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Original Article

Effectiveness of the complex movement program of physical training for professional soldiers

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Abstract
The purpose of the paper is to summarize results of the research on the effectiveness of a complex movement program of physical training for professional soldiers.
Materials and methods: To determine effectiveness, the factor rotation technique (crossover experimental design) was used. The monitored groups consisted of 74 professional soldiers from the Academy of the Armed Forces (AAF) in Liptovský Mikuláš, who were randomly divided into experimental and reference groups. The experimental group was subjected to a 10-week long experimental intervention. Before and after the intervention, input and output testing was performed (somatometry, sit-and-reach, standing long jump, sit-ups per 1 minute, 10×10 m shuttle run, pull-ups, 30-m dash, 20 m beep test, and jumping-acrobatic exercises). The examined groups performed 20-minute long morning exercises 5 times per week and 90-minute long physical education 2 times per week, while a complex movement program was applied to the experimental group.
Results: The experimental group achieved significant improvements: a small effect ($p \leq 0.01$, $r \leq 0.41$) in the standing broad jump, sit-and-reach, 30-m dash, a medium effect ($p \leq 0.01$, $r = 0.42$-0.70) in sit-ups per 1 minute, pull-ups, jumping acrobatic exercise and significant improvements with a large effect ($p \leq 0{,}01$, $r \geq 0{,}71$) in a 10×10 m shuttle run and 20 m beep test. In the control group, we also noticed significant small effect improvements ($p \leq 0.01$, $r \leq 0.41$) in pull-ups, sit-ups per 1 minute, 10×10 m shuttle run, jumping acrobatic exercise and a medium effect ($p \leq 0.01$, $r = 0.42$-0.70) in 20 m beep test.
Conclusions: An important observation is that the experimental group achieved significant improvements in each of the tested subjects compared to the control group. This suggests that the proposed complex movement program of physical training is more effective and appropriate for developing motor performance of professional soldiers than the current physical training system. Therefore, we recommend that this movement program be put into practice and used as an effective means of training professional soldiers.
Key words: movement program, professional soldier, motor performance, physical abilities.

Introduction

The armed forces are increasingly emphasizing the importance of physical training, which also includes conditioning training to ensure the optimum level of physical fitness and movement performance of professional soldiers. This problem can be understood as creating the necessary basis, but not a sufficient prerequisite for achieving the optimal level of the movement and combat performance of professional soldiers. Through physical training are formed physical resistance to the effects of extreme climatic conditions, as well as stress factors resulting from combat activities (cold, heat, hunger, noise, hypoxy, sleep deficit, etc.). The issue of physical training in the Armed Forces of the Slovak Republic have been partly devoted to the Department of Physical Education and Sport AAF in Liptovský Mikuláš. Current legislation on physical education - the Tel-1-1 regulation is outdated in many areas, it needs optimization of existing training methods by modern approaches, and therefore we have decided to develop a complex movement program and compare it with the current system of functioning. In the past, have been updating and streamlining the training system for professional soldiers Pápay et al. (2010), Pápay, Litva (2012), Litva (2005). Abroad, the optimization, effectiveness and usability of the movement programs in the armed forces were investigated by Santilla, et al. (2015), Roos et al. (2015), Groeller (2015), Harman et al. (2008), Knapik et al. (2009), Heinrich et al. (2012). The findings of all these authors were used to create a complex movement program that we applied during the experiment. In the course of the content creation of a complex movement program in the area of physical development, we have referred to many valuable researches in the area, namely Stilwell (2015, 2005), Lauren, Clark (2013), Perič and Dovalil (2010) in the field of power development Zatsiorsky and Kraemer (2014), Vanderka (2013), Tsatsouline (2004), Speed and Dufour (2015), Wade (2015). In the field of endurance, we have referred to the findings of Dívald (2010), Bielik (2014), coordination skills - Šimonek (2009, 2013) and compensation exercises - Bursová (2005). Valuable information about the impact of stressors on the human organism and its performance in combat

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activities was obtained from the research of Lindholm and Lundgren (2009), Wilmore-Costill (2008), Máček and Radvanský (2011), McAardle et al. (2006), Driskell and Salas (2009).

Aim

The aim of the work is to find out the effectiveness of a complex movement program of physical training for the increase of motor performance of professional soldiers.

Hypotheses

H 1: The experimental complex movement training program of physical training will be a more effective means of developing the selected physical abilities of the professional soldiers than the control current physical training system.

