

RESEARCH REGARDING PHYSICAL TRAINING IN FIREFIGHTERS CARRYING THE INTERVENTION DEVICE

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ABSTRACT

Emergency occupations and mostly firefighter job demands high level of expertise managing critical situations that require a strong psychological and physical preparation. The investigation started from the assumption that having a good physical preparation program we will be able to develop physical strength and agility so that we can improve time in intervention situation simulated in the firefighter specific event of carrying the intervention device and mount the moto-pomp. The sample of the study was formed by the Inspectorate for Emergency Situations from Sibiu firefighter team that was composed by 10 male athletes with age between 30± 3.5 years old with experience in this kind of competitions between 2 and 7 years. The intervention program with a specific firefighter program was presented, work load and exercises that were applied, proving that can improve time and physical development of our athletes. The results showed relatively good improvements in the performance time starting from an initial time of 30.66 seconds at the initial testing to come close at the final testing at a 24.51 seconds result that is very close to the national record 22.07 seconds, and also to the international record of 21.05 seconds. The results were than calculated for statistical significance with the t Student test, and found that between the initial and final test values is a statistically significant difference with a value of $p = 0.00001$. Conclusions of our research showed that firefighters need to be physically prepared to intervene in critical situations for search and rescue in any situations that appeared thus a strong physical program can contribute to their physical shape and skills.

KEYWORDS: physical training, firefighters, intervention device of firefighters

1. Introduction

Firefighting job is a dangerous physical and psychological demanding occupation that includes working with high rates of pulse, low oxygen uptake, stair climbing, crawl, search and rescue (Ensari et al., 2017; Perroni et al., 2014).

Latest statistics proving that more than a half of the tragic incidents come from carrying heavy equipment with protective gear, heat stress, and working at near maximal heart rates for extended periods of times (Selkirk & McLellan, 2004).

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Other investigations showed a direct link between better and safer rescues and firefighter performance and well prepared physical level of the emergency employees (Michaelides et al., 2011).

Extreme workload under high temperature, polluted and toxic elements produced by fire, heavy equipment can cause high levels of anxiety and psychological stress (Eglin & Tipton, 2005; Von Heimburg et al., 2006).

Other studies (Smith et al., 2005; Perroni et al., 2009; Blaker et al., 2010) reviewed that the combining the demand for physical activity, unpredictable conditions, high temperature and also exposure to external heat sources can develop an increased physiological, psychological, anxiety and stress being very novice for firefighter health (Perroni et al., 2014).

Although physical stress and the workload of a real emergency are difficult to measure, several authors have claimed that the firefighting causes a heart rate (HR) close to the maximum values (Smith, 2001; Perroni et al., 2009) with decrease in the stroke volume (Smith, 2001), and increase in the core temperature, in the levels of blood lactate (Perroni et al., 2009) and psychological stress (Ray et al., 2006).

For this reason, it is recognized that firefighters must possess the physiological characteristics that enable them to respond to the emergencies. Study of Hammer & Heath (2013) emphasizes the need of a higher priority for firefighter fitness programs in order to best ensure the safety of firefighters and the public.

2. Objectives of the Research

The objective of our investigation was to analyze the importance of physical development and specific training for firefighters in order to improve the physical resistance through athletic exercises and perform better in the firefighters specific competitions.

3. Research Method

Firefighters professional service from our country test their skills in emergency competitions that are organized annually on different stages local, regional on final competition where all the cities participate.

The research method used in our investigation was mostly the experiment method and the observation method. The inquire used physical testing that are specific to the firefighters' service.

All the skills trained for firefighter's service are tested in a national competition organized by the Inspectorate for Emergency Situations from Romania that is similar to the international competitions organized by the International Committee for Fire Prevention and Extinction (CTIF).

The contest events and the number of competitors at each team are:

- ladder competition – 8 competitors;
- obstacle 100 meters run – 8 competitors;
- the relay race 4×100 meters – 2 teams with 4 competitors;
- realizing the intervention device – 7 competitors.

The "*intervention device relay race*" competition (MAI, 2007). Each lot presents a team of 7 competitors and is entitled to two attempts.

The competition track has a length of 95 meters (from the beginning to the line of action of the pipe heads) and a width of 20 meters. At 9 meters from the start line, the platform is located (the side edges).

Competitors are equipped with trainers, helmets, belts and sports shoes and have five minutes available to dispose of accessories on the platform and test preparation.

