, remote-controlled fire extinguishing or rescue devices, various special support poles, security glass films). In sometimes fire investigations can help to find the correct ways. [13] [14]

CONCLUSION

Disaster management activities, including firefighting and technical rescue conducted by the fire service are considered considerably dangerous. The main aim is to increase the safety of interventions as much as possible so that the rescuers do not need rescue. Handling sources of dangers and protection against them have been introduced besides listing further potential risks. There are several ways and methods to increase safety, which have been presented, but they constantly need to be examined and introduced.

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