

ORIGINAL SCIENTIFIC PAPER

The Effect of Training in Military Pentathlon on the Physiological Characteristics of Academy Cadets

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Abstract

The physiological characteristics of the students of two military academies of the same age and sports qualification were studied, using the data of 60 men at the age from 20.6 to 23.4 years, 30 from each military academy. In one sample, 30 students trained and participated in pentathlon competitions; in the other sample were 30 students who were athletes in other sports. Physiological characteristics were related to the activity of the cardiovascular, respiratory, neuromuscular systems; the necessary data were obtained using well-known functional tests. Their physical preparation was studied according to the results in tests for the display of motor abilities; tests that are recommended by physical education specialists were used. We established that among the students engaged in military pentathlon, the level of development of absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed force of the muscles of the lower extremities, and strength endurance in various motor activities were significantly ($p < 0.05$) higher than among those students who were engaged in other sports. A similar result was obtained by comparing the ability to differentiate power and time parameters of motion, as well as all indicators of special physical preparation. The obtained data indicate that each student of the military academy must necessarily engage in a chosen sport. However, the most significant positive effect in the development of various physical qualities, physiological characteristics, special physical preparation is achieved with the military pentathlon.

Keywords: students, military academy, sport activities, physical preparation, physiological characteristics

Introduction

The current system of physical training of soldiers, formed at the Ukrainian Armed Forces is not sufficiently effective (Iedynak & Prystupa, 2012; Roliuk, 2016). The traditional approach to professional-applied physical training does not contribute to the quality of education in terms of the future motor experience formation in combat training and combat activities and training of military men with sustainable motivation to improve their professional level (Afonin, 2012). The need for the special (in particular, physical) training of soldiers for

conducting combat operations has been indicated by some authors (Sliusarchuk & Iedynak, 2015; Klymovych, Oderov, Romanchuk, Lesko, & Korchagin, 2019). Research and experience of combat training show that the use of exercise that similar in its impact on physical activity and professional actions of soldiers of different military specialities can be an effective way of improving specialized physical training (Borodin, 2005; Kontodimaki, 2014). Among the means that contribute to the necessary physical and special qualities, forming the necessary applied skills and professional techniques with great



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success, exercises of military-applied sports and several different sports can be used but united by one criterion, which is to hold competitions in a particular sport in areas with different terrain and with military ammunition, which significantly complicates the issue (Romanchuk, Popovych, & Fedak, 2010). In a complex situation with the need to counteract high mental stress and overcome the maximum physical load that is characteristic for competitive activities in sports, the improvement of professional skills of soldiers, cadets, future officers is provided (Afonin & Semenova, 2012; Prystupa & Romanchuk, 2012). With the growth of military skills and the accumulation of professional experience, the intensity of muscle tension when performing the necessary military operation at a certain qualitative level is somewhat reduced (Korobeynikov, Korobeinikova, Mytskan, Chernozub, & Cynarski, 2017).

However, in the case of the use of competitive activities during the improvement of various professional activities, as well as running competitions in various sports, soldiers (cadets, future officers) are encouraged to overcome further difficulties. In this regard, they perform with courage, resolution, discipline, and desire to win (Borodin, 2005; Popovich & Afonin, 2011). This is one of the main reasons that the use of different sports, but above all in complex areas with different terrain and with military ammunition, is currently considered to be a promising direction for achieving a high level of professional preparation of soldiers, cadets and future officers.

The purpose of the study is to show the important role of specialized physical training in shaping the readiness of a soldier, cadet or officer of the Armed Forces to effectively perform official tasks.