The constructive technical details of the wooden platform and the way of placing the materials on it are provided in Figure no. 1, and the elements targeting the target (the installations of the signaling system and the associated basin), in Figure no. 2.

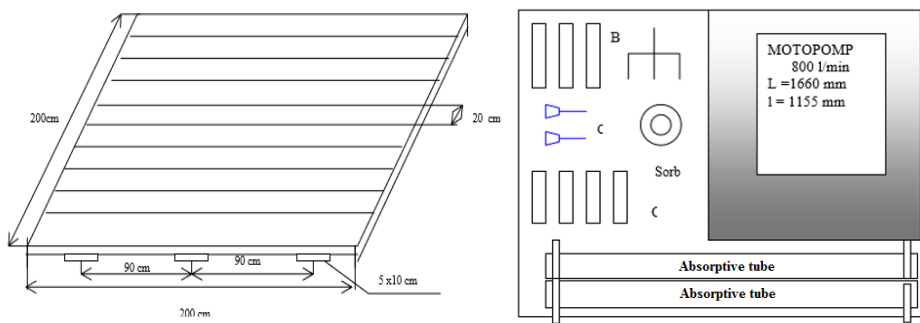


Figure no. 1: *The wooden platform and the arrangement of accessories on the wooden platform (variant)*
(Source: Ministry of Internal Affairs, 2007)

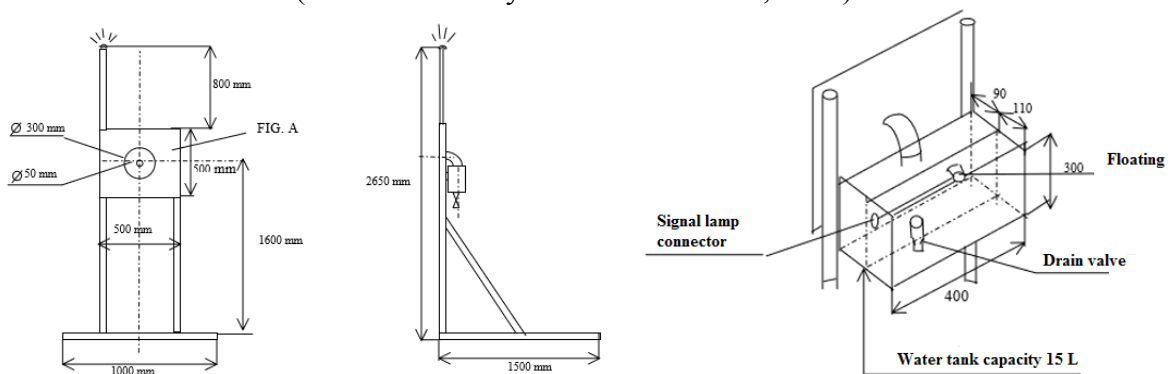


Figure no. 2: *The target*
(Source: Ministry of Internal Affairs, 2007)

The organization of the competition device, the location of the materials and the

variants of the teams for the start are shown in Figure no. 3.

