

Dynamics of health and physical development indicators of cadets during their professional training in the field environment

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ABSTRACT


Aim: To investigate the dynamics of health and physical development indicators of cadets during their field training exercises of various durations.

Materials and Methods: The research involved 246 cadets (men) of the 1st-4th training years, who were majoring in the specialty 253 referred to as "Military Management" (specialization "Management of Tank Troops"). The research was conducted in 2022-2023 during field training exercises lasting 2 and 4 weeks. Research methods: theoretical analysis and synthesis of literature, medical and biological methods, testing, statistical analysis.

Results: It was found that the level of health and physical development of cadets deteriorates during their field training exercises. The worst level among the studied indicators after the cadets' field training exercises was recorded in the indicators of vital index, Robinson index, and endurance level. It was found that the longer the duration of field training exercises, the more the health and physical development of cadets deteriorates. The most pronounced deterioration in the level of the studied indicators was found in the cadets of junior training years.

Conclusions: The deterioration of cadets' health and physical development during their field training exercises has been proven. The most negative changes occurred in the indicators of the cadets' cardiorespiratory system. The results indicate the need to improve the organization and methods of physical training with cadets during field training exercises, which will help maintain their health and physical development at the proper level.

KEY WORDS: health, physical development, physical training, field training, cadets

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INTRODUCTION

The Russian-Ukrainian war, which began in 2014, has led to an increase in the practical component of training cadets of higher military educational institutions (HMEIs) of all military specialties [1, 2]. In the educational process of HMEIs, this was reflected in a significant increase in the volume of field exercises (field training exercises) aimed at: acquiring and improving cadets' practical skills in working with weapons and military equipment within their specialty; formation of general, professional (military-professional, military-specialized) competencies defined by the standards of higher education in the specialty, professional standards for the relevant degrees of higher education and levels of military education; ensuring quality of the general military training of future cadets; practicing issues of units management and organization of interaction; practicing cadets' actions during practical firing from various types of weapons and equipment; achieving

a high level of field training, unit cohesion, as well as physical and psychological readiness of personnel to perform combat missions [3, 4].

The most pronounced increase in the volume of practical training occurred in the educational process of the cadets at the HMEI of the Ground Forces (GF) of the Armed Forces (AF) of Ukraine. At the same time, observations of cadets' health and level of physical fitness (physical development) after returning from field training exercises indicate a significant deterioration. Herewith, the magnitude of changes in these indicators depends on the year of training and the duration of field training exercises. This does not allow us to fully achieve the goal of physical education of future specialists of the tank troops of the Armed Forces of Ukraine during their studies at HMEIs, namely, ensuring their physical readiness for professional activities [5, 6]. At the same time, physical readiness is determined by graduates' physical condition at HMEIs, which allows them to

perform combat and other assigned tasks following the requirements of modern combat [7].

AIM

The aim is to investigate the dynamics of health and physical development indicators of cadets during their field training exercises of various durations.

MATERIALS AND METHODS

The research involved male cadets of the Military Institute of Tank Troops of the National Technical University "Kharkiv Polytechnic Institute" ($n = 246$) of the 1st-4th training years, who were majoring in the specialty 253 referred to as "Military Management" (specialization "Management of Tank Troops"). The research involved 62 1st training year cadets, 64 2nd training year cadets, 59 3rd training year cadets, and 61 4th training year cadets. The research was conducted in 2022-2023 during field training exercises in the fall (September-October) and spring (April-June) periods. The duration of the field training exercises was 2 weeks in the fall and 4 weeks in the spring.

Research methods: theoretical analysis and synthesis of literature, medical and biological methods, testing, statistical analysis. Theoretical analysis and synthesis of literature were used to find out the current state of the researched problem, systematize and generalize information to achieve the aim of the article (14 sources on the topic of the article from the databases PubMed, Scopus, Web of Science Core Collection, Index Copernicus and others were investigated). Medical and biological methods were used to study health indicators of cadets. Cadets' health was assessed by the following indicators: body mass index (BMI, kg/m^2), vital index (VI, ml/kg), the Robinson index (RI, c. u.). Cadets' physical development was determined by the results of their testing in exercises that characterize different motor qualities: speed qualities – 100 m run, strength qualities – pull-ups, endurance – 3 km run.