Methods

Participants

The study involved 30 students from two military academies, men at the age from 20.6 to 23.4 years with the same sports qualification, but in various sports. Two samples were formed: one with 30 students (15 from each military academy), who trained in military pentathlon; in the other sample were 30 students, namely in groups of three from each military academy, who attended sections on hand-to-hand fighting, arm wrestling, lifting weights, as well as free-style and Greco-Roman wrestling. Such sports were chosen because the physical exercise parameters and most of the motor actions used in these sports are very similar to those that form the basis of military pentathlon. The research was conducted during the fifth-sixth terms of the academic year. The study was conducted in compliance with the World Medicine Association Declaration of Helsinki: Ethical principles for medical research involving human subjects, 2013. The study protocol was approved by the Ethical Committee of the National Academy of the State Border Guard Service of Ukraine named after Bogdan Khmelnytskyi and National Academy of Armed Forces of Ukrainian named after Petro Sahaidachnyi.

Procedure

We determined the magnitude of the display of physical qualities, physiological and individual morphological characteristics in each sample of students. To obtain the necessary data on physical qualities, we formed a battery of tests. These tests met the established requirements (Turvey & Fonseca, 2009; Klymovych, Olkhovyi, & Romanchuk, 2016) and contained the most common practices of physical education motor tasks.

The battery included tests that allowed studying such physical qualities: 100 m race - speed endurance; 3000 m race - aerobic endurance; standing long jump - speed force of muscles of the lower extremities; of leading and non-dominant hands (using the Camry dynamometer handgrip) - absolute muscle strength.

Moreover, the battery contained tests to assess the strength of endurance in the various motor activities of students of military academies (Regulation on physical training in the Armed Forces of Ukraine, 2014), including pressing two 16 kg kettle balls, lifting the body from the lying position on the back (an additional weight of 10 kg is on the chest and held with two hands), keeping of 20 kg weight in front of oneself with both hands (hands are not bent in the elbow joints), and pull-up on a high crossbar.

We studied the morphological characteristics of students, namely body length and body weight (using an RGZ-120 mechanical platform scale). The following physiological characteristics were also determined: heart rate (HR) at quiescent; HR after 30 squats during 45 seconds; HR after 3 minutes rest; vital capacity (VC); the ability to differentiate power parameters of motion; the ability to differentiate the time parameters of motion (Klymovych, & Olkhovyi, 2016). To determine the ability to differentiate the power parameters of motion, we used the Camry handgrip dynamometer; to determine the ability to differentiate the time parameters of motion, we used a stopwatch. Definition of both indicators was made according to the standard procedure (Omorczyk & Lah, 2009). We also offered students the tests used in the Ukrainian Army to establish a level of special physical preparation. By content, these tests are very similar to those used in the armies of NATO alliance countries. The tests were exercises on the obstacle course, 5000 m race in military equipment, 100 m swimming, throwing grenades at a distance, shooting from a machine gun, 6×100 m shuttle run.

Data analysis

Results of descriptive statistics in this study were presented as an arithmetic mean of the sample, standard error of the mean. The comparison established whether there is a statistically significant difference between the two averages. The data were normally distributed in each test, which allowed using the t-test for related samples; a 0.05 probability level was used to indicate statistical significance. All statistical analyses were performed using SPSS Version 21.

Results

Comparison of data among samples indicated that the values of morphological characteristics in each sample of students were practically similar. The difference between the values of body length in the samples was very small, at 0.8 cm. The difference between body weight values was also inconspicuous, namely 2.7 kg. This was verified by the value of the t-test, which in both cases was at the level of $p > 0.05$ (Table 1).

A similar result was obtained when comparing the values of all physiological characteristics, as well as the indicators of such physical qualities: speed endurance, strength endurance of the upper extremity muscles during pull-ups on the crossbar, strength endurance during keeping of 20 kg weight. As for other indicators, then when comparing their values, the result in all cases was similar. It consisted in the fact that Sample 1 had an advantage over Sample 2 by the level of development of physical qualities, which was evidenced by the value of the

Table 1. Display of morphological and physiological characteristics of students in different samples