H 2: By including the experimental factor, we expect statistically significant changes in the level of dynamic and endurance force of the abdominal, hind leg muscle, as measured by the test sit ups per 1 minute.

H 3: The influence of the experimental factor will have a positive influence on the speed abilities in the experimental set, where we expect statistically significant changes in the running speed with the changes in direction as measured by the 10 x 10-meter shuttle run test.

H 4: In the experimental set, we expect statistically significant changes in the level of runners' endurance, followed by the 20 m beep test.

H 5: The influence of the experimental factor in a 10-week mesocycle will result in a professional soldier's positive influence and statistically significant changes in the level of coordination abilities followed by the jumping-acrobatic exercise test.

Material & methods

The research design represented pedagogical experiment using the technique of factor rotation, where we worked with two groups of individuals in three phases of the experiment. The experiment was carried out at the Academy of the Armed Forces in Liptovský Mikuláš (hereinafter AAF LM), with first and second year students. The entire course of the experiment using the technique of factor rotation is explained in Table 1 and the characteristics of the examined groups are presented in Tables 2, 3.

Table 1. Schematic of the course of the experiment.

	group A – 2nd year	group B – 1st year
	INPUT TESTING	
Phase 1 2.10.2017 - 11.12.2017	*experimental intervention* **Complex movement program** 5 times weekly 20 minutes in the time 05:40 to 06:00 **Physical education** 2 times weekly 90 minutes	*control intervention* **Morning physical exercises** 5 times weekly 20 minutes in the time 05:40 to 06:00 **Physical education** 2 times weekly 90 minutes
	OUTPUT TESTING	
Phase 2 12.12.2017 - 2.3.2018	*Without experimental and control intervention* **Physical education** 2 times weekly 90 minutes	*Without experimental and control intervention* **Physical education** 2 times weekly 90 minutes
	INPUT TESTING	
Phase 3 5.3.2018 - 14.5.2018	*control intervention* **Morning physical exercises** 5 times weekly 20 minutes in the time 05:40 to 06:00 **Physical education** 2 times weekly 90 minutes	*experimental intervention* **Complex movement program** 5 times weekly 20 minutes in the time 05:40 to 06:00 **Physical education** 2 times weekly 90 minutes
	OUTPUT TESTING	

Table 2. Characteristics of the research groups in individual phases

Group	Phase	Probands	Age AVG	Testing		Experimental factor	Participation
				input	output		
Experimental	1	students 2nd year	20,67	50 students	42 students	Complex movement program of physical training 5 x 20 min weekly in the time (5:40 to 6:00)	69%
						Physical education 2 x 90 min weekly	85%
Control	1	students 1st year	19,71	53 students	37 students	Morning physical exercices 5 x 20 min weekly in the time (5:40 to 6:00)	84%
						Physical education 2 x 90 min weekly	88%
Experimental	3	students 1st year	20,25	37 students	34 students	Complex movement program of physical training 5 x 20 min weekly in the time (5:40 to 6:00)	87%
						Physical education 2 x 90 min weekly	76%
Control	3	students 2nd year	21,23	42 students	40 students	Morning physical exercices 5 x 20 min weekly in the time (5:40 to 6:00)	83%
						Physical education 2 x 90 min weekly	86%

Table 3. Summary characteristics of the research groups in individual phases

Group	Probands	Age AVG	Testing		Experimental factor	Participation
			input	output		
Experimental	students 1st, 2nd year	20,5	103 students	74 students	Complex movement program of physical training 5 x 20 min weekly in the time (5:40 to 6:00)	78%
					Physical education 2 x 90 min weekly	81%
Control	students 1st, 2nd year	20,5	103 students	74 students	Morning physical exercices 5 x 20 min weekly in the time (5:40 to 6:00)	84%
					Physical education 2 x 90 min weekly	87%

During the cross-over experiment, experimental and control groups were separated. Research in the experimental group was carried out in the gym no. 1 AAF LM. At the beginning of the observation period, the conditions for the course and organization of a complex physical program of physical training were determined by the author of the research. In the control group, morning physical exercises took place at AAF LM premises as a training instructor. The input and output testing of the experimental and control groups were performed in the gym no. 1 AAF LM, under the supervision of the author of the research and one member of the AAF LM Department of Physical Education and Sports, which was present in all measurements. The control group performed 5 x a week 20-minute early physical exercises based on a military program, and 2 x per week 90 minutes of physical education performed on the basis of accredited study programs for individual study departments. Figure 1 shows the contents of the individual control unit units in the control group.