The significance of the difference in the results of the cadets was determined during the studying based on the Student's t-test. The significance for all statistical tests was set at $p < 0.05$. All statistical analyses were performed with the SPSS software, version 21, adapted to medical and biological researches. This research followed the regulations of the World Medical Association Declaration of Helsinki. Also this research complies with the ethical standards of the Order of the Minister of Defense of Ukraine "On Approval of the Regulation on the Organization of Scientific and Technical Activity in the Armed Forces of Ukraine" No. 385 dated 27.07.2016.

Informed consent was received from all cadets who took part in this research.

RESULTS

The analysis of BMI, which was determined by the ratio of body weight to double height, showed that its value decreased insignificantly ($p > 0.05$) during the period of field training exercises for the cadets of all training years (Table 1). At the same time, the difference between the BMI before and after the field training exercise was greater in junior cadets compared to senior ones. In addition, it was found that after a field training exercise for 4 weeks, the BMI indicators underwent greater changes in the cadets of all training years than after a two-week field training exercise. Changes in BMI are due to a decrease in body weight in cadets of all training years because of intensive practical training in the field and an increase in the volume of their motor activities.

The analysis of VI showed some deterioration of this indicator in the cadets of all training years during their field training exercises (Table 2), but the deterioration became more pronounced with the increase in the duration of the field training exercise. In addition, for junior cadets, the difference between the indicators of the VI before and after field training exercises was greater than for senior cadets. The deterioration of the cadets' VI during field training exercises is due to a decrease in the vital capacity of the lungs and the detraining of the respiratory system in cadets.

The analysis of RI showed that, as in the case of VI, there was a deterioration in the performance of the cardiovascular system in the cadets of all training years (Table 3). However, this trend was more pronounced in junior cadets than in senior cadets. Moreover, as the duration of the field training exercise increased, the difference between the RI indicators before and after the field training exercise increased. This indicates that long-duration field training exercises hurt both the activity of the respiratory system of the cadets' body and the cardiovascular system.

The analysis of the development of speed qualities during the field training exercise lasting 2 weeks showed that the indicators deteriorated by 0.04-0.12 s in all training years, but no significant difference between the results before and after the field training exercise was found ($p > 0.05$) (Table 4). The greatest deterioration in the development of high-speed qualities was found in the 1st training year cadets (0.12 s). Comparison of the indicators before and after the field training exercise lasting 4 weeks testified to more expressed negative changes in the level of development of high-speed qualities of cadets of all training years, in comparison

Table 1. BMI dynamics in cadets during their field training exercises of different durations ($M \pm m$, $n=246$, kg/m^2)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	23.17±0.14	23.08±0.12	0.09	0.49; >0.05
2 nd	64	23.68±0.11	23.61±0.10	0.07	0.47; >0.05
3 rd	59	24.06±0.15	24.01±0.14	0.05	0.24; >0.05
4 th	61	24.32±0.13	24.29±0.12	0.03	0.17; >0.05
The field training exercise lasting 4 weeks					
1 st	62	23.34±0.13	23.21±0.11	0.13	0.76; >0.05
2 nd	64	23.82±0.12	23.73±0.11	0.09	0.55; >0.05
3 rd	59	24.25±0.16	24.18±0.14	0.07	0.33; >0.05
4 th	61	24.47±0.15	24.42±0.15	0.05	0.24; >0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

Table 2. VI dynamics in cadets during their field training exercises of different durations ($M \pm m$, $n=246$, ml/kg)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	55.89±0.64	55.48±0.66	0.41	0.45; >0.05
2 nd	64	56.14±0.61	55.76±0.64	0.38	0.43; >0.05
3 rd	59	56.32±0.65	56.05±0.67	0.27	0.29; >0.05
4 th	61	56.61±0.58	56.43±0.60	0.18	0.21; >0.05
The field training exercise lasting 4 weeks					
1 st	62	56.03±0.59	55.11±0.57	0.92	1.12; >0.05
2 nd	64	56.20±0.57	55.37±0.55	0.83	1.05; >0.05
3 rd	59	56.39±0.60	55.93±0.60	0.46	0.54; >0.05
4 th	61	56.72±0.55	56.24±0.54	0.48	0.62; >0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

with the field training exercise for 2 weeks. The difference was 0.08 s in the 4th training year and 0.22 s in the 1st training year, but it was unreliable in all training years ($p > 0.05$).

