

Informational indicators of functional capacities of the body for teaching cadets from higher military educational institutions power types of sports

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Abstract:

The article investigates the level of functional capacities and health of kettlebell lifters of different qualification in order to substantiate the components of functional preparedness that are informatively important for teaching of the cadets in kettlebell lifting. In total, 77 cadets, who were engaged in kettlebell lifting in the section of the higher military educational institution, participated in the investigation. Three groups were formed: group 1 – cadets who reached the III and II class in kettlebell lifting (n=34), group 2 – cadets of the I class and the candidates for master of sport (CMS) (n=27), and group 3 – cadets who obtained the level of masters of sport (MS) and masters of sport of international class (MSIC) (n=16). Based on the indicators of the heart rate at rest, vital capacity, the Robinson index, the duration of breath-holding, physical performance and maximum oxygen consumption it was determined that the group 3 cadets have a significantly better level of functional capacities ($p < 0.05 - 0.001$) than the cadets of lower classes. It was established that the functional capacities of the cardio-respiratory system are informatively important components of functional preparedness for teaching kettlebell lifting to the cadets.

Keywords: functional capacities, informatively important components of functional preparedness, cadets, kettlebell lifting.

Introduction

Improvement and emergence of new methods and forms of armed struggle, carrying out the Antiterrorist Operation in eastern Ukraine, equipping the army with new types of armaments and performing strategic tasks with small but well-prepared armed formations, this all places increased demands on the training and preparing of future officers, first of all in terms of their professionalism, personal physical and methodical preparedness. This gives rise to a necessity of improvement of the physical education of cadets of higher military educational institutions (HMEI).

According to scientists, the modern professional activity of graduates of HMEI takes place in extreme conditions of the environment in the presence of such adverse factors of military activity as: permanent stay in a state of nervous and physical stress, in a state of fatigue and stress; low motor activity during long-term stay in conditions of limited space (checkpoints, dugout); carrying significant weight (weapons, equipment, ammunition); the need to act at night, in any weather and in any locality; irregularity of the motor regime and others. Unfavorable factors of military activity lead to negative changes in the body of the military personnel. In addition, the lack of systematic physical training in the Antiterrorist Operation zone and the appropriate material base causes such effects as: metabolic disorders and weight gain (overweight), reduced physical fitness and health deterioration, increased traumatism (especially musculoskeletal system), occurrence of various diseases, deterioration of indicators of psychological state.

The analysis of literary sources showed that an effective means of physical training of cadets of HMEI, as well as servicemen in the period of combat operations, may be kettlebell lifting which has several advantages: lack of significant material costs; compact size of equipment; possibility of training both in limited space and in the open area; possibility of conducting both self-training and classes with a large group of people simultaneously; a wide range of simple and achievable exercises eliminates the possibility of adaptation to the same type of load; the possibility to conduct classes simultaneously with servicemen with different levels of physical fitness, high efficiency in the development of physical and moral qualities, strengthening the muscles of the back and the whole body; prevention of injury to the spine and joints. At the same time, graduates of the HMEI as teachers are not acquainted with the methods of conducting classes using means of kettlebell lifting and

methods of training the servicemen. Therefore, the relevance of our research is called by the need to determine the components of general and special physical preparedness for informational purposes for effective training of cadets in kettlebell lifting.

Materials and methods

In total, seventy seven cadets, who were engaged in kettlebell lifting in the section of the higher military educational institution (S. P. Koroliiv Zhytomyr Military Institute), participated in the investigation. Three groups were formed: group 1 – cadets who reached the III and II class in kettlebell lifting (n=34), group 2 – cadets of the I class and the candidates for master of sport (CMS) (n=27), and group 3 – cadets who obtained the level of masters of sport (MS) and masters of sport of international class (MSIC) (n=16).

The research of functional capacities was performed according to indicators: of the heart rate at rest (HRR), systolic and diastolic blood pressure (SBP, DBP), lung capacity (LC), Rosenthal test, the Robinson index, the duration of breath-holding during inhalation and exhalation, duration of recovery of the heart rate (DRHR) after standard exercise, physical performance PWC₁₇₀ test and maximum oxygen consumption (MOC).