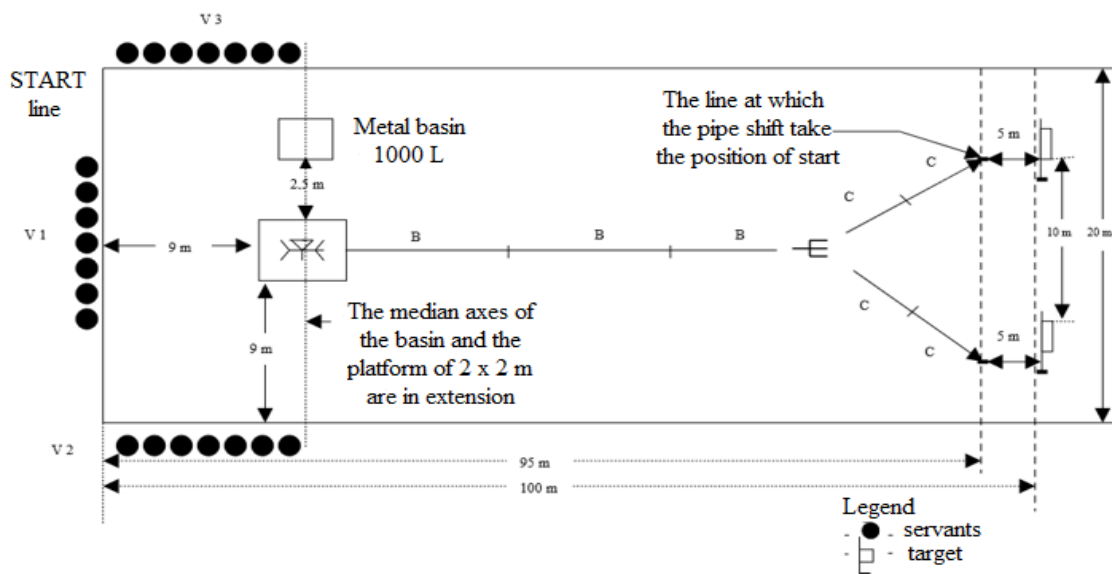


Figure no. 3: *Realization of the intervention device at the motor pump*
(Source: Ministry of Internal Affairs, 2007)

The device must also meet the following criteria:

- a) Pump motor, with a minimum flow of 800 l/min at a maximum pressure of 8 bars, and the two targets, be equipped with a water tank of 15 liters capacity, a level indicator and a signal lamp. The lamp lights up when the tank has been filled with 10 liters of water. The targets are located at a distance of five meters in front of the pipe heads action line.
- b) All accessories, except the 1000-liter metal basin and the targets, are located on the platform. The hose must be tightened in a roll or ribbon, but not connected. The absorption tubes can exceed the platform edges by up to 50 centimeters.
- c) The 1000-liter metal basin is located 2.5 m to the left of the left edge of the platform. The distance from the median axis of the basin to the starting line is 10 meters.
- d) The valves of the motor pump and its connection must be in the open position.

The connections must not be touched and the motor pump can be started for one minute during the preparation period.

Each team is placed off the track, and competitors can start from behind the platform, left or right. Depending on which option the team has chosen, all competitors will occupy the same starting line.

After giving the signal "START!" The team starts the engine of the motor pump, provides water supply from the 1000-liter tank, with two absorption tubes and realizes the intervention device of three hose types "B," which it connects to the distributor and two lines. Two "C" type hose, one on each side of the distributor.

After completing the hose lines, the two pipe heads act for filling the basins with water, without exceeding the marking line for work, drawn five meters in front of the targets and without helping each other.

The test is considered completed when the signal lamps from the two targets are lit continuously.

4. Research Protocol

4.1. Research Hypothesis

The research started from the assumption that if special training programs and rigorous motor development for firefighters were followed the result at the specific firefighters competitions organized by the Inspectorate for Emergency Situations from Romania or the International Committee for Fire Prevention and Extinction.

4.2. Period and Location of the Research

The investigation was undertaken between March and September 2018 at the Inspectorate for Emergency Situations from Sibiu and was formed from four phases: on departments, counties, regional and final phase – national.

4.3. Subjects of the Research

The research subjects were selected among the Inspectorate for Emergency Situations from Sibiu team and was composed of 10 males with age between 27-33 years old (with an average of 30.2 ± 3.5 years old) and an experience in the specific contest between 2-7 years old.

4.4. The Training Program Developed for Training the Firefighters

The experimental stage was continued after finding and interpreting the kinematic parameters with the monitoring and evaluation of the results that allowed me to know, to identify the technical errors and to develop the motor qualities of the athletes in order to adapt some measures to correct them. For the purpose of the correction, the development of an adequate motor program for the monitoring and evaluation of the technical training for the specific tests of the competitions of the professional services for emergencies was used.

In collaboration with the coach of the batch Inspectorate for Emergency Situations from Sibiu, we agreed that this motor program based on tests and exercises

in athletics, must be carried out as accurately as possible with the proposed model, which corresponds to what the athlete chosen as a reference subject has

already repeated several times until upon acquiring a precise motor image and a sequence of movements corresponding to the correct execution.

Table no. 1
The design of the training process

No.	Special training program	The training micro-cycles			
		Micro-cycle (one week)		Micro-cycle before the competition	
		Allocated percentage	Time (min)	Allocated percentage	Time (min)
1	Training program from athletics	30%	108	30%	108
2	Training program for developing motor skills	20%	72	10%	36
3	Simulating the specific firefighters event	20%	72	10%	36
4	Global execution of the race	30%	108	50%	180

Note: The training time is 6 hours a day, totaling 360 minutes.