Indicator	Sample 1 (n=30)	Sample 2 (n=30)	t-test
	Mean±SD	Mean±SD	
Body height (cm)	178.7±1.8	177.9±1.9	p>0.05
Body weight (kg)	73.4±1.6	70.7±2.8	p>0.05
3000 m race (s)	735.1±18.1	798.3±33.2	p<0.05*
100 m race (s)	13.8±0.52	14.1±0.8	p>0.05
Pull-ups (number of times)	13.9±1.1	13.5±1.5	p>0.05
Standing long jump (cm)	217.2±2.2	202.4±3.3	p<0.05*
Dynamometry (dominant hand) (kg)	50.4±2.3	42.3±5.1	p<0.05*
Dynamometry (non-dominant hand) (kg)	46.6±3.1	37.1±4.2	p<0.05*
2 weights press (16 kg each) (number of times)	14.5±3.4	5.7±2.8	p<0.05*
Body lifting (number of times)	22.4±±2.1	15.5±3.6	p<0.05*
Keeping of 20 kg weight (s)	60.7±2.2	59.0±2.2	p>0.05
Muscular sensations (error) (%)	13.6±3.8	20.3±4.3	p<0.05*
Time sense (error) (%)	25.1±4.8	34.4±5.2	p<0.05*
Heart Rate - HR at quiescent (bpm)	70.8±1.7	72.6±2.5	p>0.05
Heart Rate - HR after 30 squats (bpm)	147.0±3.4	150.6±3.5	p>0.05
Heart Rate - HR after 3 minutes rest (bpm)	78.6±2.4	83.5±2.6	p>0.05
Vital Capacity - VC (ml)	4215.0±185.0	3723.0±215.0	p>0.05

Note: Sample 1 - cadets who attended military pentathlon classes; Sample 2 - cadets who attended classes in other sports; *p <0.05

t-tests, because they were p<0.05. This concerned the absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed force of the muscles of the lower extremities, strength endurance in various motor activities. Also, in Sample 1, the students' ability to differentiate the force and time parameters of motion was much better developed than in Sample 2.

Consequently, students who were preparing for the military pentathlon competitions had a higher level of physical preparation and physiological characteristics than those who trained to compete in hand-to-hand fighting, arm wrestling,

weight lifting, free-style or Greco-Roman wrestling.

To confirm or refute such a conclusion, these students performed test tasks that are used to determine the level of readiness of the soldier of the Army of Ukraine (cadet, future officer) to carry out professional activities. The obtained data indicated that the results of students in both samples in each test corresponded to the higher-than-the average level. However, higher results were noted for Sample 1. The difference in the test results ranged from 7.5% to 13.5%. Only the results of shooting a gun and 6×100 m shuttle run were not different (Table 2).

Table 2. Display of indicators of special physical preparation of students in different samples

Indicator	Sample 1 (n=30)	Sample 2 (n=30)	t-test
	Mean±SD	Mean±SD	
Special exercise on the obstacle course (s)	121.0±2.3	135.0±3.4	p<0.05*
5000 m race (min)	25.1±0.6	28.2±2.1	p<0.05*
100 m swimming (s)	102.5±3.2	111.7±5.1	p<0.05*
Throwing grenades at a distance (m)	42.0±4.3	37.0±5.1	p<0.05*
Shooting from a machine gun (points)	4.3±0.23	4.0±0.34	p>0.05
6×100 m shuttle run (s)	134.0±3.1	144.0±3.8	p>0.05

Note: *p <0.05

Discussion

Specialized physical training has a leading place in the formation of the readiness of a soldier, cadet, or officer of the Armed Forces to carry out performance targets effectively. However, at the stage of formation of professional competence, the majority is convinced that the physical preparation they have is sufficient for the successful completion of training and combat tasks, including in the context of combat operations (Romanchuk et al., 2010; Sliusarchuk & Iedynek, 2015). To a certain extent, the above-mentioned is confirmed by data that the development of all the basic physical qualities does not lead to an increase in the combat readiness of the students of the military academy (Iedynek & Prystupa, 2012; Prystupa & Romanchuk, 2012; Roliuk, 2016). In this regard, other researchers point out that at the stage of the formation of professional competence during the physical training of students of military academies, it is necessary to form the moti-

