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# Dynamics of cadets' physical condition and somatic health indicators in the process of their functional training

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# Динаміка показників фізичного стану та соматичного здоров'я курсантів у процесі функціонального тренування

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## Introduction

During the period of martial law in Ukraine, academic training in higher military educational institutions (HMEIs) is conducted at temporarily established locations in conditions of personnel dispersion. The lack of places, conditions, and adequate material and technical resources for physical training and sports at temporary places of residence, which change periodically, does not allow the main goal of physical training of cadets to be fully achieved, which is to ensure the physical readiness of military personnel for combat operations, the performance of service duties as assigned, and the promotion of other tasks related to their training and education [1]. As scientists point out [2; 3], physical readiness is the physical condition of a service member that allows them to perform combat missions and other assigned tasks in accordance with the requirements of modern combat.

The problem of inadequate conditions and material and technical resources for physical training during martial law is particularly acute for junior training-year cadets, as the level of physical fitness and health of yesterday's school graduates is not high enough [4; 5]. According to scientists [6], during academic training in the first years, due to insufficient adaptation to the conditions of military service during dispersal, cadets experience higher morbidity than in the senior training years, leading to missed training sessions and other forms of physical training. In addition, constant air raid alerts (day and night), which disrupt academic training sessions, including physical training, morning exercises, and sporting and mass participation activities, do not allow for the full implementation of training sessions according to the current working program of the academic subject area (CWPASA) [7]. Most of all, according to experts [8], during the junior training years, while staying in temporary locations, the strength and endurance of cadets, which serve as the basis for the development of military-applied skills and special qualities in their senior training years, «suffer». All this requires timely changes to the physical training educational process to develop the physical qualities of junior training-year cadets, improve their physical condition, and promote their health.

Studying the experience of organizing physical training for service members in field conditions (without sufficient and adequate material and technical resources and equipment), the experience of physical training in NATO countries, other law enforcement agencies, and departments of Ukraine [9; 10] allows us to conclude that the most effective means of maintaining the physical fitness of junior-training year cadets at temporary locations is CrossFit, which includes high-intensity functional loads and is mainly conducted using the circuit training method. The results of the work of many scientists [11–14], who studied the effect of CrossFit training sessions on the human body, have proven its effectiveness in improving physical qualities (in particular, strength, speed, endurance, agility, flexibility), reducing body weight, improving cardiovascular and respiratory system function, strengthening the body, restoring psycho-emotional state, and improving overall physical condition. At the same time, there has been insufficient research on the impact of CrossFit training sessions on physical condition and somatic health indicators among junior training-year cadets during their training at temporary locations under martial law, which guided the direction of our research.

**The aim of the research** is to investigate the impact of functional training using the CrossFit system on the physical condition and somatic health of junior training-year cadets during their academic training under martial law.

## Object, materials and research methods

*Participants*. The research, conducted in 2023–2025, involved 67 male cadets in their first and second training years (aged 17–20) enrolled in 2023 at the Korolyov Zhytomyr Military Institute (Zhytomyr, Ukraine). At the beginning of the research (September 2023), two groups were formed from the first-year cadets: an experimental group (EG, $n = 33$) and a control group (CG, $n = 34$). The groups were formed randomly and did not involve any special selection: the EG included male cadets from the first and second study groups of the training year, and the CG included cadets from the third and fourth study groups. The levels of physical condition and somatic health indicators of the EG and the CG cadets at the beginning of the research were not significantly different ($p > 0.05$). During physical training sessions, the EG cadets followed the methodology we developed to improve their physical condition and somatic health through CrossFit. In contrast, the CG followed the CWPASA on "Physical Education, Special Physical Training". The number of hours per week devoted to physical training sessions in the EG and the CG was the same and amounted to 4 hours (2 training sessions of 2 hours each). The main difference between the EG and the CG was the content of the physical training sessions. Inclusion criteria for participants: male cadets; membership in a specific study group; admission to training sessions based on health status; exclusion criteria: illness that prevents physical activity. All cadets in the EG and the CG were informed of the aim of the research, after which they provided written consent to participate solely for scientific purposes. The level of physical condition and somatic health of cadets in the EG and the CG was assessed during the 1st and 4th semesters of academic training in their 1st and 2nd training years.

*Research methods*: analysis and generalization of literary sources, testing, medical and biological methods, statistical analysis. Analysis and generalization of literary sources were used to conduct an analytical review of scientific sources on the outlined range of issues (30 sources from Scopus and Web of Science Core Collection were analyzed).

Testing was used to assess the physical condition of the EG and the CG cadets using the following tests: 100 m run (speed qualities), pull-ups (strength qualities), and 3 km run (endurance). The exercises were tested under the same conditions by the Department of Physical Education's instructors.