As for the micro-cycle it is possible to stretch while it is allocated, it is possible to train specific athletic programs (108 minutes), programs to develop motor qualities (72 minutes) and to simulate the specific firefighters event (72 minutes), for a total of 252 minutes – a total of 360 minutes of daily training (including global execution of the race). At this time 70% is required during training.

5. Results

Segmented and assembled execution of the test “*installing the intervention pump device*”:

- a) Demonstrative presentation of the evidence, together with explanations.
- b) Execution of duties on groups of sportive and their execution.
- c) Joint execution of the sample without and with water.
- d) Training in the execution of the race using water:
 - Location of the pump at the source (5 exercises).
 - Making the device up to the distributor (5 exercises).

- Location of the pump at the source, realization of the device up to the distributor and up to the pipe heads including.

- The start with 5 sportive and the connection of the absorption tubes between them, to the pump and to the suction, with its introduction in the 1000-liter tank. Scale: under 7 seconds.

- 10 m run, connection and implementation of the intervention device to the distributor – Scale: under 18 seconds.

- Run with pipe to the belt and two “C” type hose reels on a distance of 60 m, right hand roller extension, 20 m running and left-hand roller extension, 20 m running and connection, in scale, under 30 seconds.

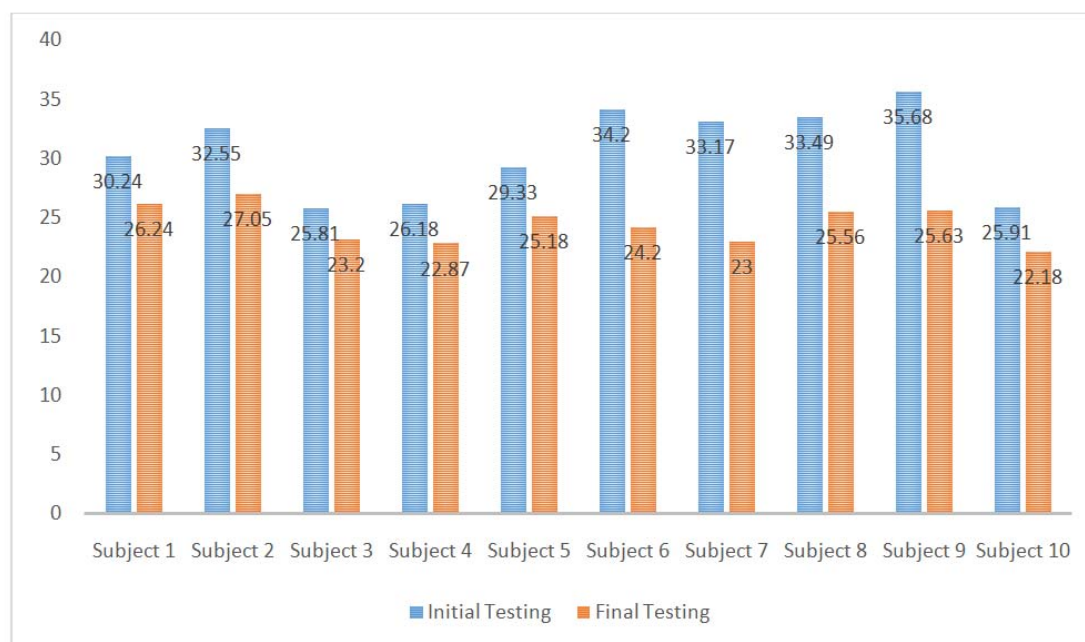
- Training in the joint execution of the sample (5 exercises).

After completing the motor program and conducting the initial evaluations, we mention that the training programs of all the subjects in the experiment were individualized on each subject, through tables in which the dynamics of effort records the volume by number of repetitions, the distance in meters and the intensity by percentages and times.

Table no. 2*The performances of the firefighters at the carrying the intervention device test*

Firefighters contest		Carrying the intervention device			
Subject	Age	March (initial test)		September (final test)	
		Performance	Grade	Performance	Grade
Sub. 1	30	30.24	7	26.24	9
Sub. 2	29	32.55	6	27.05	8
Sub. 3	26	25.81	9	23.20	10
Sub. 4	31	26.18	9	22.87	10
Sub. 5	27	29.33	7	25.18	9
Sub. 6	30	34.20	5	24.20	10
Sub. 7	32	33.17	5	23.00	10
Sub. 8	28	33.49	5	25.56	9
Sub. 9	30	35.68	5	25.63	9
Sub. 10	29	25.91	9	22.18	10
Average	29.2	30.66	6.7	24.51	9.4

Legend: values between 22-25 were noted with 10; values between 25-27 were noted with 9; values between 27-29 were noted with 8; values between 29-31 were noted with 7; values between 31-33 with 6; values between 33-35 with 5

Figure no. 4: *Results at the initial and final test*

The research, analysis and interpretation of the results continued with the latest specific evidence for the competitions of the professional structures for emergencies, namely the intervention device at the motor pump.