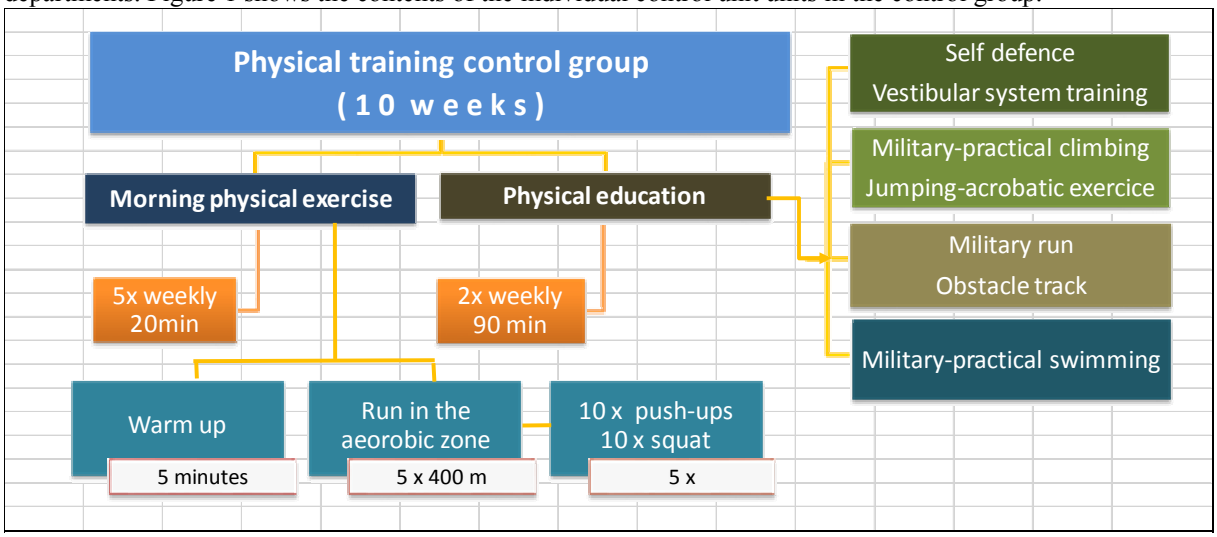

Fig. 1. Scheme of control factor

Experimental factor was represented by exercises of the complex movement program of physical training, which was performed 5 times a week for 20 minutes in an experimental group. The experimental group also completed two-week 90-minute physical education exercises based on accredited study programs for individual study departments. Figure 2 shows the contents of the individual units of the experimental group that was carried out in the experimental group.