vation to exercise in their spare time (Hao, & Yin-shan, 2015; Korobeynikov et al., 2017); use only specific physical exercises (Klymovych, Olkhovyi, & Romanchuk, 2016), which should be those that are very similar according to the biomechanical structure to motor activities that will form the basis of their professional activities (Afonin & Semenova, 2012; Koryahin et al., 2018). The above-mentioned is promising in the aspect of improving the content of the physical training of future officers while studying at the military academy, which is based on the fact that the current content of physical training is practically the same in all academies. Specifically, this content virtually ignores the peculiarities of the future professional activity of students; In the military sphere, the latter is designated as a certain type of troops (Prystupa & Romanchuk, 2012).

Such an approach to the formation of the content of physical training of student youth is not new. However, at present, it is not sufficiently used in practical activities (Popovich &

Afonin, 2011). Consequently, the achievement of the science of physical education of various groups of the population, including the use of advanced devices and information technologies during physical training, also predetermines the need to find new ways of organization, formulation, and implementation of the content (Kontodimaki, 2014).

In connection with this, it is proposed to provide classes on the physical training of sports orientation of students of military academies (Borodin, 2005). Other researchers emphasize the promise of the integrated content of physical training. The key feature of such content is that its implementation contributes to the development not only of all the basic physical qualities but above all of the special qualities, that is, those which determine the successful performance of future professional activities (Romanchuk et al., 2010; Bloshchynskiy, 2017; Sliusarchuk & Iedynak, 2015). In connection with the latter, taking into account typological peculiarities of development of physical qualities, and the physiological and morphological characteristics of young men is recommended.

As for the data obtained when comparing the results in the samples, this was due to complex reasons. One of the main reasons was the content of the military pentathlon. It involves five types of motor activity, namely shooting from an automatic machine, overcoming obstacles, swimming with obstacles, throwing grenades at range and accuracy, 8000 m race. The high result in each type of motor activity depends on different physical qualities. Therefore, during the training sessions, the sportsman develops each such quality, in particular: accuracy, aerobic-anaerobic endurance in overcoming the obstacles and swimming, explosive strength and accuracy, and aerobic endurance. In Sample 2, students in the training sessions developed a smaller number of physical qualities, namely those needed for a high result in hand-to-hand fighting, arm wrestling, lifting weights, as well as free-style and Greco-Roman wrestling. One of the main reasons for higher special physical preparation in Sample-1, compared with Sample-2, is due to the development of aerobic-anaerobic endurance (Prystupa &

Romanchuk, 2012). The high level of its development precisely in cyclic forms of motor activity (swimming, running) provides the transfer of this effect to other cyclic types of motor activity.

Of the above-mentioned kinds of sports, aerobic-anaerobic endurance is the basic physical quality only for free-style wrestling and, to a certain extent, hand-to-hand fighting. However, these types of motor activity are inherently acyclic; the transfer of the training effect is much less pronounced in this case than in the cyclic kinds of motor activity (Klymovych & Olkhoviy, 2016). It is emphasized that the high level of development of aerobic-anaerobic endurance is the basis for the professional activity of soldiers and military officers (Romanchuk et al., 2010).

The absence of differences in the results of the shooting from the automatic machine in both samples was associated, primarily, with the specifics of this type of motor activity, which is based on coordination. For this reason, the result does not directly depend on the level of development of special physical preparation (Omorczyk & Lah, 2009).

In military academies, students must necessarily engage in specific kinds of sport, which is essential for the development of physical qualities and physiological characteristics, which are an essential element in the structure of the professional preparation of future military officers. The most significant positive effect is achieved if the student attends training sessions and takes part in military pentathlon competitions. The effect involves achieving a higher level of development of the basic physical qualities, namely: absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed strength of the muscles of the lower extremities, strength endurance in various motor actions, the ability to differentiate force and time parameters of motion. Additionally, systematic training of military pentathlon provides a higher level of special physical preparation. Such a result is one of the essential preconditions for the professional competence of a future military officer.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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