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DYNAMICS OF INDICATORS OF CADETS' MORPHOLOGICAL AND FUNCTIONAL DEVELOPMENT IN THE PROCESS OF THEIR PHYSICAL EXERCISES OF DIFFERENT ORIENTATION

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The article aimed to investigate the dynamics of indicators of cadets' morphological and functional development in the process of practicing various military-applied sports during their academic training. The research involved 218 male cadets aged 17-23 years who were engaged in various military-applied sports (n = 188) and who were not additionally engaged in sports (n = 30) during their academic training. Cadets' morphological and functional development was assessed by the following indicators: body mass index, vital index, strength index, and the Robinson index, results in 100 m run, pull-ups, and 3 km run. It was found that military-applied sports have a more efficient impact on the indicators of cadets' morphological and functional development compared to the traditional method of physical training. Depending on the orientation of physical exercises that underlie the sport, each has one or another pronounced impact. Thus, the improvement of the cardiovascular and respiratory systems, as well as the development of endurance are more effectively influenced by military pentathlon and orienteering; the improvement of the muscular system and the development of strength qualities – by kettlebell lifting and powerlifting; the development of speed and agility – by hand-to-hand combat and sports games. A high level of cadets' morphological and functional development will ensure the formation of their physical readiness for future professional and combat activities and will contribute to the performance of assigned tasks.

Key words: morphological and functional development, cadets, military personnel, physical training, military-applied sports.

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ДИНАМІКА ПОКАЗНИКІВ МОРФОФУНКЦІОНАЛЬНОГО РОЗВИТКУ КУРСАНТІВ У ПРОЦЕСІ ЗАНЯТЬ ФІЗИЧНИМИ ВПРАВАМИ РІЗНОЇ СПРЯМОВАНОСТІ

Метою було дослідити динаміку показників морфофункціонального розвитку курсантів у процесі занять різними військово-прикладними видами спорту під час навчання. У дослідженні взяли участь 218 курсантів-чоловіків віком 17–23 роки, які під час навчання займалися різними військово-прикладними видами спорту (n=188) та які додатково не займалися спортом (n=30). Морфофункціональний розвиток оцінювався за показниками: індекс маси тіла, життєвий індекс, силовий індекс, індекс Робінсона, результати з бігу на 100 м, у підтягуванні та з бігу на 3 км. Встановлено, що заняття військово-прикладними видами спорту більш ефективно, порівняно із традиційною методикою фізичної підготовки, впливають на показники морфофункціонального розвитку курсантів. Залежно від спрямованості фізичних вправ, які лежать в основі виду спорту, кожен вид має той чи інший яскраво виражений ефект. Так, на покращання серцево-судинної та дихальної систем, а також на розвиток витривалості більш ефективно впливають заняття військовим п'ятиборством та орієнтуванням; на покращання м'язової системи та розвиток силових якостей – заняття гирьовим спортом і пауерліфтингом; на розвиток швидкісних якостей та спритності – заняття рукопашним боем та спортивними іграми. Високий рівень показників морфофункціонального розвитку курсантів забезпечить формуванню їх фізичної готовності до майбутньої професійної і бойової діяльності та сприятиме виконанню завдань за призначенням.

Ключові слова: морфофункціональний розвиток, курсанти, військовослужбовці, фізична підготовка, військово-прикладні види спорту.

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Modern combat operations with the Russian aggressor, 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 [4, 5]. 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 [3]. Among the main tasks of physical training of military personnel specialists [6, 12] single out: formation and improvement of their physical readiness for service activities, increase of combat readiness of military units and subdivisions by the development of physical and special qualities, mastering and improvement of military-applied motor skills; formation of readiness to overcome extreme physical and psychological loads during