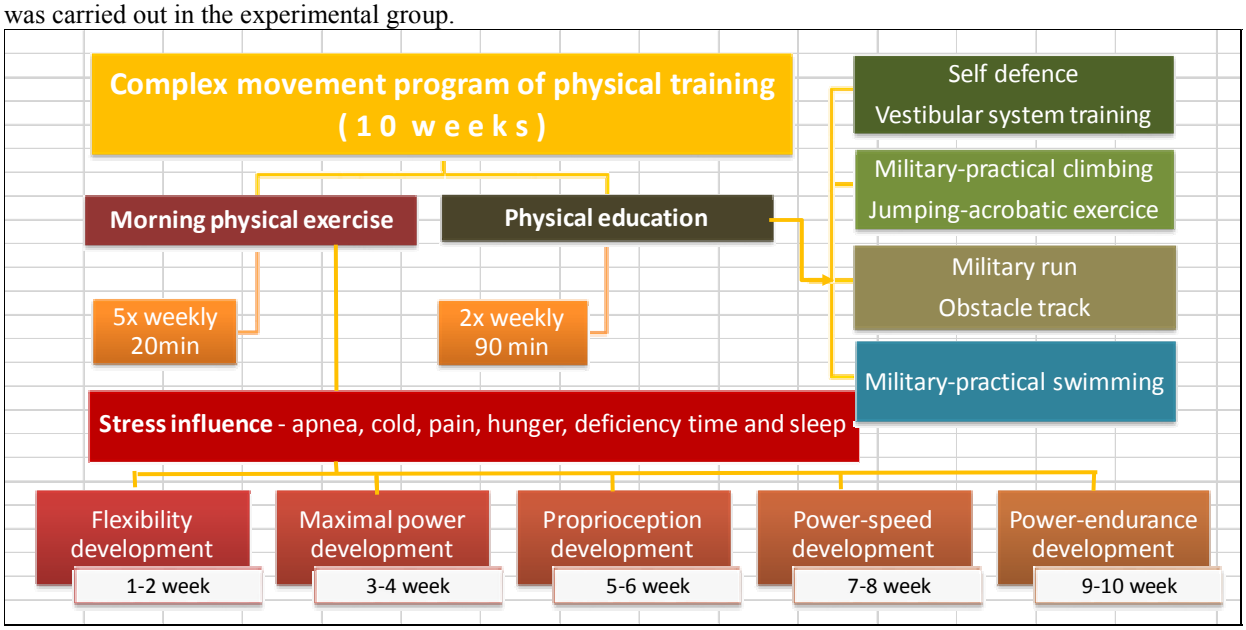

Fig. 2. Scheme of experimental factor

The experimental factor was represented by exercises of the complex movement program of physical training, the main essence of which is based on the development of coordination and fitness skills, not only through athletic, gymnastic, fighting exercises, but also by gradually increasing adaptation of the human body to the stressors (hunger, apnea, pain, time deficit and sleep deficit).

At the beginning and end of the study, somatometry was used for body weight (using Omron BF 500 Calibrated Personal Balance) and body height (Laczo et al., 2013). From these data, we calculated the body mass index (BMI). Using Omron BF 500 personal weighing we have determined % body fat and % visceral fat. We used the following input and output tests to determine the level of general movement performance and the impact of complex movement program on physical training:

- Sit-and-reach (Eurofit, 2002)
- sit ups per 1 minutes (Vestník MO SR č.100, 2015, Eurofit, 2002),
- standing broad jump (Eurofit, 2002),
- pull ups (Vestník MO SR č.100, 2015),
- 30 m dash (Šimonek, 2015),
- 10 x 10 m shuttle run (Vestník MO SR č.100, 2015),
- beep test 20 m (Eurofit, 2002),
- jumping acrobatic exercise (Vojenský predpis Tel 1-1, 2001).

The reference groups were characterized in numerical and graphical form. In numerical form, we used the basic statistical characteristics of the central position (average, median) and variability (standard deviation, maximum, minimum, integer quotient). Normality of distribution was reviewed by Shapiro - Wilk test. Differences between significance levels (average and median) were characterized by difference (d), statistical significance and magnitude of effect. Changes in motor performance and somatic variables in dependent groups were assessed by paired t-test to assess the significance level equivalence in order to demonstrate the statistical, factual, practical and clinical significance of the tests, using the Effect Size coefficient based on their estimate (Cohen's coefficient of action "d"). To reject the zero hypothesis about equivalence of significance levels, we determined the significance level $p \leq 0.01$. Numerical processing of empirical data was evaluated by table and statistical program MS Excel.

Results

The aim of the research was to find out the effectiveness of a complex movement program of physical training. We can measure the effectiveness of the incentive based on the changes in the status of the monitored indicators. Based on the results from table no. 4 we can state that we have demonstrated, on the basis of the mathematical difference "d", the improvement of the motor performance in all disciplines tested in both groups. In the experimental group, we recorded more significant performance gains than in the control group, thus confirming H1. In the experimental group, we have seen significant improvements in all disciplines at 1% level of statistical significance ($p \leq 0.01$). The experimental group achieved significant improvements with low effect ($p \leq 0.01$, $r \leq 0.41$) in the sit-and-reach, standing broad jump, 30 m dash, medium effect ($p \leq 0.01$, $r = 0,42\text{-}0,70$), in the pull-ups, shown in Figure 3. In the discipline, sit-ups in 1 minute ($p \leq 0,01$, $r = 0,52$) and jumping acrobatic exercise ($p \leq 0,01$, $r = 0,64$), there were also significant increments in the experimental group with medium effect, thus confirming H2 and H5. Here we have confirmed significant changes in the level of flexibility, dynamic and endurance strength, maximum speed and change in the level of coordination capabilities. Due to the complex movement program, there were significant improvements with a great effect ($p \leq 0,01$, $r \geq 0,71$) in the 10x10m shuttle run and the 20 m endurance shuttle run, and also in the level of running speed with changes in direction and level of run-in endurance, thus confirming H3 and H4.

In the control group, we also noticed significant small-effect improvements ($p \leq 0.01$, $r \leq 0.41$) in the sit-and-reach, sit-ups in 1 minute, 10 x 10 m shuttle run, jumping acrobatic exercise, pull-ups and moderate effect ($p \leq 0,01$, $r = 0,42\text{-}0,70$) in 20 m endurance shuttle run.