Medical and biological methods were used to assess the somatic health of cadets in the EG and the CG. For this purpose, we used the methodology of Professor G. L. Apanasenko, which is based on indicators of physical development (height, body weight, vital lung capacity, hand dynamometry) and indicators of the functional state of the cardiorespiratory system (heart rate, blood pressure). The somatic health level (SHL) was calculated using five indices: body mass index (BMI), vital index (VI), strength index (SI), Robinson index (RI), and heart rate recovery time index (HRRTI) [15]. The sum of points determined the SHL of cadets for each of the five indices: 3 points or less – low SHL; 4–6 points – below average SHL; 7–11 points – average SHL; 12–15 points – above average SHL; 16–18 points – high SHL.

*Data processing*. Statistical analysis was used to process the experimental data obtained. The compliance of the sample data distribution with the Gauss' law was assessed using the Shapiro-Wilk W test. The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as M±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.

*Ethics*. 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. The procedure for organizing the study was previously agreed with The Committee on Compliance with Academic Integrity and Ethics of the Korolyov Zhytomyr Military Institute (Protocol No. 14 dated 29.08.2023). Also this research followed the regulations of the World Medical Association Declaration of Helsinki. Informed consent was received from all cadets who took part in this research.

## Research results

Taking into account the experience of Ukrainian Armed Forces personnel, including graduates of the Korolyov Zhytomyr Military Institute, in the Russian-Ukrainian war, the experience of NATO countries, Ukrainian law enforcement agencies and departments, and the results of scientific research by many scientists, we have developed a methodology for improving the physical condition and somatic health of junior training-year cadets through CrossFit during their academic training in wartime conditions. The purpose of the developed methodology is to ensure the comprehensive physical development of junior training-year cadets, improve the development of all physical qualities, and strengthen somatic health, thereby laying the foundation for the formation of military-applied motor skills in senior training-year cadets. The objectives of the methodology are defined as follows: comprehensive (complex) development of the physical qualities of junior training-year cadets in a short period of time; improving the physical condition of cadets and their somatic health; forming motivation for systematic physical exercise during their academic training and service; providing a basis (foundation) for the formation of military-applied motor

skills and the development of special qualities of cadets in senior training years. The developed methodology includes: general developmental exercises (10–20 %), special developmental (high-intensity) exercises, including weight training, bodyweight exercises, and exercises on exercise machines (50–70 %), auxiliary exercises, including cardio exercises (20–30 %). The percentage ratio of exercises varies according to the stages of the methodology: with each subsequent semester, the volume of special preparatory and auxiliary exercises increased, while general preparatory exercises decreased. Special preparatory exercises include: kettlebell, dumbbell, barbell disc, medicine ball, sandbag, block, car tire, sandbox, exercise machine, pair sets, and bodyweight exercises. Training methods: interval, repetitive, uniform, alternating, circuit, competitive. Principles: general pedagogical principles, principles of physical education, and sports training. Stages of implementation of the methodology: Stage 1 – adaptive (1st semester): familiarization and learning of exercise techniques according to the CrossFit system; Stage 2 – developmental (2nd semester): development of physical qualities, improvement of physical condition, strengthening of health through CrossFit; Stage 3 – training (3rd–4th semesters): improvement of physical qualities through CrossFit.

The main feature of the methodology was the use of developed exercise complexes according to the CrossFit system at the end of the main part of the training session, depending on the topic of the main part of the training session: the duration of such complex training was 20–40 minutes and depended on the training year and the level of physical fitness of the cadets. Thus, for the first training year, cadets' training using CrossFit methods lasted 20–30 minutes, and for the second training year, it lasted 30–40 minutes. The cadets' training program included high-intensity exercise complexes. Physical activity was regulated by heart rate. In the first training year, cadets had high activity, with heart rates of 170–180 beats per minute during exercise; in the second training year, cadets had 180–190 beats per minute. The physical load was dosed according to the number and complexity of exercises in the complexes, the duration of the exercise, the duration of the entire complex, the duration and nature of rest, the number of sets, the number of repetitions in a set, the pace of the exercises, and the amount of load. Thus, for the 1st training year, cadets used complexes of 5–7 exercises, performed in 3–4 sets (rounds), and for the 2nd training year, cadets used 6–10 exercises in 4–5 sets (rounds).

The results of the study of the physical condition of the EG and the CG cadets (based on the results of physical exercise testing) are presented in Table 1. For all tests in the 1st–3rd semesters of academic training, no significant difference was found between the EG and the CG indicators ($p > 0.05$). In the 4th semester, the EG cadets' results on all tests were significantly better than those of the CG. Thus, according to the results of the 100 m run, the difference was 0.5 seconds ($p \leq 0.05$), in pull-ups, 2.1 times ($p \leq 0.05$), and in the 3 km run, 29.1 seconds ($p \leq 0.05$).