preparation and conduct of combat actions; increase of body resistance to the influence of adverse factors of service activities; furtherance of improvement in terms of the combat cohesion of military units, raising the level of professional training of military personnel, improving their physical development and promoting their health. Maintaining constant physical fitness is achieved by systematic physical training, through a rational combination of forms, methods, and means of physical training [11]. According to many scientists [1, 8], to solve the above-mentioned problems of physical training, especially in higher military educational institutions (HMEIs), it is effective to introduce military-applied sports, which are very popular among cadets, into the educational process. Modern military-applied sports, on the one hand, contribute to a high level of general physical fitness of cadets, improve their morphological and functional development, and on the other hand, form military-applied motor skills that are necessary in modern combat [2]. In many armies of NATO countries, the concepts of physical training provide for the approximation of the content of physical training to combat activities through the introduction and development of modern military-applied sports [14]. Many scientific researches are devoted to the issues of improvement of the physical training of cadets through military-applied sports. However, the comparative characteristic of indicators of cadets' morphological and functional development in the process of their physical exercises of different orientations (different military-applied sports) is not enough explored, which led to the choice of the research topic.

The purpose of the study was to investigate the dynamics of indicators of cadets' morphological and functional development in the process of practicing various military-applied sports during their academic training.

Materials and methods. The research was conducted at the Military Academy (Odesa) in 2019–2023. A total of 218 male cadets aged 17–23 participated in the research. For 5 years, the indicators of morphological and functional development of graduate cadets who were engaged in various military-applied sports during their training (n = 188) were evaluated: military pentathlon (Group a, n = 28), hand-to-hand combat (Group b, n = 33), powerlifting (Group c, n = 29), kettlebell lifting (Group d, n = 31), orienteering (Group e, n = 24), and sports games (Group f, n = 43). To compare the results obtained, a group of final-year cadets was formed who were not additionally engaged in sports (Group g, n = 30). Sports activities took place during the hours of sporting and mass participation events (SMPEs) three times a week for 1.5 hours in the sports clubs of the Academy. The cadets of Group g attended SMPEs according to the traditional method also three times a week in the same volume.

Research methods: analysis and synthesis of literary sources, testing, and statistical analysis. Cadets' morphological and functional development was assessed by the following indicators: body mass index (BMI, which was determined in kg/m^2 by the ratio of body weight to body length squared), vital index (VI, which was determined in ml/kg by the ratio of lung capacity to body weight), strength index (SI, which was determined in percentage by the ratio of the dynamometry of the stronger arm in kg to body weight in kg), the Robinson index (RI, which was determined in c. u. as the ratio of the product of heart rate and systolic blood pressure to 100). In addition, we assessed the level and dynamics of the development of cadets' motor skills: speed qualities (based on the results of the 100 m run), strength qualities (based on the results of pull-ups), and endurance (based on the results of the 3 km run). All of the above indicators were evaluated at the beginning of training at the HMEI, in the 1st year (1st stage), and at the end of training, in the 4th year (2nd stage).

The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as $M \pm m$, where M is the arithmetic mean, m is the error of the arithmetic mean. The reliability of the difference for all statistical tests was set at $p < 0.05$. All statistical analyses were performed using STATISTICA 6.1 software package (number AGAR909E415822FA), adapted for medical and biological research.

This research followed the regulations of the World Medical Association Declaration of Helsinki and ethical principles for medical research involving human subjects. The procedure for organizing the study was previously agreed with The Committee on Compliance with Academic Integrity and Ethics of the Military Academy (Odesa) (Protocol No. 14 dated 26.08.2019). Informed consent was received from all cadets who took part in this research.

Results of the study and their discussion. The results of the study of indicators of cadets' morphological and functional development in the process of training in various military-applied sports during their studies at the HMEI are presented in Table 1. It was found that the indicators to be evaluated in cadets of all study groups did not differ significantly ($p > 0.05$) at the beginning of the research.

The BMI allows us to assess the degree of correspondence between the cadets' body weight and their height and thus, in an indirect way, to assess whether the body weight is insufficient, normal, or excessive (obesity). The analysis of the BMI showed that the indicators in all groups increased during the training period, but in cadets who were involved in sports during their academic training, the BMI did not change significantly ($p > 0.05$), except for the group of cadets who were engaged in powerlifting ($p < 0.05$).

