STUDIES IN PHYSICAL CULTURE AND TOURISM
Vol. 17, No. 1, 2010

INGRID RUŽBARSKÁ[1], MILAN TUREK[2]
[1]International School of Management ISM Slovakia in Prešov, Slovakia
[2]Faculty of Sport, University of Prešov, Prešov, Slovakia

ANALYSIS OF MOTOR PERFORMANCE INDICATORS OF MEDICAL RESCUERS

Key words: physical fitness, medical rescuers, physically demanding profession.

ABSTRACT

In Slovakia hardly any research has been carried out on motor performance of professional medical rescuers. The purpose of this study was to describe and compare the physical fitness of medical rescue candidates and active rescuers. The research sample consisted of 71 students in the bachelor study program "Medical Rescuer" at the Faculty of Health of the University of Prešov in Slovakia. Physical fitness was measured using the EUROFIT test battery. Additional motor tests for coordination abilities were used to determine the space of these abilities in more detail. Results of this study indicate lower muscular and cardio-respiratory endurance of male and female rescuers in comparison with younger rescue candidates. In the group of male rescuers a significantly higher body weight and total skinfold thickness were also noted. Studies determining the kinetic particularities of individual professions make it possible to improve a given profession profile and professional training.

INTRODUCTION

The bachelor study program "Medical Rescuer" at the Faculty of Health of the University of Prešov in Slovakia focuses on training professional rescuers who are qualified and competent to provide urgent paramedical care and life-saving procedures. The program graduates can work in the component parts of the integrated rescue system, in the sphere of premedical urgent health care, emergency departments, intensive care units, critical care units, military health care units, fire squads and others units delivering life and health saving services.

It is unquestionable that there are high physical demands of the career of emergency service personnel. Regarding the safety of professional rescuers they need to be in an excellent physical condition to be able to perform such a demanding job for a long time. Increased physical demands of this profession must be taken into account regarding the number of female candidates in this profession as well as the number of active professional female rescuers [3, 13]. Stressors experienced by medical emergency personnel include high physical exertion during prolonged manual cardiopulmonary resuscitation, heavy lifting manouevres involved with patient transfer and mental strain associated with trauma situations and shiftwork [1, 2].

Tasks that involve prolonged and repetitive pulling, pushing, holding, carrying, and lifting can lead to cumulative trauma disorders such as low back pain, sprains, strains, and neck pain. Low levels of physical fitness are associated with low back problems. Improved aerobic and muscular fitness reduces the risk for back problems and enhances the ability of men and women to perform tasks in physically demanding occupations [3, 7, 8]. Low-fit rescuers are forced to work at a higher

Correspondence should be addressed to: Ingrid Ružbarská, Ph.D., Duchnovičovo námestie č. 1 080 01 Prešov, Slovakia, e-mail: ruzbarska@ismpo.sk

intensity, risking fatigue and injury. Workplace injuries cause loss of work time, reduce productivity, and add to the cost of workers' compensation. Unfit workers not only lower productivity, but also increase the risk of musculoskeletal injuries, particularly low-back injuries. Ergonomic research demonstrated that the risk of back injury was not just a function of the demands of the materials-handling task, but also the physiological capacity [15].

Physical training can be used as a preventive or rehabilitative tool in occupational settings. Training can also prevent mismatches between physical capabilities and job demands and decrease incidences of injury-related absenteeism.

It can be supposed that rescue tasks such as hoisting tasks and saving victims are related to factors such as stature, body mass, body fat, push-up scores, sit-up scores, total hand-grip strength, endurance [16]. It can be assumed that if the job requires lifting and dragging victims, tests of muscular strength and endurance may be highly correlated with performance. It is stated that muscular endurance tests such as timed sit-ups, push-ups, and pull-ups are often part of the selection process or fitness assessment of law enforcement, public safety, and military personnel [14]. They were also identified as key physical components of the rescue tasks total body coordination, eye-hand coordination and total speed to be necessary for rescuers to successfully perform their duties [4].