In the course of the researches, the reliability of the difference between the indicators of cadets of the studied groups was determined by using Student's criterion. The dynamics of indexes in each of groups was also estimated.

The aim of the article is to investigate the level of functional capacities of the body of cadets-kettlebell lifters of different qualifications.

Research methods: theoretical analysis and generalization of scientific and methodical literature, pedagogical supervision, testing, methods of mathematical statistics.

Results

Important indicators of the effective functioning of the cardiovascular system of kettlebell lifters are heart rate and blood pressure. The analysis of heart rate at rest showed that this value is the best one in the group of qualified kettlebell lifters (group 3) and is 61.9 beats per minute. In group 2, the indicator of heart rate at rest (68.7 beats/min) is significantly worse than in group 3 by 6.8 beats/min ($p < 0.01$), but significantly better than in group 1 by 2.5 beats/min ($p < 0.05$). In the group of cadets of the III and II class, the heart rate (71.2 beats/min) is the worst among the studied groups ($p < 0.05$; $p < 0.001$) (Table 1).

Table 1. The level of functional preparedness of cadets-kettlebell lifters of different qualifications ($X \pm m$, n=77)

Indicators which are investigated	Group 1 (III, II class) n=34	Group 2 (I class, CMS) n=27	Group 3 (MS, MSIC) n=16	Reliability of difference		
				P1-P2	P2-P3	P1-P3
HRR, beats./min	71.2±0.72	68.7±0.79	61.9±1.09	<0.05	<0.001	<0.001
SBP, mmHg	123.8±1.03	119.2±1.06	116.1±1.12	<0.01	<0.05	<0.001
DBP, mmHg	72.8±0.92	70.7±0.89	68.2±0.80	>0.05	<0.05	<0.01
LC, ml	4060.7±79.25	4485.5±71.42	4897.2±113.5	<0.01	<0.01	<0.001
Rosenthal test, ml	3912.3±84.22	4407.2±75.39	4915.3±115.6	<0.001	<0.01	<0.001
Robinson index, s.u.	88.3±1.95	81.9±2.09	72.6±1.74	<0.05	<0.01	<0.001
Stange test, s	64.7±3.20	80.8±3.92	96.5±3.66	<0.01	<0.05	<0.001
Genchy test, s	39.8±1.64	46.9±1.58	57.1±1.76	<0.01	<0.001	<0.001
DRHR, s	115.7±3.57	98.2±3.88	79.4±3.25	<0.01	<0.01	<0.001
PWC ₁₇₀ , kgm/min	1094.3±59.71	1298.7±62.52	1476.6±56.80	<0.05	<0.05	<0.001
PWC ₁₇₀ /kg, kgm/min/kg	15.3±0.91	17.9±0.86	21.1±1.03	<0.05	<0.05	<0.001
MOC, ml/min	3477.4±76.54	3920.5±69.83	4318.5±79.76	<0.01	<0.01	<0.001
MOC/kg, ml/min/kg	48.6±1.53	53.7±1.47	62.3±1.60	<0.05	<0.01	<0.001

The analysis of (systolic and diastolic) blood pressure shows that the best values of SBP and DBP were recorded by the cadets of the level of the MS and MSIC (116.1 mmHg and 68.2 mmHg respectively) (Table 1). The value of SBP in group 2 (119.2 mmHg) is by 3.1 mmHg lower than in group 3 ($p < 0.05$), and in group 1 (123.8 mmHg), it is significantly lower than in the groups of cadets of high qualification ($p < 0.01$; $p < 0.001$). The difference between the values of DBP in groups 3 and 2, as well as 3 and 1 is also reliable ($p < 0.05-0.001$) and is 2.5 mmHg and 4.6 mmHg respectively.