Instead, in the cadets who were not engaged in additional sports, the BMI increased (deteriorated) significantly, by 1.29 kg/m² ($p < 0.01$). At the end of the research, the BMI of the cadets of Group g was significantly ($p < 0.05$; $p < 0.01$) worse than that of the cadets of other groups, except for the representatives of powerlifting. However, a more detailed analysis of the ratio of body weight components in this group showed that the increase in body weight in powerlifters was caused by an increase in muscle mass, not fat mass. It was found that at the end of the research, in all groups of cadets who were involved in sports, no overweight cadets were found (everybody's BMI was within the age norm), while in the group of cadets who were not additionally engaged in sports, 36.7 % of such cadets were found. It was found that the most pronounced effect on the stabilization of cadets' body weight was provided by military pentathlon, orienteering, sports games, kettlebell lifting, and hand-to-hand combat.

Table 1

Dynamics of indicators of cadets' morphological and functional development in the process of training in various military-applied sports (n=218)

Indices	Groups	n	Stages of research		Difference	t; p
			1 st	2 nd		
BMI, kg/m ²	a	28	22.89±0.23	23.06±0.25	0.17	0.50; >0.05
	b	33	23.17±0.27	23.70±0.29	0.53	1.34; >0.05
	c	29	23.39±0.32	24.45±0.30	1.06	2.42; <0.05
	d	31	23.09±0.30	23.41±0.32	0.32	0.73; >0.05
	e	24	23.14±0.29	23.29±0.28	0.15	0.37; >0.05
	f	43	22.97±0.25	23.20±0.27	0.23	0.63; >0.05
	g	30	23.28±0.26	24.57±0.31	1.29	3.19; <0.01
VI, ml/kg	a	28	57.41±0.49	60.07±0.47	2.66	3.92; <0.01
	b	33	57.34±0.46	58.89±0.45	1.55	2.41; <0.05
	c	29	57.45±0.51	58.72±0.50	1.27	1.78; >0.05
	d	31	57.53±0.48	59.22±0.46	1.69	2.54; <0.05
	e	24	57.62±0.58	60.34±0.58	2.72	3.32; <0.01
	f	43	57.31±0.41	59.19±0.39	1.88	2.83; <0.05
	g	30	57.35±0.47	57.92±0.49	0.57	0.84; >0.05
SI, %	a	28	59.43±0.77	61.36±0.75	1.93	1.80; >0.05
	b	33	59.85±0.69	63.72±0.64	2.87	3.05; <0.01
	c	29	60.21±0.73	66.04±0.70	5.83	5.76; <0.001
	d	31	60.04±0.76	64.73±0.74	4.69	4.42; <0.001
	e	24	58.95±0.81	60.68±0.79	1.73	1.53; >0.05
	f	43	59.11±0.67	60.94±0.68	1.83	1.92; >0.05
	g	30	59.27±0.78	60.41±0.80	1.14	1.02; >0.05
RI, c. u.	a	28	84.36±1.53	77.04±1.39	7.32	3.54; <0.01
	b	33	84.79±1.32	79.88±1.25	4.91	2.70; <0.05
	c	29	84.91±1.59	82.30±1.58	2.61	1.16; >0.05
	d	31	83.95±1.48	79.76±1.45	4.19	2.02; <0.05
	e	24	83.86±1.64	76.93±1.60	6.93	3.02; <0.01
	f	43	84.12±1.24	78.93±1.20	5.19	3.01; <0.05
	g	30	85.02±1.50	83.19±1.57	1.83	0.84; >0.05

Legend: t – Student's t-test value; p – significance of difference between the cadets' indicators at the 1st and 2nd stages of research.