For this event, a team consisting of seven athletes was selected, all these subjects have the necessary experience and skills formed by selecting them in the Inspectorate for Emergency Situations from

Sibiu lot and participating in previous years in the competitions specific to the professional structures for emergencies in this event.

The initial evaluation was carried out on 01 March 2018 by completing the full test of the pump intervention device. The training through the individual and team motor program continued as well as the monthly evaluations of the subjects. The cycle of these evaluation activities

ending – on 02 September 2018 with the final evaluation.

In Figure no. 4 above, we have presented only the times achieved by the team selected for the pump intervention device sample at the initial evaluation and at the final evaluation.

The conclusion is as follows:

- Initial evaluation: Average time = 30.66
- Final evaluation: Average time = 24.51

The analysis of the times and of the execution technique was performed monthly from one stage to another. By watching the sample executed by international team champions to this sample as well as by

filming and watching the execution of the sample by the selected subjects, the faster and easier correction of the execution errors and the improvement of the technique was achieved. This can also be noted because the time of execution of this sample between the initial and final evaluation was shortened by an average of 7 seconds. The time achieved by 24 seconds is a good time considering that the international record of the motorcycle intervention device sample is 21.05 belonging to the professional firefighting group of the Russian Federation, and the national record of 22.07 belongs to the Inspectorate for Emergency Situations from Bacău team.

Statistical interpretation of the results:

The P value and statistical significance:

The two-tailed P value equals 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 6.1450

95% confidence interval of this difference: From 3.9484 to 8.3416

Intermediate values used in calculations:

$$t = 6.3284$$

$$df = 9$$

$$\text{standard error of difference} = 0.971$$

6. Discussions

The firefighter's first preoccupation is to intervene in stopping fire but they are also set for responding emergencies calls, rescue, and search for lost people or protect human life and health (Braedley, 2015; Selkirk et al., 2004).

Physical fitness is a crucial element in firefighters training bringing efficient and proper contribution strategies to complete formation of emergencies employees (Nazari et al., 2018).

The investigation undertaken by us highlighted that the training program developed good motor abilities, strength and fitness, the results of the firefighters team improved from 30.66 second at the initial

testing compared with the final testing where they obtained 24.51 seconds result.

The improvement of 6.15 seconds from initial to the final evaluation highlighted the efficiency of the training program undertaken with the firefighters team.

Many research proved that a direct association between improved firefighting efficiency performance at their job requires a high level of physical fitness (Michaelides et al., 2011). Firefighting involves strenuous work that leads to maximal or near-maximal heart rates (HR) and rapid changes in core temperature (T_{co}) (Barr, Gregson, & Reilly 2010; Kong et al. 2010; Colburn et al. 2011; Walker et al. 2015).

Also important aspects of specific firefighters fitness, present a crucial development of cardiorespiratory system, muscle strength and resistance. Developing cardiorespiratory fitness is very important characteristic and a contributing factor to improved performance enabling firefighters to carry out on-duty tasks more efficiently (Perroni et al., 2013).

Firefighters are commonly warned about the impacts of high body mass and low fitness on their risks for fire ground injury and sudden cardiac events. These data provide compelling evidence that low fitness and excess fat also impair work performance on the fire ground.

7. Conclusions

The conclusions of our research showed that using specific fitness program regarding firefighters preparation for emergencies can improve performance time of interventions.

The hypothesis of our research was confirmed, using specific programs of training for firefighters we managed to improve the performance at the intervention moto-pomp event specific to the firefighters competitions.

Also we improved physical strength, motor qualities and bring the time for event from 31 seconds to 24 seconds, having an improvement time of 7 seconds, bringing the performance closer to the national record of 21 seconds and 20 seconds the international time.

Firefighters occupation demand a lot of physical and psychical resistance that need specific programs for developing speed, strength, resistance and coordination. Firefighters need to keep up in good physical shape and improve and develop their skills so that they can intervene prompt in critical situations.

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