The research of the Robinson index testifies to similar dynamics as the previous indicators – Improvement of functional capacities of kettlebell lifters with increasing their sports qualification. Thus, the indicators of the group of cadets of the III and II class are the worst – 88.3 standard units (s.u.) and correspond to the average level of functional capacities (Table 1). In the group of I class and CMS, the Robinson index is 81.9 s.u., corresponds to a higher level than the average and is significantly better than in group 1 by 6.4 s.u. ($p < 0.05$).

Indicators of functional capacities of the cardiovascular system of the kettlebell lifters with the level of MS and MSIC according to the Robinson index are reliably the best (72.6 s.u.). correspond to a higher level than the average and prevail over similar indicators in groups 2 and 1 by 9.3 s.u. and 15.7 s.u. respectively ($p < 0.001$).

We evaluated the functional capacities of the respiratory system of the kettlebell lifters according to the level of the LC and according to the results of the performance of Rosenthal, Stange and Genchy tests. The vital capacity of the lungs, i.e. the maximum amount of exhaled air after the deepest inhalation, indicates the state of the apparatus of external respiration. For example, the analysis of the LC of the kettlebell lifters of different qualification showed that the level of LC improves with the increase of the qualification of the cadets. The highest value were found by the cadets of group 3 (4897.2 ml). This value is significantly better than in groups 2 and 1 by 411.7 ml and 836.5 ml respectively ($p < 0.01$; $p < 0.001$) (Table 1), which lets us assert that the indicator is informative and its consideration during the training of cadets in kettlebell lifting is necessary. The investigation of the results of the Rosenthal test, which consists in a 5-fold examination of the LC in 15 seconds and allows us to assess the endurance of the respiratory muscles by the cadets and the performance of their cardio-respiratory system, shows that in the group 1 the values of the LC unreliably deteriorated by 148.4 ml ($p > 0.05$), in group 2 did practically not change (difference is 78.3 ml, $p > 0.05$), and in group 3 – Improved a little by 16.1 ml ($p > 0.05$). This once again confirmed that the cadets of a higher sport qualification have the best indicators of functional preparedness. At the same time the value of the LC of the cadets of group 3 after the performance of the Rosenthal test remained significantly better than in the groups of lower qualification ($p < 0.01$; $p < 0.001$) (Table 1). Functional tests with breath holding (Stange, Genchy) are generalized the indicators of the respiratory and cardiovascular systems and characterize the body's resistance to lack of oxygen. The longer the duration of breath-holding are the higher functional capabilities of these systems. The analysis of the results of the Stange test shows that the level of functional capacities of the cardiovascular and respiratory systems is significantly higher among the high-skilled cadets (group 3) than by the kettlebell lifters of the III to I classes and the CMS (groups 2 and 1) ($p < 0.05$ – 0.001) (Table 1). The difference between the indicators of breath-holding during inhalation by the cadets of groups 1 and 2 is 16.1 s ($p < 0.01$), between groups 2 and 3 – 15.7 s ($p < 0.05$) and between groups 1 and 3 – 31.8 s ($p < 0.001$). The results of the Genchy test of the kettlebell lifters are characterized by a similar tendency – by the cadets of group 3 the duration of breath-holding during exhalation (57.1 s) is the best and significantly higher than that by the cadets of group 1 (39.8 s) by 17.3 s ($p < 0.001$) and 2 (46.9 s) by 10.2 s ($p < 0.001$) (Table 1). The research of the duration of recovery of heart rate to the baseline after a standard exercise (20 squats for 30 s) indicates that by the cadets of group 3 (1 min 19 s) this value is the best and significantly better than that by the cadets of group 1 (1 min 56 s) ($p < 0.001$) and 2 (1 min 38 s) ($p < 0.01$) (Table 1). This once again confirmed the need to take into account the importance of the functional capacities of the cadets during their teaching in kettlebell lifting in the process of physical education.