During the study period in the 1st and 2nd training years, test results improved in both study groups, but more significant changes in physical condition indicators were observed in the EG cadets. Thus, the results of the 100 m

Table 1

**Dynamics of physical condition indicators in the EG ($n$ = 33) and the CG ($n$ = 34) cadets during their 1st and 2nd training years under martial law (Mean ± $m$)**

| Semesters of study | EG ($n$ = 33) | CG ($n$ = 34) | Significance of the difference | |
|---|---|---|---|---|
| | | | $t$ | $p$ |
| 100 m run, s | | | | |
| 1st | 14.3 ± 0.17 | 14.2 ± 0.20 | 0.31 | $p > 0.05$ |
| 2nd | 14.1 ± 0.17 | 14.1 ± 0.19 | 0.09 | $p > 0.05$ |
| 3rd | 13.7 ± 0.16 | 13.9 ± 0.18 | 0.85 | $p > 0.05$ |
| 4th | 13.2 ± 0.15 | 13.7 ± 0.17 | 2.21 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 4.85 ($p \leq 0.001$) | 1.90 ($p > 0.05$) | | |
| Pull-ups, times | | | | |
| 1st | 12.3 ± 0.79 | 12.1 ± 0.81 | 0.18 | $p > 0.05$ |
| 2nd | 14.4 ± 0.76 | 13.2 ± 0.79 | 1.09 | $p > 0.05$ |
| 3rd | 15.5 ± 0.72 | 14.1 ± 0.77 | 1.35 | $p > 0.05$ |
| 4th | 16.7 ± 0.70 | 14.6 ± 0.74 | 2.06 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 4.17 ($p \leq 0.001$) | 2.28 ($p \leq 0.05$) | | |
| 3 km run, s | | | | |
| 1st | 793.2 ± 9.18 | 788.8 ± 9.05 | 0.34 | $p > 0.05$ |
| 2nd | 761.4 ± 9.05 | 772.5 ± 8.97 | 0.87 | $p > 0.05$ |
| 3rd | 748.3 ± 8.92 | 765.2 ± 8.94 | 1.34 | $p > 0.05$ |
| 4th | 732.5 ± 8.76 | 761.6 ± 8.90 | 2.33 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 4.78 ($p \leq 0.001$) | 2.14 ($p \leq 0.05$) | | |

*Legend:* $n$ – number of cadets; Mean – arithmetic mean; m – error of the arithmetic mean; $t$ – value of Student's t-test; $p$ – significance level of the differences; $t_{1-4}$ ($p$) – significance level of the differences between the indicators of cadets in the 1st and the 4th semesters

run in the EG improved significantly by 0.9 seconds ($p \leq 0.001$), while in the CG the changes were insignificant and amounted to 0.5 seconds ($p > 0.05$); in pull-ups, the results in the EG increased by 4.4 times ($p \leq 0.001$), and in the CG – by 2.5 times ($p \leq 0.05$); in the 3 km run, the EG indicators improved by 60.7 seconds ($p \leq 0.001$), while the CG they improved by 27.2 seconds ($p \leq 0.05$).

The analysis shows that training sessions conducted using the developed methodology proved more effective than the CWPASA in improving the physical condition of junior training-year cadets during their academic training at temporary locations under martial law.

The results of assessing the dynamics of somatic health indicators of the EG and the CG cadets (according to the methodology of Professor G. L. Apanasenko) are presented in Table 2. It was found that in the 1st–3rd semesters, there were no significant differences in BMI between the EG and the CG cadets ($p > 0.05$), but in the 4th semester, the CG cadets had a significantly worse BMI than the EG cadets, by 0.67 kg/m$^2$ ($p \leq 0.05$). During the 1st and 2nd training years, both groups experienced an increase in BMI, but the negative changes were more pronounced in the CG (1.46 kg/m$^2$, $p \leq 0.001$) than in the EG (0.91 kg/m$^2$, $P \leq 0.01$).

Table 2

**Dynamics of somatic health indicators in the EG ($n$ = 33) and the CG ($n$ = 34) cadets during their 1st and 2nd training years under martial law (Mean ± $m$)**