As a matter of fact, in Slovakia hardly any research studied have been carried out on the physical fitness of professional medical rescuers. The physical fitness characteristics of firefighters, police officers, and armed service personnel have been well documented. There are defined criteria for the required level of physical fitness and motor performance as well as for exercise programs to enhance and maintain the optimal level of motor preparedness in these professions. In contrast, there is a relative lack of data describing the physical attributes of emergency medical service personnel. Up to this day, no key points for consolidation of essential minimal requirements concerning the optimal level of motor performance in candidates for professional rescue have been defined.

The present research project supported by a Slovak Academy of Sciences grant attempts to determine key factors of a motor profile within the professional preparation for the career of medical rescuer; define and specify the relevant diagnostic procedures for monitoring condition and coordination space of motor performance, and functional efficiency applicable as a pre-employment and regular occupational testing.

The purpose of this study is to describe and compare some indicators of motor performance of medical rescue candidates and active rescuers.

METHODS

The research sample consisted of 71 students in the bachelor study program "Medical Rescuer" at the Faculty of Health of the University of Prešov, Slovakia. 35 full-time students (17 men, 18 women) and 36 extramural students (19 men and 17 women) took part in the study. In fact, all the extramural students were employed at that time as medical rescuers in various emergency services. The mean of their years of practice was 2.7 ± 1.9 years for men, varying from 1 to 8, and 5.1 ± 3.7 years for women, varying from 2 to 12. Even though they were already employed, it was compulsory for them to complete the qualification by graduating from the mentioned study program. In contrast, the full-time students had no work experience in the professional rescue systems. For the purpose of this study we marked the group of full-time students with no professional rescue experience as "Rescue candidates" and the group of extramural students employed in some parts of the integrated rescue system as "Rescuers". The mean age of the male rescue candidates was 21.6 and the male rescuers 28.1 years. The mean age of the female rescue candidates was 20.3 and the female rescuers 31.6 years. The subjects were informed of the purpose of this study and the test procedures during special information sessions. All tests were performed at the beginning of the term in the subjects' first year of studies.

The motor tests selected for the purpose of this study represent important physical capacities of occupationally competent medical rescuers. Physical fitness was measured using the EUROFIT test battery [6] consisting of 9 tests which measure the basic motor capacities.

Table 1. EUROFIT [6] tests and anthropometric measurements

Eurofit tests	Motor abilities
Flamingo balance (n)	Static balance
Plate tapping (sec)	Frequency speed of an arm
Sit and reach (n)	Joint flexibility of the trunk
Standing broad jump (cm)	Explosive strength of the lower limbs
Hand grip (kg)	Static strength of a dominant hand
Sit-ups (n)	Dynamic and endurance strength of abdominal, coxal and thigh muscle
Bent arm hang (sec)	Static and endurance strength of upper limbs
Shuttle run 10x5 m (sec)	Running speed – agility
Endurance shuttle run (n)	Cardio-respiratory endurance
Anthropometric measures	Weight (kg)
	Height (cm)
	Total thickness of five skinfolds (mm) / biceps, triceps, subscapular, anterior suprailiac, medial calf

Body weight was measured with a precision of 0.5 kg. Stature was measured using Martin's anthropometer with a precision of 0.1 cm. Skinfolds were measured using the Harpenden caliper with a precision of 0.1 mm. Then the total thickness of skinfolds was calculated.

Motor tests for coordination abilities [9, 12] were used to determine the space of coordination motor abilities in more detail, as there only the flamingo balance and plate tapping tests represent coordination dimensions within the Eurofit test battery [6].