Physical performance is an indicator that allows us to conclude about the functional capacities of different systems of the body of the cadets and, first of all, the cardio-respiratory system. To determine the physical performance of the kettlebell lifters, test PWC_{170} with applying bicycle ergometer was conducted. The analysis of indicators of physical performance of kettlebell lifters of different qualification showed that their changes are positive (Table 1). By the cadets of the III and II class, the value of PWC_{170} is the smallest, amounts to 1094.3 kgm/min and does not significantly differ from those who are not engaged in sports. For comparison, by healthy men (average age 23.9 ± 6.1 years) not engaged in sports, the value of PWC_{170} is 1001 ± 136 kgm/min, and by the qualified kettlebell lifters PWC_{170} it is 1148 kgm/min. This confirms our preliminary conclusions that the increase in sporting results by the kettlebell lifters is mainly due to the development of power qualities. By the cadets of the I class and CMS there is a significant increase in work capacity (1298.7 kgm/min) compared with the cadets of group 1 by 204.4 kgm/min ($p < 0.05$). The highest value of PWC_{170} is determined by the cadets with the level of MS and MSIC – 1476.6 kgm/min; it is significantly better than by the cadets of the group 2 by 177.9 kgm/min ($p < 0.05$) and group 1 – by 381.7 kgm/min ($p < 0.001$). Significant influence on the physical performance has the specificity of the physical development of cadets – the absolute values of PWC_{170} are in direct proportion to the body weight. Therefore, for the purpose of leveling the individual differences in body weight, we have determined the relative values of physical performance – PWC_{170}/kg . The research of the relative values of physical performance shows that their dynamics has a similar character to absolute – the growth of PWC_{170}/kg indicators with the increase of qualification of the kettlebell lifters. Thus, by the cadets of the group 1 the PWC_{170}/kg are 15.3 kgm/min/kg and practically does not differ from the same indicator by the weightlifters (15.2 kgm/min/kg) and people who don't go in for sports (men of 20–30 years old, 14.4 kgm/min/kg). The highest value of PWC_{170}/kg was recorded by the cadets of group 3 (21.1 kgm/min/kg); in group 2 this value is significantly lower than in group 3 by 3.2 kgm/min/kg ($p < 0.05$) but significantly higher than in group 1 by 2.6 kgm/min/kg ($p < 0.05$) (Table 1).

Maximum oxygen consumption is an important criterion for the functional status of respiratory and circulatory systems. In a state of rest by the persons who don't go in for sports, MOC is 200–300 ml/min and depends on individual characteristics of a person (age, sex, body weight, etc.). In the conditions of high physical activity, MOC can increase by 15–20 times and depends on such factors as: the amount of work performed, its duration, intensity, etc. Particularly high values of MOC are demonstrated by athletes, in whose training the load

on endurance is mainly applied, the MOC can reach 4000–6000 ml/min or more. The definition of MOC in our research was carried out indirectly, using the PWC₁₇₀ test. Thus, the analysis of MOC by the kettlebell lifters showed its significant improvement with the increase of the qualifications of cadets – the highest value was found by the cadets of the level of MS and MSIC, it is 4318.5 ml/min and is significantly better than that of the cadets of group 2 (3920.5 ml/min) and 1 (3477.4 ml/min) by 398 ml/min ($p < 0.01$) and 841.1 ml/min ($p < 0.001$) respectively (Table 1). The trend of changes in the relative values of MOC is of a similar nature as the absolute ones – the improvement of the indicators occurs with the development of qualification of the cadets. Thus, in group 1, MOC/kg is 48.6 ml/min/kg and is significantly worse than that in group 2 (53.7 ml/min/kg) by 5.1 ml/min/kg ($p < 0, 05$) and in group 3 (62.3 ml/min/kg) by 13.7 ml/min/kg ($p < 0.001$).