Table 4. Statistical significance and mathematical diference

TESTED DISCIPLINE	1% LEVEL OF STATISTICAL SIGNIFICANCE (p≤0,01)	
	MATHEMATICAL DIFFERENCE d (x1-x2)	
	CONTROL GROUP	EXPERIMENTAL GROUP
Sit-and-reach [cm]	YES	YES
	-0,85	-2,69
Standing broad jump [cm]	NO	YES
	0,09	-4,27
Sit ups per 1 minute [reps]	YES	YES
	-2,09	-3,11
10 x 10 m shuttle run [s]	YES	YES
	0,45	0,67
Pull ups [reps]	YES	YES
	-1,14	-2,30
30 m dash [s]	NO	YES
	0,04	0,09
Beep test 20m [reps]	YES	YES
	-7,62	-15,01
Jumping acrobatic exercise [s]	YES	YES
	0,37	0,89

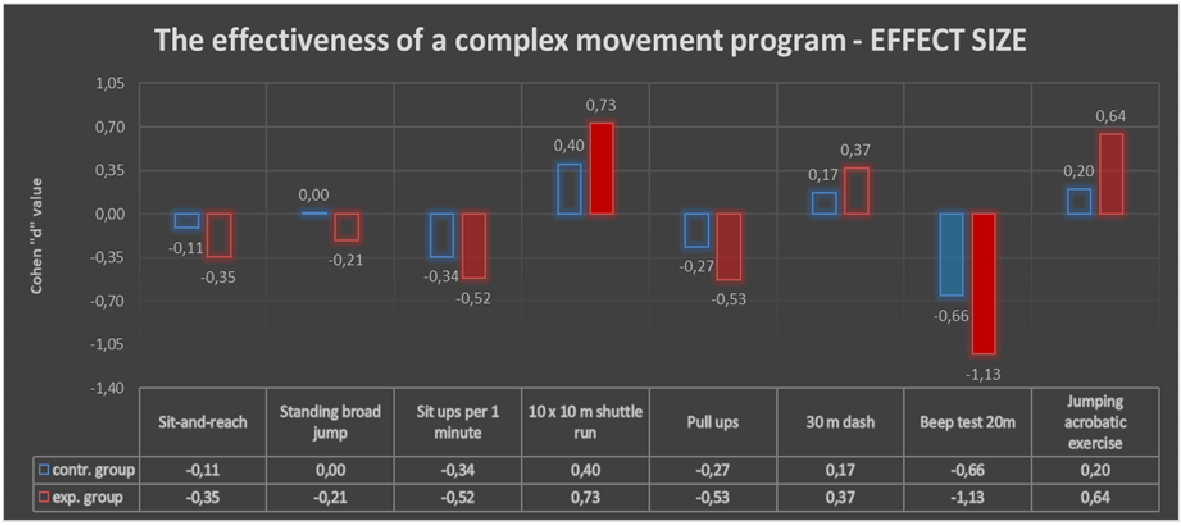

Fig. 3. The effectivness of a complex movement program - Effect size (Cohen „d“)

Conclusions

On the basis of the results obtained, we have come to the conclusion that the current system of physical training for professional soldiers and our proposed comprehensive physical training program of physical education positively influenced the development of the physical performance of both groups. An important point is that in the experimental group which performed a complex movement program over a 10-week period, the hypothesis assumed was significantly confirmed as the experimental group achieved more significant improvements in each of the tested subjects compared to the control group. This suggests that the proposed comprehensive movement training program is a more effective and appropriate means of developing motor performance for professional soldiers than the current physical training system. We can also say that compared to similar studies by Heinrich et al. (2012), Harman et al. (2008), which found the effectiveness of the Standard Movement Program (SPT) and weight-based training (WBT) in US Army soldiers, found that calisthenics exercises (SPT) are more effective means of developing exercise performance than WBT. By comparing the results, we found similarities with the results of the control group and the US Army's standard movement program. In the experimental group, we observed higher percentage differences in the increase in exercise performance than in the similar SPT and WBT where we expect the positive effect of special training to increase tolerance to stressors. Therefore, we recommend that this movement program be put into practice and used as an effective means of training professional soldiers. Under AAF, we recommend running the movement program in unaltered form, and that the exercise program be supplemented by additional special body exercises with regard to the functional inclusion of units within the armed forces. We will propose the complex movement program to supplement the legislation in the field of professional training of professional soldiers, which would contribute to an increase in the physical fitness and movement performance of professional soldiers of the Armed Forces of the Slovak Republic.

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