Table 2. List of coordination abilities tests

Motor tests	Motor abilities
Jump on a mark (cm)	Kinaesthetic differentiation
Run towards balls (sec)	Orientation ability
Random drumming (n)	Rhythmical ability
Ditrich's stick (n)	Reaction ability
Complex motor test (sec)	Ability of joining of the acyclic movements
Target throwing (n)	Ability of adaptation and transfer of movements

According to different authors [9, 12], the reliability of the motor tests of coordination abilities is 0.7 to 0.9. After the test session descriptive statistics (means, SD) were calculated for the groups of rescue candidates and rescuers, in male and female groups respectively. Possible differences between the groups were explored using *t*-tests for independent samples. The significance level was set at $p \leq 0.05$.

RESULTS

The descriptive statistics (means, SD and *t*-values) of the examined groups are presented in Tables 3 to 6. The t-test analyses in the male groups (Table 3 and 4) indicate significant differences between the male group of "Rescue Candidates" and "Rescuers" in the level of static and endurance strength of the upper limbs, running speed and cardio-respiratory endurance. Also significant differences were found in coordination indicators – static balance, orientation ability. The rescue candidates displayed a significantly higher level of static balance, and on the contrary, the active rescuers dominated in the level of orientation ability. However, these results indicate significantly higher body weight and total skinfold thickness in the group of rescuers.

Table 3. Descriptive statistics, t-values of condition motor indicators, anthropometric characteristics of male rescue candidates and rescuers

	Rescue candidates (n =17)		Rescuers (n =19)		t-valu
Variables	Mean	SD	Mean	SD	
Sit-and-reach (cm)	27.3	9.2	28.3	10.6	–0.2
Standing broad jump (cm)	226.5	22.5	210.9	24.2	1.9
Handgrip (kg)	56.1	6.9	58.4	8.8	–0.8
Sit-ups (n)	28.5	4.3	25.6	4.9	1.8
Bent-arm hang (sec)	50.9	16.8	33.8	12.4	3.5*
Shuttle run 50 (sec)	18.9	0.9	20.2	1.3	–3.2*
Endurance shuttle run (n)	67.5	14.2	49.7	13.8	3.8*
Weight (kg)	76.8	9.2	88.1	10.1	–3.5*
Height (cm)	182.0	7.1	182.9	6.6	–0.4
Sum skinfolds (mm)	56.6	16.9	67.9	9.4	2.5*

$p \leq 0.05$

Table 4. Descriptive statistics, t-values of coordination motor indicators of male rescue candidates and rescuers

	Rescue candidates (N=17)		Rescuers (N=19)		t-valu
Variables	Mean	SD	Mean	SD	
Flamingo balance (n)	4.8	1.8	8.3	4.0	–3.2*
Plate tapping (sec)	10.3	1.6	10.1	1.4	0.3
Jump on the mark (cm)	2.9	1.5	3.9	2.3	–1.4
Run towards the balls (sec)	9.2	1.1	8.3	1.0	2.5*
Random drumming (n)	11.4	2.4	12.6	3.5	–1.2
Ditrich´s stick (cm)	15.8	3.8	16.3	5.3	–0.3
Complex motor test (sec)	16.7	1.6	18.4	3.0	–1.9
Target throwing (n)	1.8	0.9	1.3	0.8	1.9

$p \leq 0.05$

Table 5. Descriptive statistics, t-values of condition motor indicators, anthropometric characteristics of female rescue candidates and rescuers

	Rescue candidates (n =18)		Rescuers (n =17)		t-valu
Variables	Mean	SD	Mean	SD	
Sit-and-reach (cm)	26.7	9.2	30.2	4.7	–1.4
Standing broad jump (cm)	177.9	14.4	152.6	23.1	3.8*
Handgrip (kg)	35.2	8.0	34.4	5.6	0.4
Sit-ups (n)	24.7	3.8	17.7	3.5	5.4*
Bent-arm hang (sec)	39.1	12.6	22.7	9.5	3.5*
Shuttle run 50 (sec)	22.4	2.0	23.3	1.6	–1.4
Endurance shuttle run (n)	38.2	8.1	25.2	10.6	3.9*
Weight (kg)	57.5	7.7	59.4	8.7	–0.6
Height (cm)	166.4	7.5	165.2	6.3	0.4
Sum skinfolds (mm)	70	15.5	75.6	15.1	–1.1