Discussion

The analysis of heart rate at rest by the cadets of different qualification showed that all values of heart rate by the kettlebell lifters in group 1 were in the range of 68–80 beats/min, by the cadets of group 2 – within 60–76 beats/min, and in group 3 – 52–72 beats/min. That is signs of tachycardia by the kettlebell lifters were not revealed during the research. Moreover, there are more than 70% of cadets in group 3 whose heart rate is in the range of 58 ± 5 beats/min which indicates the marked signs of bradycardia, which is typical for the representatives of sports with high endurance requirements and by whom sports activities take place predominantly in aerobic power supply. Thus, the analysis of heart rate at rest showed that the improvement of the functional preparedness of kettlebell lifters occurs with the increase of sports qualification which is confirmed by a significant decrease in heart rate. These data must be taken into account when teaching the cadets of HMEI in kettlebell lifting.

Blood pressure is the force of blood pressure on the walls of the vessels during systole (blood throwing out – systolic pressure) and diastole (blood intake – diastolic pressure) of the cardiac muscle. Research of blood pressure testifies to the improvement of cardiovascular functionality by the cadets with an increase in their qualifications – the best values of SBP and DBP were recorded by the cadets of the MS and MSMC levels. The investigation of Robinson index showed that the indicators of functional capacities of the cardiovascular system by the kettlebell lifters of MS and MSIC level are the best among other groups and correspond to a higher level than the average. An analysis of the results of Rosenthal test showed that by the 86.3% of the cadets in group 3 after the test the indicators of the LC were 2–5% better than at the beginning of the test; by the cadets of group 2 such cases made up 35.2%; and in 94.8% of the cadets of group 1 the deterioration of the LC was detected. The conducted researches show an increase of endurance of respiratory muscles and improvement of productivity of a cardio-respiratory system by the cadets with increase of their sport qualification.

By comparing the value of PWC₁₇₀ by the kettlebell lifters of the MS and MSIC level with the reference table proposed by V. L. Karpman with co-authors, it can be established that it equates to the ability of representatives of cyclic sports which develop endurance (athletics, skiing, pentathlon etc.). This testifies to the high level of development of endurance and wide functional capacities of the vegetative systems of the body by the kettlebell lifters of high qualification and it stipulates the need to focus on endurance indicators in the teaching the cadets of HMEI in kettlebell lifting. An analysis of the relative values of physical capacity and maximum oxygen consumption showed that the level of functional capacities of the body improves with the increase of qualification of cadets.

The conducted researches show that in order to achieve high results in the kettlebell lifting and ensure effective teaching the cadets in kettlebell lifting, on the background of high level of strength development, flexibility and other qualities, considerably high requirements are put forward on the development of endurance, the results of testing of high-skilled cadets are reliably better in comparison with the cadets of III to I class and CMS according to all indicators of functional preparedness.

Conclusions

1. It was found out that the components of functional preparedness by the cadets of high qualification are significantly better ($p < 0.05$ – 0.001) than by the cadets of the I class and the CMS, as well as by cadets of III and II class, according to: heart rate – by 7.5 beats/min (10.9%) and 9.3 beats/min (13.1%); SBP – by 3.1 mmHg (2.6%) and 7.7 mmHg (6.2%); DBP – 2.5 mmHg (3.5%) and 4.6 mmHg (6.3%); LC – by 411.7 ml (10.1%) and 836.5 ml (17.1%); Robinson's index – 9.3 s.u. (11.3%) and 15.7 s.u. (17.8%); Stange test – by 15.7 s (16.3%) and by 31.8 s (32.9%); Genchy test – by 10.2 s (17.9%) and 17.3 s (30.3%); the duration of recovery of heart rate – by 18.8 s (19.1%) and 36.3 s (31.4%); PWC₁₇₀ – by 177.9 kgm/min (12.1%) and by 382.3 kgm/min (25.9%); MOC – by 398 ml/min (9.3%) and by 841.1 ml/min (19.5%)

2. It has been established that informatively important components of functional preparedness for teaching the cadets of HMEI in kettlebell lifting are the functional capacities of the cardio-respiratory system, determined by heart rate, SBP, DBP, Robinson index, LC, Rosenthal, Stange, Genchy tests, time of heart rate recovery, physical performance and MOC.

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