| Semesters of study | EG ($n$ = 33) | CG ($n$ = 34) | Significance of the difference | |
|---|---|---|---|---|
| | | | $t$ | $p$ |
| BMI, kg/m$^2$ | | | | |
| 1st | 21.94 ± 0.24 | 22.06 ± 0.27 | 0.33 | $p > 0.05$ |
| 2nd | 22.35 ± 0.22 | 22.78 ± 0.24 | 1.78 | $p > 0.05$ |
| 3rd | 22.62 ± 0.19 | 23.15 ± 0.21 | 1.84 | $p > 0.05$ |
| 4th | 22.85 ± 0.18 | 23.52 ± 0.20 | 2.49 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 3.03 ($p \leq 0.01$) | 4.35 ($p \leq 0.001$) | | |
| VI, ml/kg | | | | |
| 1st | 59.02 ± 1.77 | 58.74 ± 1.69 | 0.11 | $p > 0.05$ |
| 2nd | 60.59 ± 1.75 | 59.41 ± 1.70 | 0.48 | $p > 0.05$ |
| 3rd | 61.28 ± 1.74 | 59.54 ± 1.68 | 0.72 | $p > 0.05$ |
| 4th | 61.90 ± 1.71 | 59.72 ± 1.66 | 0.91 | $p > 0.05$ |
| $t_{1-4}$ ($p$) | 1.17 ($p > 0.05$) | 0.1 ($p > 0.05$) | | |
| SI, % | | | | |
| 1st | 58.55 ± 1.89 | 58.98 ± 1.92 | 0.16 | $p > 0.05$ |
| 2nd | 61.89 ± 1.84 | 59.14 ± 1.91 | 1.04 | $p > 0.05$ |
| 3rd | 63.22 ± 1.80 | 59.39 ± 1.86 | 1.48 | $p > 0.05$ |
| 4th | 65.07 ± 1.75 | 60.01 ± 1.82 | 2.01 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 2.53 ($p \leq 0.05$) | 0.39 ($p > 0.05$) | | |
| RI, c.u. | | | | |
| 1st | 88.20 ± 1.55 | 87.66 ± 1.69 | 0.24 | $p > 0.05$ |
| 2nd | 84.45 ± 1.49 | 86.56 ± 1.65 | 0.95 | $p > 0.05$ |
| 3rd | 81.12 ± 1.43 | 85.71 ± 1.61 | 2.13 | $p \leq 0.05$ |
| 4th | 79.82 ± 1.38 | 84.95 ± 1.57 | 2.45 | $p \leq 0.05$ |
| $t_{1-4}$ ($p$) | 4.04 ($p \leq 0.001$) | 1.17 ($p > 0.05$) | | |
| HRRTI, s | | | | |
| 1st | 127.1 ± 3.45 | 126.8 ± 3.58 | 0.06 | $p > 0.05$ |
| 2nd | 120.6 ± 3.41 | 121.6 ± 3.50 | 0.20 | $p > 0.05$ |
| 3rd | 109.1 ± 3.32 | 116.2 ± 2.43 | 1.49 | $p > 0.05$ |
| 4th | 98.7 ± 3.27 | 110.4 ± 3.36 | 2.50 | $p \leq 0.01$ |
| $t_{1-4}$ ($p$) | 5.97 ($p \leq 0.001$) | 3.34 ($p \leq 0.01$) | | |
| SHL, c.u. | | | | |
| 1st | 1.57 ± 0.56 | 1.65 ± 0.64 | 0.09 | $p > 0.05$ |
| 2nd | 2.43 ± 0.51 | 2.03 ± 0.61 | 0.51 | $p > 0.05$ |
| 3rd | 6.89 ± 0.49 | 3.41 ± 0.57 | 4.63 | $p \leq 0.001$ |
| 4th | 7.35 ± 0.47 | 5.07 ± 0.53 | 3.22 | $p \leq 0.01$ |
| $t_{1-4}$ ($p$) | 7.91 ($p \leq 0.001$) | 4.12 ($p \leq 0.001$) | | |

*Legend*: $n$ – number of cadets; Mean – arithmetic mean; $m$ – error of the arithmetic mean; $t$ – value of Student's $t$-test; $p$ – significance level of the differences; $t_{1-4}$ ($p$) – significance level of the differences between the indicators of cadets in the 1st and the 4th semesters

The analysis of VI indicators showed that during the research period, the cadets in the EG experienced a more pronounced improvement in respiratory system indicators (2.88 ml/kg, $p > 0.05$) compared to the CG (0.98 ml/kg, $p > 0.05$), however, no significant difference between the VI indicators in the EG and the CG was found in all semesters of training years ($p > 0.05$). The study of the SI shows that in the 4th semester, the strength indicators of the EG cadets were significantly better than those of the CG by 5.06 % ($p \leq 0.05$). During the 1st and 2nd training years, cadets in both groups showed improvement in the SI, but in the EG the change was 6.52 % and was significant ($p \leq 0.05$), while in the CG it was 1.03 % and the difference was not significant ($p > 0.05$). This indicates a more positive effect of CrossFit training sessions on the development of strength indicators and overall strengthening of the cadets' bodies than training according to the CWPASA. A pronounced effect of CrossFit training sessions was also found on the cardiovascular system indicators of junior training-year cadets. Thus, the RI indicators of cadets in the EG in the 3rd and 4th semesters are significantly better than those in the CG, by 4.59 c. u. ($p \leq 0.05$) and 5.13 c. u. ($p \leq 0.05$), respectively. At the same time, during the research period, there were significant positive changes in the RI indicators in the EG (8.38 c. u., $p \leq 0.001$). In contrast, in the CG, the changes were insignificant (2.71 c. u., $p > 0.05$). The results obtained are confirmed by indicators of recovery process duration in the bodies of cadets in the EG and the CG: HRRTI in the 4th semester EG cadets is significantly lower by 11.7 seconds than in the CG ($p \leq 0.01$).

The analysis of the SHL indicators showed that in the 3rd and 4th semesters, SHL indicators were significantly better in the EG than in the CG, by 3.48 points ($p \leq 0.001$) and 2.28 points ($p \leq 0.01$), respectively. During the research, the SHL improved significantly in both groups ($p \leq 0.001$), but the changes were more pronounced in the EG: the difference between the indicators of the 1st and 4th semesters was 5.78 points, and in the CG, 3.42 points. Moreover, at the end of the research, the SHL in the EG cadets was assessed as average, whereas in the CG it was assessed as below average. All this convincingly demonstrates the positive impact of CrossFit training sessions on the health indicators of junior training-year cadets during their academic training in a state of martial law.