$p \leq 0.05$

Table 6. Descriptive statistics, t-values of coordination motor indicators of female rescue candidates and rescuers

	Rescue candidates (N=18)		Rescuers (N=17)		t-value
Variables	Mean	SD	Mean	SD	
Flamingo balance (n)	4.9	2.0	8.7	3.1	–4.1*
Plate tapping (sec)	12.0	1.0	11.3	1.1	1.8
Jump on the mark (cm)	4.5	2.7	5.2	2.8	–0.5
Run towards the balls (sec)	9.6	0.8	9.5	1.5	0.01
Random drumming (n)	13.0	3.2	12.4	2.1	0.6
Ditrich´s stick (cm)	16.9	5.2	17.2	6.4	–0.1
Complex motor test (sec)	18.3	1.8	21.8	2.8	–4.3*
Target throwing (n)	2.1	0.9	1.7	0.8	1.1

$p \leq 0.05$

Comparisons between the female groups (Table 5 and 6) yielded relatively similar results. Significant differences were found between the group of female "Rescue candidate" and female "Rescuers" in explosive strength, dynamic and static endurance, and cardio-respiratory endurance. The results indicate a significantly higher level of static balance and ability of the joining of movements in the group of rescue candidates. The higher level in rescue candidates concerned all differences. There was no significant difference in the anthropometric characteristics between the groups.

DISCUSSION

The results of this study indicate a lower level of muscular and cardio-respiratory endurance of male and female rescuers as compared with the younger rescue candidates. In the group of male rescuers a significantly higher body weight and total skinfold thickness were observed. According to Davis et al. [5] state that that performance was more affected by the increasing percentage of body fat than by the increasing age in earlier studies. Overweight, and especially obesity, is a limiting factor not only for performance of rescue tasks but also for the rescuers' health. The rescuers in the present study stated that their employers did not provide them any kind of health or job-related fitness program, entry or annual fitness testing. It is likely that the motivation of the rescuers for regular training is rather low. Surprisingly, in the group of

female rescuers, even the mean age difference was more than 10 years, and no increased body weight or skinfold thickness were observed.

During normal ambulance rescue duties, body fat may prove to be a more important physiological variable than aerobic capacity. While many tasks are completed below the maximal aerobic levels (cardiopulmonary resuscitation, patient handling, etc), an increased body fat level may lead to an increase in the relative intensity of such activities [2].

The question is whether job or fitness standards should be absolute – that is, the same for all employees – or relative to age and gender. Sharkey and Davis [8] argue that those performing the same job should meet the same standard, regardless of gender or age. On the other hand, it is stated that age is an important factor, which should be taken into account. Training and schooling are necessary for physically demanding jobs [3].

However, aerobic fitness declines with age, even when people remain active [11]. Fitness declines rapidly in the general population, and body fat levels double during a typical 20-year career. With this physical decline comes a high rate of heart disease, which, surprisingly, is viewed as a job-related disability. Taxpayers deserve the best public servants available, and the incumbents deserve to remain healthy and fit for the job. The solution is to test recruits and follow up with an annual performance evaluation, coupled with a job-related physical maintenance fitness program.

The motor components, mainly coordination indicators involved in this study, have not been extensively investigated in earlier studies. The tests most used in employment issues are strength and aerobic endurance; flexibility and balance tests are used less often [15]. Rescuers – men and women displayed a lower level of static balance than rescue candidates. But tin general, the results show that there were not many differences in the level of coordination abilities between the groups of rescue candidates and rescuers, neither in male or female groups. It can be assumed that the space of coordination components of motor performance is less influenced by anthropometric characteristic (increased body weight, body fat) or age than the condition abilities. We assume that coordination factors of motor performance are more stable than factors of muscular endurance and strength. However, further research is needed to ascertain the relation of particular coordination indicators and job tasks, and to determine the necessity of including such parameters in future physical testing and development of specific fitness programs. Although there were no significant differences in flexibility, male and female rescuers revealed a higher level of this component than the rescue candidates. We presume that flexibility should be an important part of regular diagnostics for physically demanding professions.