The comparative analysis of the VI indicators showed that in all groups where cadets were engaged in military-applied sports, except for powerlifting, there was a significant ($p < 0.05$; $p < 0.01$) improvement in the functional capabilities of the respiratory system of cadets in the process of their training at the HMEI. However, in the cadets who were not engaged in additional sports, there were no significant changes in the VI ($p > 0.05$). Moreover, the indicators of the VI in Group g were significantly the worst among all the studied groups ($p < 0.05$; $p < 0.01$) at the end of the experiment, which confirms the positive impact of additional sports activities during the training at the HMEI on the improvement of cadets' morphological and functional development. The best values of the VI at the end of the research, as well as the most pronounced changes in the VI, were found in cadets who were engaged in orienteering (2.72 ml/kg) and military pentathlon (2.66 ml/kg), which indicates the greatest effect of these sports on improving the respiratory system in cadets.

The analysis of the dynamics of the SI indicators showed that powerlifting and kettlebell lifting have the most pronounced effect on the development of strength qualities and improvement of muscular system activity. The cadets of these groups had a significant ($p < 0.001$) improvement in the SI and its biggest changes (5.83 % and 4.69 %, respectively), compared to other groups. Significant changes also occurred in the representatives of hand-to-hand combat ($p < 0.01$). The cadets involved in other sports showed a certain improvement in the SI, but the changes were not significant ($p > 0.05$). At the same time,

the worst dynamics among all groups was observed in the cadets who were not engaged in any sports (1.14 %).

The assessment of the RI, the decrease of which characterizes the improvement of the functional state of the cardiovascular system, shows that in the cadets of all groups involved in sports, the RI decreases during their training at the HMEI. However, the most pronounced significant ($p < 0.001$) changes occurred in the cadets who were engaged in military pentathlon (7.32 c. u.) and orienteering (6.93 c. u.). The representatives of sports games, hand-to-hand combat, and weightlifting also had significant ($p < 0.05$) changes in the RI. The cadets who were engaged in powerlifting showed improvement in the RI, but the changes were not reliable. At the same time, the worst indicators of the RI at the end of the research were found in the cadets who were engaged in traditional methods of physical training and did not do additional sports, which emphasizes the effectiveness of military-applied sports in improving cadets' morphological and functional state.

The mentioned conclusions were also confirmed in the course of the research on the dynamics of indicators characterizing the development of cadets' physical qualities (Table 2). Thus, the analysis of the results of the 100 m run showed that in all groups of the cadets, there was a significant ($p < 0.001$) improvement in the development of speed qualities, but the most pronounced effect was found in the process of training in hand-to-hand combat and sports games (changes were 1.09 s and 1.07 s, respectively). This is due to the specifics of sports, where speed and agility are effectively significant in these sports. The worst level of speed qualities and the smallest increase in results were found in the cadets who were not additionally engaged in sports.

Table 2

Dynamics of indicators of cadets' physical qualities development in the process of training in various military-applied sports (n=218)

Indices	Groups	n	Stages of research		Difference	t; p
			1 st	2 nd		
100 m run, s	a	28	14.15±0.11	13.24±0.10	0.91	6.12; <0.001
	b	33	14.26±0.10	13.17±0.09	1.09	8.10; <0.001
	c	29	14.12±0.11	13.39±0.10	0.73	4.91; <0.001
	d	31	14.35±0.12	13.56±0.11	0.79	4.85; >0.001
	e	24	14.17±0.13	13.42±0.12	0.75	4.24; <0.001
	f	43	14.09±0.09	13.02±0.07	1.07	9.38; <0.001
	g	30	14.38±0.12	13.75±0.11	0.63	3.87; <0.01
Pull-ups, times	a	28	13.17±0.91	17.05±0.95	3.88	2.95; <0.05
	b	33	13.85±0.84	19.16±0.85	5.31	4.44; <0.001
	c	29	12.99±0.97	19.81±0.92	6.82	5.10; <0.001
	d	31	13.71±0.93	20.64±0.87	6.93	5.44; <0.001
	e	24	12.83±1.07	16.34±0.95	3.51	2.45; <0.05
	f	43	12.94±0.78	16.23±0.81	3.29	2.93; <0.05
	g	30	13.15±0.95	16.17±0.98	3.02	2.21; <0.01
3 km run, s	a	28	779.1±7.37	667.9±6.84	111.2	1.06; <0.001
	b	33	785.6±6.91	716.4±6.37	69.2	7.36; <0.001
	c	29	798.3±7.54	756.2±7.47	42.1	3.97; <0.001
	d	31	791.1±7.09	697.3±6.95	93.8	9.45; <0.001
	e	24	782.4±7.62	678.7±7.24	103.7	9.87; <0.001
	f	43	779.2±5.97	703.8±5.81	75.4	9.05; <0.001
	g	30	793.7±7.14	739.1±6.97	54.6	5.47; <0.001