The study of the dynamics of results in pull-ups showed that the level of strength qualities development, as well as speed qualities, in the cadets of all training years, deteriorated during field training exercises. At the same time, the longer the duration of the field training exercise, the more pronounced was the deterioration in results. Thus, after returning from the field training exercise lasting 2 weeks, the cadets' results deteriorated by 0.7 times in the 1st training year; by 0.5 times in the 2nd and 3rd training years; and by 0.4 times in the 4th training year. After the 4-week field training exercise, the difference between the results before and after the field training exercise increased to 0.9 times in the 1st and 2nd training years and to 0.8 times in the

senior training year (Table 5). However, there was no significant difference between the indicators before and after the field training exercise both for 2 and 4 weeks ($p > 0.05$).

The analysis of the results in the 3 km run showed that the level of endurance development in the cadets of all training years deteriorated the most among the physical qualities studied, both after the two-week field training exercise and after the four-week field training exercise. Thus, after the field training exercise lasting 2 weeks, the results in the 3 km run deteriorated by 24.5-19.3 s (depending on the training year), after the field training exercise lasting 4 weeks – by 24.8-30.6 s, respectively (Table 6). At the same time, the difference in the indicators of endurance development before and after the field training exercises of different durations was reliable in the cadets of most training years ($p < 0.05$).

It should be noted that the greatest deterioration in

Table 3. RI dynamics in cadets during their field training exercises of different durations ($M \pm m$, $n=246$, c. u.)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	88.03±0.59	88.67±0.60	0.64	0.76; >0.05
2 nd	64	87.46±0.56	87.88±0.58	0.42	0.52; >0.05
3 rd	59	86.78±0.58	87.06±0.59	0.28	0.34; >0.05
4 th	61	84.97±0.60	85.25±0.61	0.28	0.33; >0.05
The field training exercise lasting 4 weeks					
1 st	62	87.56±0.57	88.71±0.59	1.15	1.40; >0.05
2 nd	64	86.89±0.55	87.90±0.57	1.01	1.28; >0.05
3 rd	59	86.24±0.56	87.13±0.57	0.89	1.11; >0.05
4 th	61	84.21±0.58	85.08±0.60	0.87	1.04; >0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

Table 4. The dynamics of cadets' speed qualities development during their field training exercises of different durations ($M \pm m$, $n=246$, s)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	13.78±0.12	13.97±0.13	0.12	1.03; >0.05
2 nd	64	13.34±0.10	13.42±0.12	0.08	0.51; >0.05
3 rd	59	13.05±0.09	13.11±0.10	0.06	0.45; >0.05
4 th	61	12.75±0.08	12.80±0.09	0.05	0.42; >0.05
The field training exercise lasting 4 weeks					
1 st	62	13.56±0.11	13.78±0.12	0.22	1.35; >0.05
2 nd	64	13.25±0.09	13.39±0.11	0.14	0.99; >0.05
3 rd	59	13.09±0.09	13.22±0.11	0.12	0.91; >0.05
4 th	61	12.87±0.08	12.95±0.10	0.08	0.62; >0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

the level of endurance development, as well as other physical qualities, was found in junior cadets. This is due to insufficient adaptation of their body to the conditions of educational activities, instability of motor skills and capabilities, and inability to independently maintain the level of development of their physical qualities at the achieved level in the field environment. The results obtained indicate the need to find effective forms, methods, and means of physical training that would ensure the solution of this problem during field training exercises.

DISCUSSION

Modern combat operations, which take place in extreme environmental conditions, are an extremely difficult test of the physical strength to the military personnel of the Armed Forces of Ukraine. Combat

activities, accompanied by significant physical and psychological stress, increasing fatigue, and the negative impact of other adverse factors, place high demands on both the physical readiness of military personnel and the level of their morphological and functional development and health [8, 9]. Physical readiness, as a physical condition of military personnel that allows them to perform combat and other assigned tasks following the requirements of modern combat, is the main goal of physical training and is formed in the process of systematic physical exercises [10, 11].