The knowledge of actual physical readiness of rescuers should be presented as a way to promote and support employee health and safety and to enhance not only physical health. It is an important step in the development of a comprehensive employee health program, entry-level testing, health education and health-related fitness and periodic assessment of work capacity [8]. Further studies determining the kinetic particularities of individual professions will enable to particularize and improve the profile and training o demanding professions.

Acknowledgement

This research was supported by the Slovak Academy of Sciences grant no. 1/0424/08 awarded to the authors.

REFERENCES

[1] Bridgewater F.H., Bridgewater K.J., Zeitz C.J., Using the ability to perform CPR as a standard of fitness: a consideration of the influence of aging on the physiological responses of a select group of first aiders performing cardiopulmonary resuscitation. *Resuscitation*, 2000, 45 (2): 97-103.

[2] Chapman D., Peiffer J., Abbiss C.R., Laursen P.B., A descriptive Physical Profile of Western Australian Male Paramedics, *Journal of Emergency Primary Health Care (JEPHC)*, 2007, 5, 1: 87-92.

[3] Claessens A.L. et al., Physical fitness of professionnal firemen, *Kinesiology*, 35, 2003, 2, 119-130.

[4] Considine W., Misner J.E., Boileau R.A., Pounian C., Cole J., Abbatieilo A., Developing a physical performance tests battery for screening Chicago firefighting applicants, *Pub. Pers Mgt.*, 1976, 5: 7-14.

[5] Davis O.O., Dotson C.O., Santa Maria D.L., Relationship between simulated fire fighting tasks and physical performance measures, Medicine & Science in Sports & Exercises, 14, 1: 65-71.

[6] Eurofit: Handbook for the Eurofit tests of physical fitness. Council of Europe, Strasbourg 1988.
[7] Knapik J. et al., Injury and fitness outcomes during implementation of physical readiness training, *International Journal of Sports Medicine*, 2003, 24: 372-381.
[8] Sharkey B.J., Davis P.O., Hard work: Defining physical performance requirements. Human Kinetics, Champaign Ill 2008.
[9] Hirtz P., Koordinative Fähigkeiten im Schulsport (Coordination abilities in school sport), Volk und Wissen Volkseingener Verlang, Berlin 1985.
[10] Hoffman J., Norms for fitness, performance, and health, Human Kinetics, Champaign, Ill 2006.
[11] Malina R.M., Bouchard C., Bar-Or O., Growth, Maturation, and Physical Activity. Human Kinetics, Champaign Ill 2004.
[12] Měkota K. & Blahuš P., Motorické testy v tělesné výchově (Motor Tests in Physical Education) SPN (State Pedagogical Publishing), Praha 1983.
[13] Miller A., MacDougall J., Tarnopolsky M. and Sale D., Gender differences in strength and fiber characteristics. *European Journal of Applied Physiology and Occupational Physiology*, 1993, 66: 254-262.
[14] Morrow J.R., Jr., Jackson A.W., Disch J.G., Mood D.P., Measurement and Evaluation in Human Performance, Human Kinetics, Champaign, Ill 2005.
[15] Wood T.M. & Zhu W., Measurement Theory and Practice in Kinesiology, Human Kinetics, Champaign, Ill 2006.
[16] Williford H.N., Duey W.J., Olson M.S., Howard R., Wang N., Relationship between fire fighting suppression tasks and physical fitness. *Ergonomics*, 1999, 42: 1179-1186.