Legend: t – Student's t-test value; p – significance of difference between the cadets' indicators at the 1st and 2nd stages of research.

There was a significant ($p < 0.05 - < 0.001$) increase concerning the results in pull-ups in all the studied groups, which indicates the improvement of strength qualities of cadets in the process of their academic training. At the same time, the best results at the end of the research were found in the representatives of kettlebell lifting (6.93 times increase), powerlifting (6.82 times), and hand-to-hand combat (5.31 times), which is due to the requirements of the sport for the development of physical qualities of cadets. The worst level of development of strength qualities was found in the cadets who were not engaged in sports (an increase of 3.02 times), which emphasizes the expediency of practicing military-applied sports during their training at the HMEI. The dynamics of the results in the 3 km run had a similar trend to the results in the previous exercises – a significant ($p < 0.001$) improvement in the level of endurance development in the cadets of all groups. The best results at the end of the research, as well as the largest increase in results during the training, were found in the cadets who were engaged in military pentathlon (increase – 111.2 s) and orienteering (103.7 s). This indicates high requirements for the development of endurance to achieve high

results in these sports. The lowest increase in results was found in the cadets who were engaged in powerlifting (42.1 s) and the cadets who were not engaged in sports (54.6 s).

The experience of combat activities of the Armed Forces of Ukraine and the results of scientific research [6, 10] show that in the process of professional training of military personnel, it is effective to use physical exercises and sports with the closest structure and nature of action to professional combat activities. It is proved that military-applied sports and physical exercises have a wide range of effects on the body of military personnel; with their proper application, it is possible to successfully develop the necessary skills, increase the functional reserves of the body of military personnel, improve their physical as well as moral and psychological readiness for combat operations [7, 11].

As noted by scientists [2, 9], SMPEs are one of the most important forms of physical training of cadets at HMEIs, which is aimed at involving cadets in regular military-applied and mass sports, increasing their level of physical fitness and sportsmanship, and organizing meaningful leisure-time activities.

The SMPEs have the following main peculiarities: a combination of compulsory sports with voluntary choice of sports for sports improvement; cadets' enduring maximum physical and mental stress in the process of sports, which contributes to the formation of cadets' physical and mental readiness for future combat activities in extreme conditions [10, 13].

Our results confirmed the conclusions of many scientists [7, 10, 15] about the effectiveness of military-applied sports in forming the physical readiness of cadets for future professional and combat activities. Depending on the specifics and peculiarities of professional activities, taking into account the orientation of physical exercises that underlie each sport, it is possible to develop certain physical qualities more effectively: speed, strength, endurance, agility, strength endurance, maximum strength, and others, as well as to focus on the functional capabilities of the main body systems: cardiovascular, respiratory, muscular systems and the musculoskeletal system, etc. However, as the results of our research have shown, practicing any military-applied sport during the hours of SMPEs is more effective than the traditional method of conducting SMPEs.

Conclusions

It was found that military-applied sports have a more efficient impact on the indicators of cadets' morphological and functional development compared to the traditional method of physical training. Depending on the orientation of physical exercises that underlie the sport, each has one or another pronounced impact. Thus, the improvement of the cardiovascular and respiratory systems, as well as the development of endurance are more effectively influenced by military pentathlon and orienteering; the improvement of the muscular system and the development of strength qualities – by kettlebell lifting and powerlifting; the development of speed and agility – by hand-to-hand combat and sports games. Most of the studied sports are aimed at stabilizing body weight and improving body composition. A high level of cadets' morphological and functional development will ensure the formation of their physical readiness for future professional and combat activities and will contribute to the performance of assigned tasks.

