

Energy expenditure of candidates for students of the Main School of Fire Service (MSFS) during the “adjust to working together” field exercises

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Summary:

Introduction: Rescue activity is primarily teamwork. Life of rescuers as well as rescued people depends on cooperation of all of them.

Material and methods: The aim of the work was to assess the amount of energy expenditure expended by candidates for students of the Main School of Fire Service during the “adjust to working together” field exercises. Total of 24 men, future students, divided into 3 groups of eight men in the group, took part in the research. Examination of energy expenditure was based on measurements of heart contractions frequency registered by the Polar Sport Tester 810.

Results: The “adjust to working together” exercises are the fundamental exercises when precision, safety and time of performance are assessed.

Value of energy expenditure expended by candidates for students of the MSFS during the “adjust to working together” field exercises allows to classify carried out works as very heavy ones. Value of energy expenditure related with training activities performed by candidates for students of MSFS should be a base to determine time of training activities execution. During these exercises a source of smoke (fire) was located, room full of smoke was opened, fire-fighting activities were carried out and injured were evacuated from the fire zone.

Conclusions: Value of energy expenditure expended by candidates for students of the MSFS during the “adjust to working together” field exercises allows to classify carried out works as very heavy ones. Value of energy expenditure related with training activities performed by candidates for students of MSFS should be a base to determine time of training activities execution.

Key words: energy expenditure, firemen, field exercises, Main School of Fire Service.

Introduction

Occupational hazards of firemen related to their work that are not dependent on the environment conditions but on ways of working resulting from its specificity are:

- huge physical load;
- exposure to stress;
- changeable daily rhythm of work;
- necessity to demonstrate full psychomotor efficiency [1].

Rescue activity is primarily teamwork. Life of rescuers as well as rescued people depends on cooperation of all of them. Candidates for future State Fire Service officers before beginning their studies in the Main School of Fire Service, take part in eight-week field training, where they acquire practical skills related with actions in situations and conditions that will be part of their work and service. The “adjust to working together” exercises are the last stage of candidates training. Such exercises require maximum efforts. Precision and safety of exercises are assessed. The size of energy expenditure associated with carrying out different training activities by candidates for fire fighters is a determinant that determines amount of the daily energy expenditure.

Additional impediment is necessity to carry out the set of exercises wearing specialist clothing that protect rescuers from loss of life and health. Weight of the protective clothing and indispensable rescue equipment for typical action, so-called residential fires, is about 20 kg.

Energy expenditure is a fundamental parameter describing amount of energy expended by a man during doing the work. To determine amount of energy expenditure many methods are used, in addition in the field conditions and huge physical activity, measurements of heart contraction frequency are usually used. The base of the method is use of linear relation between heart contractions frequency during physical activity and body energy expenditure [2].

The aim of the work was to assess the amount of energy expenditure expended by candidates for students of the Main School of Fire Service during the “adjust to working together” field exercises.

Material and methods

Total of 24 men, future students, divided into 3 groups of eight men in the group, took part in the research. The average age of examined candidates for students amounted to 19.8 ± 1.2 years, body height and body mass amounted to $180,6 \pm 4,6$ cm and $75,7 \pm 6,6$ kg respectively. The BMI value was $23,2 \pm 1,6$ kg/m². The percentage fat content and lean body mass amounted to $12,9 \pm 1,8\%$ and $65,9 \pm 5,5$ kg respectively. Examination of energy expenditure was based on measurements of heart contractions frequency

registered by the Polar Sport Tester 810 heart rate meters, in which energy expenditure value is calculated from relation between heart contractions frequency and oxygen usage [3].

Results and discussion

The “adjust to working together” exercises are the fundamental exercises when precision, safety and time of performance are assessed. Examination of energy expenditure was carried out in three groups of 8 men in each. During these exercises a source of smoke (fire) was located, room full of smoke was opened, fire-fighting activities were carried out and injured were evacuated from the fire zone. Obtained results are presented in Table 1.

Table 1: Amount of the energy expenditure during the “adjust to working together” exercises

Group	Duration of the activity [min]	Value of the energy expenditure of the activity [kcal]	Value of the energy expenditure kcal/min
I	58.8	683.7	11.6
II	52.4	583,1	11.1
III	51.8	495.4	9.6
Average:	54,4	587.4	10.8

According to the obligatory Christensen's & co. classification of the work heaviness [4] work of such load should be rated as very heavy work. Amount of expended energy related with carried out work makes that the higher energy expenditure connected with the work the shorter permissible period of its implementation [5] (Table 2).

Table 2: Amount of the energy expenditure that can be sustained for specific time

Amount of the energy expenditure kcal/min	Acceptable time of activity
25	5 minutes
15	1 hour
10	10 hours
5	2-3 days
4	10 days
3	Months
2.5	Unlimited for healthy people
2	Average for population

Average value of the pulse rate in groups of examined men confirms heaviness of the work (Table 3) [6].

Table 3: Average heart contractions frequency among subjects

Examined group	Pulse min. value / min	Pulse max. value / min	Average pulse value / min
I	81.5±13.7	193.3±9.5	128.5±12.8
II	77.1±5.8	187.0±8.9	138.1±15.8
III	76.2±8.9	182.1±12.4	127.5±18.3
Average value:	78.2±9.4	187.4±10.2	131.3±15.6

Results of previous research on energy expenditure of third-year students of MSFS carried out during rescue training on the training ground revealed that the higher energy expenditure (11.47 kcal/min) was expended by firemen rescuing injured from a car crushed by a bus. Huge energy expenditure (10.66 kcal/min) expended students dealing with organization of so-called water position i.e. connecting pumps and rolling up of fire fighting equipment [7].

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Research carried out by Pokorski *et al.* [8] including assessment of energy expenditure during fire fighting action showed that firemen's energy expenditure amounted to 46.1-53.2 kJ/min, what allows to classify this work as heavy one.

Results of research carried out by Bugajska *et al.* [9] revealed that amount of energy expenditure of fire fighters during climbing a fire ladder amounted to 54.5±15.2 kJ/min, and during climbing stairs with a fire hose full of water — 55.5±14.9 kJ/min, while energy expenditure during evacuation of injured amounted to 50.0±15.6 kJ/min.

Conclusions

- 1) Value of energy expenditure expended by candidates for students of the MSFS during the “adjust to working together” field exercises allows to classify carried out works as very heavy ones.
- 2) Value of energy expenditure related with training activities performed by candidates for students of MSFS should be a base to determine time of training activities execution.