**Discussion of research results**

According to scientists [16; 17], the essence of the CrossFit system lies in performing simple, accessible physical exercises to develop different muscle groups through high-intensity circuit training. The uniqueness and originality of CrossFit lie in the many variations of exercise combinations, mainly strength-oriented, and in the fact that each workout is significantly different from the previous one. As scientists point out [18], CrossFit is a training system characterized by high intensity and constant changes in exercises. CrossFit workouts include bodyweight, jumping, gymnastic equipment (if available), and weight-based exercises (kettlebells, dumbbells, barbell discs, medicine balls, sandbags, and other available equipment) [19; 20].

Scientists [21–23] note that CrossFit constantly goes beyond the boundaries of a particular sport or training regime, using different movements, changing the energy regimes that power muscle activity and, accordingly, the load on various body systems. One of the basic principles of training in the armies of the world's leading countries is regular daily exercise; this is precisely the method used by CrossFitters. Thus, specialists [24; 25] in CrossFit distinguish three types of loads: M – training of metabolic functions (cardio) – running, swimming, cycling, rowing, etc.; G – gymnastics, bodyweight exercises – pull-ups, push-ups, jumps, squats, lunges, etc.; W – free weight exercises, weightlifting, powerlifting, kettlebell lifting, etc. – barbell squats, barbell presses, kettlebell snatches, deadlifts, etc. In addition, a high level of development of the ability to differentiate movements in space, time, and muscle effort, the ability to relax muscles promptly, and the ability to maintain body balance during motor actions indicate the development of agility and coordination in individuals during CrossFit training sessions [26].

Scientists [27], studying the effect of CrossFit training sessions on the physical condition of people of different ages, genders, and professions, note that as a result of systematic CrossFit training, in addition to the development of basic physical qualities, the volume of the heart muscle gradually increases, the network of blood vessels expands; changes occur in blood composition (the number of red blood cells and hemoglobin increases); chest circumference and vital lung capacity increase; nervous system activity improves, and cognitive functions improve.

Scientists [28] list the following advantages of CrossFit training sessions for cadets during their training in dispersed conditions: the ability to train in a limited space and without proper conditions; the ability to train simultaneously with a large group of people; a wide range of simple and accessible exercises eliminates the possibility of adaptation to the same type of load; the ability to conduct training sessions simultaneously with cadets of different physical fitness levels and genders; the absence of monotony in training sessions; effectiveness in developing basic physical qualities, improving functional status, and strengthening health; the ability to comprehensively develop different muscle groups and reduce body weight; ensuring high density and intensity of training sessions; training sessions conducted to music contribute to the formation of motivation and interest of cadets in systematic physical exercise; formation of a basis for practicing any sport.

Taking into account the results of research by many scientists, as well as the combat experience of the Armed Forces of Ukraine, we have substantiated and developed a methodology for improving the physical condition and somatic health of junior training-year cadets through

CrossFit during their academic training under martial law. The main goal of CrossFit training sessions with junior training-year cadets using the developed methodology is to maintain and improve physical condition (development of strength and speed qualities, endurance, agility, flexibility), improving the functioning of the cardiovascular and respiratory systems, accelerating the body's adaptation to changes in load, strengthening health, and laying the foundation for improving the military-applied skills of cadets in their senior training years. The research results confirmed the conclusions of many scientists [4; 13; 17; 23–26; 29; 30] regarding the effectiveness of functional training using the CrossFit system in improving cadets' physical condition and somatic health during their junior training years under martial law.

**Prospects for further research**

It is planned to investigate the impact of strength sports (arm wrestling, powerlifting, kettlebell lifting) on the dynamics of cadets' psychosomatic health indicators during their academic training under martial law.

**Conclusions**

The influence of functional training using the CrossFit system on the physical condition and somatic health of junior training-year cadets during their academic training under martial law conditions has been studied. It was found that at the end of the research, the results of the EG cadets in all tests were significantly ($p \leq 0.05$) better than those of the CG: in the 100 m run, by 0.5 seconds, in pull-ups, by 2.1 times, in the 3 km run, by 29.1 seconds. Based on the results of assessing the somatic health indicators of cadets in the EG and the CG, it was found that most of the indices studied at the end of the research in the EG were significantly ($p < 0.05$–$0.001$) better than in the CG: the BMI – by 0.67 kg/m$^2$, the VI – by 2.18 ml/kg, the SI – by 5.06 %, the RI – by 5.13 c. u., the HRRTI – by 11.7 seconds, the SHL – by 2.28 points. CrossFit training had the most pronounced positive effect on the following indices: strength index, body mass index, Robinson index, and somatic health level. It was found that during the academic training period, all studied indicators of physical condition and somatic health showed a more pronounced and reliable ($p < 0.05$–$0.001$) improvement compared to the CG, which indicates the higher effectiveness of CrossFit training sessions in the junior training years under martial law conditions compared to the CWPASA.

The high level of physical condition and somatic health achieved during CrossFit training sessions during the junior training years will contribute to the faster development and improvement of military-applied motor skills and special qualities of cadets in the senior training years.