Scientists note that physical training is the basis of a high level of combat readiness of service members for combat activities [12, 13]. At the same time, in the process of field training exercises, cadets experience a deterioration in both health and physical development indicators and their physical fitness, which leads to a decrease in their physical readiness for professional and

Table 5. The dynamics of cadets' strength qualities development during their field training exercises of different durations ($M \pm m$, $n=246$, times)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	13.6±0.56	12.9±0.63	0.7	0.83; >0.05
2 nd	64	15.8±0.49	15.3±0.52	0.5	0.70; >0.05
3 rd	59	16.4±0.46	15.9±0.48	0.5	0.75; >0.05
4 th	61	16.8±0.48	16.4±0.49	0.4	0.58; >0.05
The field training exercise lasting 4 weeks					
1 st	62	14.1±0.51	13.2±0.55	0.9	1.20; >0.05
2 nd	64	16.0±0.43	15.1±0.45	0.9	1.45; >0.05
3 rd	59	16.6±0.40	15.8±0.44	0.8	1.35; >0.05
4 th	61	16.9±0.38	16.1±0.42	0.8	1.41; >0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

Table 6. The dynamics of cadets' endurance development during their field training exercises of different durations ($M \pm m$, $n=246$, s)

Year of training	n	Before the field training exercise	After the field training exercise	Significance of the difference	
				Difference	t; p
The field training exercise lasting 2 weeks					
1 st	62	743.3±7.79	767.8±8.52	24.5	2.12; <0.05
2 nd	64	729.1±7.52	751.4±8.07	22.3	2.02; <0.05
3 rd	59	701.4±6.91	720.7±7.61	19.3	1.86; >0.05
4 th	61	690.5±6.83	710.9±7.39	20.4	2.03; <0.05
The field training exercise lasting 4 weeks					
1 st	62	747.5±7.63	778.1±8.40	30.6	2.70; <0.05
2 nd	64	731.3±7.41	759.7±7.94	28.4	2.61; <0.05
3 rd	59	709.8±6.98	735.2±7.55	25.4	2.47; <0.05
4 th	61	696.2±6.95	721.0±7.28	24.8	2.46; <0.05

Note: M – arithmetic mean; m – error of arithmetic mean; n – number of cadets; t – t-test value; p – significance of difference between the indicators of cadets before and after the field training exercise due to the t-test.

combat activities. The reasons for the deterioration of cadets' health and physical development during field training exercises include the absence of practical training sessions in the academic subject area referred to as "Physical Education, Special Physical Training" as the main form of physical education during field training exercises; large volumes of cadets' motor activities during practical training on weapons and military equipment; low level of cadets' motivation to perform physical exercises in the process of concurrent physical training; lack of material resources for physical training in the field environment and proper conditions for training; insufficient knowledge, skills and abilities of cadet unit commanders to conduct physical training sessions with personnel in the field environment.

The problem of improving the physical training of service members of the Armed Forces of Ukraine and cadets of HMEIs of various specialties of the Armed Forces

has been the subject of scientific research by many scientists [4, 7, 12, 14]. However, the issue of maintaining the health and physical development of cadets at the achieved level during field training exercises remains insufficiently addressed. It is also necessary to develop practical recommendations for commanders of cadet units on conducting physical training sessions with personnel in the field environment, depending on the year of cadets' training and the duration of field training exercises.

CONCLUSIONS

It was found that during field training exercises of different durations, the level of health and physical development in the cadets of all training years deteriorates. The worst level among the studied indicators after the cadets' return from the field training exercises was

recorded in VI, RI, and the level of endurance development. All these indicators showed a deterioration in the functional capabilities of the cadets' cardiorespiratory system. At the same time, it was found that the longer the duration of field training exercises, the more the level of health and physical development of cadets deteriorated. The most pronounced deterioration in the level of the studied indicators was found in junior cadets. The results indicate the need to improve the

organization and methods of physical training with cadets during field training exercises, which will help maintain their health and physical development at the proper level.

THE PROSPECT OF FURTHER RESEARCH

It is planned to investigate the motivation of cadets to exercise in the field environment.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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