Prospects for further research. It is planned to investigate the dynamics of morphological and functional development of graduates of HMEIs who were engaged in various sports during their training in the course of their further service as officers.

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LONG-COVID IMPACT ON THE REPRODUCTIVE HEALTH OF WOMEN WITH FERTILITY

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Reproductive health is a fundamental human right crucial for the health, well-being, and quality of life of individuals, families, communities, society, and the state. To determine the possible impact of COVID-19 on women's reproductive health, we included 80 patients who came to the clinic of reproductive technologies for infertility treatment in a comprehensive examination and were divided into 2 groups. The main group consisted of 60 women after COVID-19 (10 patients with only a male infertility factor were excluded, and one patient refused to participate in the study); the comparison group consisted of 20 patients without a history of COVID-19. The study was carried out using the principles of the Declaration of Helsinki. The research protocol was approved by the institution's Local Ethics Committee, mentioned in the work. Informed consent was obtained from the women for the study. Among patients with infertility, a high frequency of long COVID has been established, the consequences of which are various disorders of somatic and reproductive health, which often arise precisely after suffering from the coronavirus disease. A significantly lower success rate of assisted reproductive technologies programs in these patients was established, which is due to the systemic impact of the coronavirus infection on the woman's body and reproductive function in particular.

Key words: reproductive function, COVID-19, long COVID, infertility, assisted reproductive technologies, pandemic.

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ВПЛИВ «ЛОНГ-COVID» НА РЕПРОДУКТИВНУ СФЕРУ ЖІНОК З НЕПЛІДДЯМ

Репродуктивне здоров'я є основним правом людини, яке має вирішальне значення для здоров'я, благополуччя та якості життя окремих людей, сімей і спільнот, суспільства, держави в цілому. Для визначення можливого впливу COVID-19 на репродуктивне здоров'я жінок до комплексного обстеження ми включили 80 пацієнток, що звернулись у клініку репродуктивних технологій з приводу лікування безпліддя, яких розділили на 2 групи: основна група – 60 жінок після COVID-19 (виключили 10 пацієнток з тільки чоловічим фактором непліддя, одна пацієнтка відмовилась від участі в дослідженні), групу порівняння склали 20 пацієнток без COVID-19 в анамнезі. Дослідження виконано відповідно до принципів Гельсінської декларації. Протокол дослідження ухвалено Локальним етичним комітетом зазначеної в роботі установи. На проведення досліджень отримано інформовану згоду жінок. Серед пацієнток з непліддям встановлена висока частота «лонг-COVID», наслідками якого є різноманітні порушення соматичного та репродуктивного здоров'я, які часто виникали саме після перенесеного коронавірусного захворювання. Встановлена суттєво нижча частота успішності програм допоміжних репродуктивних технологій у цих пацієнток, яка обумовлена саме системним впливом коронавірусної інфекції на організм жінки та репродуктивну функцію зокрема.

Ключові слова: репродуктивна функція, COVID-19, лонг-COVID, непліддя, допоміжні репродуктивні технології, пандемія.

The study is a fragment of the research project "Development of diagnostic tactics and pathogenetic substantiation of effective methods of preserving and restoring reproductive potential and improving parameters of a woman's quality of life in obstetric and gynecological pathology", state registration No. 0121U109269.

One of the leading medical and social problems is protecting the reproductive health of childbearing age women because the female population is the country's primary demographic resource. One of the most critical demographic indices, the birth rate, is closely related to the stability of the socioeconomic system and confidence in the future [1].

Reproductive health refers to general well-being in all aspects of reproduction, including physical, emotional and social well-being, not just the absence of disease or bodily infirmity. The concept covers the full range of issues related to the reproductive system and its functions, including access to reproductive