**Bibliography**

1. Prontenko KV, Okhrimenko IM, Yevdokimova OO, et al. Peculiarities of formation of cadets' psychological resilience and physical readiness for combat stress. Wiad Lek. 2023;76(6):1450–1456. DOI: 10.36740/WLek202306118

2. Volianiuk OD, Klymenko IV, Rivchachenko OA, et al. Peculiarities of psychophysical readiness formation in future law enforcement officers for their professional activities under martial law. Pol Merkur Lekarski. 2025;53(1):81–87. DOI: 10.36740/Merkur202501111

3. Nindl BC, Alvar BA, R Dudley J, et al. Executive Summary From the National Strength and Conditioning Association's Second Blue Ribbon Panel on Military Physical Readiness: Military Physical Performance Testing. J Strength Cond Res. 2015;29 Suppl 11:S216–S220. DOI: 10.1519/JSC.0000000000001037

4. Griban G, Kobernyk O, Terentieva N, et al. Formation of health and fitness competencies of students in the process of physical education. Sport Mont. 2020;19(3):73–78. DOI: 10.26773/smj.201008

5. Griban GP, Tymoshenko OV, Arefiev VG, et al. The role of physical education in improving the health status of students of special medical groups. Wiad Lek. 2020;73(3):534–540.

6. Prontenko KV, Chornous VD, Aleksandrov YV, et al. Mental cognitive processes and intellectual working capacity in cadets who were engaged in different types of physical activities. Wiad Lek. 2025;78(8):1462–1469. DOI: 10.36740/WLek/209498

7. Martenko YI, Malyshenko YL, Bushai IM, et al. Impact of stressors of academic activities under martial law on the cadets' mental health. Pol Merkur Lekarski. 2025;53(2):250–255. DOI: 10.36740/Merkur202502114

8. Deng N, Soh KG, Abdullah BB, et al. Effects of plyometric training on health-related physical fitness in untrained participants: a systematic review and meta-analysis. Sci Rep. 2024;14(1):11272. DOI: 10.1038/s41598-024-61905-7

9. Gibala MJ, Gagnon PJ, Nindl BC. Military applicability of interval training for health and performance. Journal of Strength and Conditioning Research. 2015;29(Suppl. 11):40–45. DOI: 10.1519/JSC.0000000000001119

10. Blacker SD, Horner FL, Brown PI, et al. Health, fitness, and responses to military training of officer cadets in a Gulf Cooperation Council country. Mil Med. 2011;176(12):1376–1381. DOI: 10.7205/MILMED-D-11-00166

11.Prontenko K, Bondarenko VV, Plisko VI, et al. Dynamics of indicators of cadets' daily motor activity in different training years. Pol Merkur Lekarski. 2024;52(4):433–438. DOI: 10.36740/Merkur202404108

12. Okhrimenko IM, Shtykh VA, Kostenko TM, Lukasevich II, Grebeniunk TM. Dynamics of future law enforcement officers' psychophysical state indicators in the course of their diverse training sessions on motor activity. Pol Merkur Lekarski. 2024;52(6):685–690. DOI: 10.36740/Merkur202406110

13. Poirier S, Trudeau F, Houle J. Leisure-Time Physical Activity and Motivation in Police Cadets: A Self-Determination Study. International Journal of Exercise Science. 2024;17(5):1504–1516. DOI: 10.70252/INVF3871

14. Ramos-Campo DJ, Benito-Peinado PJ, Andreu-Caravaca L, Rojo-Tirado MA, Rubio-Arias JÁ. Efficacy of Split Versus Full-Body Resistance Training on Strength and Muscle Growth: A Systematic Review With Meta-Analysis. J Strength Cond Res. 2024;38(7):1330–1340. DOI: 10.1519/JSC.0000000000004774

15. Prontenko KV, Griban GP, Aloshyna AI, et al. The physical development and functional state as the important components of the students' health. Wiad Lek. 2019;72(12 cz 1):2348–2353.

16. Schlegel P. CrossFit® Training Strategies from the Perspective of Concurrent Training: A Systematic Review. J Sports Sci Med. 2020;19(4):670–680.

17. Okhrimenko IM, Pasko OM, Prudka LM, et al. The influence of modern sports technologies on health and professional activity of law enforcement officers. Wiad Lek. 2021;74(6):1365–1371. DOI: 10.36740/WLek202106115

18. Claudino JG, Gabbett TJ, Bourgeois F, et al. CrossFit Overview: Systematic Review and Meta-analysis. Sports Med Open. 2018;4(1):11. DOI: 10.1186/s40798-018-0124-5

19. Prontenko K, Griban G, Prontenko V, et al. Health improvement of cadets from higher military educational institutions during kettlebell lifting activities. J Phys Educ Sport. 2018;18(1):298–303. DOI: 10.7752/jpes.2018.01040

20. Klimek C, Ashbeck C, Brook AJ, Durall C. Are Injuries More Common With CrossFit Training Than Other Forms of Exercise? J Sport Rehabil. 2018;27(3):295–299. DOI: 10.1123/jsr.2016-0040

21. Okhrimenko IM, Okhrimenko SS, Kharchenko AS, et al. Impact of motor activity on promotion of health and restoration of mental capacity of teaching staff. Wiad Lek. 2022;75(9 pt 1):2152–2156. doi:10.36740/WLek202209119

22. Mozolev O, Khmara M, Shorobura I, et al. Comparative Analysis of the Effectiveness of Polish and Ukrainian Basic Training Programs in Physical Education for 9-10-year-old Pupils. Universal Journal of Educational Research. 2019;7(11):2345–2351. DOI: 10.13189/ujer.2019.071112

23. Mangine GT, Seay TR. Quantifying CrossFit®: Potential solutions for monitoring multimodal workloads and identifying training targets. Front Sports Act Living. 2022;4:949429. DOI: 10.3389/fspor.2022.949429

24. Martinho DV, Rebelo A, Clemente FM, et al. Nutrition in CrossFit® − scientific evidence and practical perspectives: a systematic scoping review. J Int Soc Sports Nutr. 2025;22(1):2509674. DOI: 10.1080/15502783.2025.2509674

25. Meier N, Schlie J, Schmidt A. Physiological effects of regular CrossFit® training and the impact of the COVID-19 pandemic-A systematic review. Front Physiol. 2023;14:1146718. DOI: 10.3389/fphys.2023.1146718

26. Prontenko K, Okhrimenko IM, Cherednichenko SV, et al. Cadets' physical development and functional state during the different types of motor activity. Pol Merkur Lekarski. 2024;52(6):718–723. DOI: 10.36740/Merkur202406115

27. Kim DH, Cho YH, Seo TB. Correlation between physical efficiency index using Harvard step test and heart rate variation in college students. J Exerc Rehabil. 2022;18(6):389–394. DOI: 10.12965/jer.2244400.200

28. Okhrimenko IM, Hrebeniuk MO, Borovyk MO, et al. Sport classes as effective means for psychophysical health improvement of representatives of the security and defense sector. Wiad Lek. 2021;74(5):1142–1176. DOI: 10.36740/WLek202105118

29. Prontenko KV, Konstantynov DV, Tomenko OA, et al. The level of psychophysical development of cadets engaged in orienteering compared to representatives of other sports. Clinical and Preventive Medicine. 2024;8:153–162. DOI: 10.31612/2616-4868.8.2024.18

30. Okhrimenko IM, Martenko OL, Smirnova OM, et al. Motor activity as a means of overcoming stress in law enforcement officers during their professional activities under martial law. Clinical and Preventive Medicine. 2024;7:74–82. DOI: 10.31612/2616-4868.7.2024.09

**The purpose of the work** is to investigate the impact of functional training using the CrossFit system on the physical condition and somatic health of junior training-year cadets during their academic training under martial law.

**Materials and methods.** The research, conducted in 2023–2025, involved 67 male cadets in their first and second training years (aged 17–20) enrolled in 2023 at the Korolyov Zhytomyr Military Institute (Zhytomyr, Ukraine). At the beginning of the research (September 2023), two groups were formed from the first-year cadets: an experimental group (EG, $n = 33$) and a control group (CG, $n = 34$). During physical training sessions, the EG cadets followed the methodology we developed to improve their physical condition and somatic health through CrossFit. In contrast, the CG followed the current program on «Physical Education, Special Physical Training». The number of hours per week devoted to physical training sessions in the EG and the CG was the same and amounted to 4 hours (2 training sessions of 2 hours each). Research methods: analysis and generalization of literary sources, testing, medical and biological methods, statistical analysis. The physical condition of cadets was assessed using the following tests: a 100 m run, pull-ups, and a 3 km run. The somatic health of cadets was assessed using the method developed by G. L. Apanasenko.

**Results.** It was found that at the end of the research, the results of the EG cadets in all tests were significantly ($p \leq 0.05$) better than those of the CG: in the 100 m run, by 0.5 seconds, in pull-ups, by 2.1 times, in the 3 km run, by 29.1 seconds. Based on the results of assessing the somatic health indicators of cadets in the EG and the CG, it was found that most of the indices studied at the end of the research in the EG were significantly ($p < 0.05$–$0.001$) better than in the CG: the BMI – by 0.67 kg/m$^2$, the VI – by 2.18 ml/kg, the SI – by 5.06 %, the RI – by 5.13 c. u., the HRRTI – by 11.7 seconds, the SHL – by 2.28 points. CrossFit training had the most pronounced positive effect on the following indices: strength index, body mass index, Robinson index, and somatic health level.

**Conclusions.** The high level of physical condition and somatic health achieved during CrossFit training sessions during the junior training years will contribute to the faster development and improvement of military-applied motor skills and special qualities of cadets in the senior training years.

**Key words:** cadets, physical condition, somatic health, physical fitness, physical training, CrossFit, martial law.

**Мета роботи** – дослідити вплив функціональних тренувань за системою Кросфіт на рівень фізичного стану та соматичного здоров'я курсантів молодших курсів під час навчання в умовах воєнного стану.

**Матеріали та методи.** До дослідження, проведеного у 2023–2025 рр., було залучено 67 курсантів чоловічої статі I–II курсів (17–20 років) 2023 року набору Житомирського військового інституту імені С. П. Корольова (Житомир, Україна). На початку дослідження (вересень 2023 р.) із курсантів I курсу було сформовано дві групи: експериментальну (ЕГ, $n = 33$) та контрольну (КГ, $n = 34$). Формування груп здійснювалося рандомним способом і не передбачало спеціального відбору: до ЕГ увійшли курсанти-чоловіки першої та другої навчальних груп курсу, до КГ – третьої та четвертої груп. Рівень показників фізичного стану та соматичного здоров'я курсантів ЕГ і КГ на початку дослідження був достовірно однаковим ($p > 0.05$). Курсанти

ЕГ під час навчальних занять із фізичної підготовки займалися за розробленою нами методикою покращання фізичного стану та соматичного здоров'я курсантів засобами кросфіту, КГ – за чинною робочою програмою навчальної дисципліни «Фізичне виховання, спеціальна фізична підготовка». Кількість годин на навчальні заняття з фізичної підготовки на тиждень в ЕГ і КГ була однаковою і становила 4 год (2 заняття по 2 год). Основною відмінністю між ЕГ і КГ був зміст занять із фізичної підготовки. Критерії включення учасників: чоловіча стать курсантів; належність до певної навчальної групи; допуск до занять за станом здоров'я; критерії виключення: захворювання, яке не дає змоги отримувати фізичні навантаження. Усі курсанти ЕГ і КГ були поінформовані про мету дослідження, після чого вони надали письмову згоду на участь у дослідженні виключно в наукових інтересах. Рівень фізичного стану та соматичного здоров'я курсантів ЕГ та КГ оцінювався впродовж 1–4 семестрів навчання на I та II курсах. Методи дослідження: аналіз та узагальнення літературних джерел, тестування, медико-біологічні методи, статистичний аналіз. Тестування застосовувалося для оцінювання фізичного стану курсантів ЕГ і КГ за результатами виконання ними таких тестів: біг на 100 м (швидкісні якості), підтягування на перекладині (силові якості), біг на 3 км (витривалість). Перевірка вправ здійснювалася в однотипних умовах викладачами кафедри фізичного виховання. Медико-біологічні методи було застосовано для оцінювання соматичного здоров'я курсантів ЕГ та КГ. Для цього ми використали методику професора Г. Л. Апанасенка, що базується на показниках фізичного розвитку (зріст, маса тіла, життєва ємність легень, динамометрія кисті) та показниках функціонального стану кардіореспіраторної системи (ЧСС, артеріальний тиск). Рівень соматичного здоров'я (РСЗ) було розраховано за п'ятьма індексами: індекс маси тіла (ІМТ), життєвий індекс (ЖІ), силовий індекс (СІ), індекс Робінсона (ІР), індекс відновлення пульсу (ІВП). РСЗ курсантів визначався за сумою балів за кожен із п'яти індексів: 3 і менше балів – низький РСЗ; 4–6 балів – нижчий від середнього РСЗ; 7–11 балів – середній РСЗ; 12–15 балів – вищий від середнього РСЗ; 16–18 балів – високий РСЗ.

**Результати.** Досліджено вплив функціональних тренувань за системою Кросфіт на рівень фізичного стану та соматичного здоров'я курсантів молодших курсів під час навчання в умовах воєнного стану. Виявлено, що наприкінці дослідження результати курсантів ЕГ у всіх тестах є достовірно ($p \leq 0.05$) кращими, ніж у КГ: із бігу на 100 м – на 0,5 с, у підтягуванні на перекладині – на 2,1 рази, із бігу на 3 км – на 29,1 с. За результатами оцінювання показників соматичного здоров'я курсантів ЕГ і КГ виявлено, що більшість досліджуваних індексів наприкінці дослідження в ЕГ є достовірно ($p < 0,05–0,001$) кращими, ніж у КГ: ІМТ – на 0,67 кг/м$^2$, ЖІ – на 2.18 мл/кг, СІ – на 5,06 %, ІР – на 5,13 у.о., ІВП – на 11,7 с, РСЗ – на 2,28 бала. Найбільш виражений позитивний вплив заняття кросфітом мають на такі індекси: силовий, маси тіла, Робінсона та рівень соматичного здоров'я. Установлено, що за період дослідження усі досліджувані показники фізичного стану та соматичного здоров'я мають більш виражене достовірне ($p < 0,05–0,001$) покращання порівняно з КГ, що свідчить про вищу ефективність занять кросфітом на молодших курсах в умовах воєнного стану порівняно з чинною робочою програмою навчальної дисципліни.

**Висновки.** Високий рівень фізичного стану та соматичного здоров'я курсантів, досягнутий під час занять кросфітом на молодших курсах, сприятиме більш швидкому формуванню та вдосконаленню військово-прикладних рухових навичок та спеціальних якостей курсантів на старших курсах.

**Ключові слова:** курсанти, фізичний стан, соматичне здоров'я, фізичні якості, фізична підготовка, кросфіт, воєнний стан.

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