ORIGINAL ARTICLE

CONTENTS

Motor activity as a factor in improving the physical working capacity and somatic health of higher education applicants

Vladyslav A. Danylchenko[1], Roman M. Perkatyi[1], Valerii O. Kryzhanovskyi[2], Vadym L. Shvets[2], Andriy V. Nadutiy[3], Iryna I. Shaposhnikova[4], Yurii M. Korniichuk[1]

[1]NATIONAL ACADEMY OF INTERNAL AFFAIRS, KYIV, UKRAINE
[2]EDUCATIONAL AND SCIENTIFIC INSTITUTE FOR STATE SECURITY SUPPORT OF THE NATIONAL GUARD OF UKRAINE, KYIV, UKRAINE
[3]KHARKIV NATIONAL UNIVERSITY OF INTERNAL AFFAIRS, KHARKIV, UKRAINE
[4]KHARKIV STATE ACADEMY OF PHYSICAL CULTURE, KYIV, UKRAINE

ABSTRACT

Aim: To investigate the impact of motor activity volume on the physical working capacity and somatic health of higher education applicants.

Materials and Methods: The research included male cadets from the National Academy of Internal Affairs who were admitted in 2025 (n = 240). The participants were divided into two groups: SG 1 (n = 108) – cadets who regularly engaged in additional sports activities – and SG 2 (n = 132) – cadets who limited themselves to mandatory physical training sessions only. Methods: theoretical, empirical, and mathematical statistics. The Framingham method was used to assess motor activity and daily energy expenditure. The level of physical working capacity was assessed using the Harvard step test. The level of somatic health was determined using G. L. Apanasenko's rapid assessment method.

Results: It was found that cadets who engaged in additional sports activities had significantly ($p < 0.05$-0.001) better indicators of motor activity, physical working capacity, and somatic health compared to cadets who limited themselves to only mandatory physical training sessions: in SG 1, compared to SG 2, the motor activity index was 5.6 points higher, the Harvard step test index was 9.6 a. u. higher, and the somatic health level was 6.22 points higher.

Conclusions: It was found that motor activity is an important factor in the development of physical working capacity and somatic health among higher education applicants, and that regular participation in sports contributes to increased body functional reserves, improved recovery after physical exertion, and enhanced adaptive capabilities.

KEYWORDS: higher education applicants, cadets, motor activity, somatic health, physical working capacity

Wiad Lek. 2026;79(9):2201-2206. doi: 10.36740/WLek/237517 DOI

INTRODUCTION

In today's environment, maintaining and improving the health of higher education applicants has become particularly relevant. This is due to the intensity of the educational process, significant mental strain, prolonged use of digital technologies, a sedentary lifestyle, reduced daily physical activity, and high levels of stress and neuro-emotional tension experienced while studying under martial law [1, 2]. Insufficient motor activity leads to a decline in physical working capacity, the development of musculoskeletal, cardiovascular, and nervous system disorders, and an increased risk of chronic noncommunicable diseases [3, 4]. In this regard, it is crucial to study the motor activity of higher education cadets, as it is a key factor in ensuring adequate levels of somatic health, physical fitness, and working capacity.

The analysis of recent studies and publications indicates that the issue of motor activity among today's youth remains a relevant area of scientific research for many scholars [5, 6]. Researchers are convinced that adequate motor activity positively influences physical development, the body's functional state, psycho-emotional well-being, and quality of life among young people [7]. Regular physical exercise and sports help increase the functional reserves of the cardiovascular and respiratory systems, improve indicators of physical fitness and working capacity, and prevent obesity and other diseases associated with hypodynamia [8].

In the scientific literature, the term "motor activity" is defined as any movement of the human body resulting from the work of skeletal muscles and accompanied by additional energy expenditure [9]. Given the close

relationship between the volume of motor activity and the body's energy expenditure, assessing the motor activity patterns of higher education students is of great importance. It has been established that the educational activities of higher education students, except for physical education training sessions, are classified as Category I work in terms of energy expenditure [10].

In the works [11, 12], researchers focus significant attention on studying the characteristics of students' motor activity, ways to increase their motivation for physical education, and the implementation of modern health-promoting technologies in the educational process. At the same time, the results of many studies indicate a trend toward a decline in motor activity among higher education students, driven by increased time spent at the computer, distance learning, and an insufficiently developed need for systematic motor activity [4, 13].

Despite the significant number of scientific works on this topic, the issue of determining the role and volume of motor activity as a factor in maintaining and improving health and enhancing the physical working capacity of today's youth requires further scientific substantiation.

AIM

The aim is to investigate the impact of motor activity volume on the physical working capacity and somatic health of higher education applicants.

MATERIALS AND METHODS

PARTICIPANTS

The research included male cadets recruited in 2025 at the National Academy of Internal Affairs (Kyiv, Ukraine, NAIA) (aged 18-20, first-year cadets) majoring in "Law Enforcement" and "Law" (n = 240). Based on the volume of their motor activity, two groups were formed: SG 1 (n = 108) – cadets who regularly participated in additional sports activities throughout the academic year, and SG 2 (n = 132) – cadets who limited themselves to only mandatory physical training sessions twice a week and did not participate in other forms of regular motor or sports activities. Inclusion criteria: male cadets recruited in 2025, no health-related contraindications to physical exercise, and for SG 1 – attendance at the academy's sports clubs during extracurricular hours. Exclusion criteria: willingness to withdraw from the research on one's own initiative at any time; for SG 1, exclusion from a sports club. Research limitations: we examined the volume of motor activity among first-year cadets exclusively within the educational institution. The research was conducted at the end of the first academic year (May-June) 2026.

METHODS

To achieve the research aim, a set of modern general scientific methods was used, including: theoretical methods (conceptual-comparative analysis, structural-systemic analysis, synthesis, and generalization); empirical methods (questionnaires, pedagogical observation); and methods of mathematical statistics. To determine the level of motor activity among higher education cadets, the Framingham method was used, which involves recording activity types throughout the day [14]. All types of motor activity were recorded on a special form. Activity was recorded over seven days, and the average daily result was calculated. This method provides comprehensive information on the duration of specific activities and rest periods, the combination of physical activities of varying intensities, the total volume of motor activity, and the amount of energy expenditure. The level of motor activity is assessed using the motor activity index (MAI). According to the method, a person's motor activity is divided into five levels: baseline, sedentary, low, average, and high. Each level is characterized by specific types of motor activity and a corresponding energy value, enabling determination of the cadet's daily energy expenditure.

Physical working capacity was assessed using the Harvard step test [15]. The test involves measuring heart rate (HR) after a controlled physical exertion, thereby allowing evaluation of recovery processes. According to the protocol, cadets climbed a step of a fixed height (50 cm for men). The exercise duration was 5 minutes, with a cycle frequency of 30 steps per minute – climbing the step and returning to the starting position while alternating legs. That is, 120 steps per minute. Heart rate was recorded while seated during the first 30 seconds and at the 2^{nd}-4^{th} minutes of the recovery period. Test results were expressed as the Harvard step test index (HSTI), a value that indicates the rate of heart rate recovery following a standard physical exercise. Physical working capacity levels were determined based on the criteria specified in the diagnostic protocol, namely: low physical working capacity – HSTI < 55 a. u.; below average – 55-64 a. u.; average – 65-79 a. u.; good – 80-89 a. u.; excellent – 90 a. u. and above.

Somatic health level was determined using G. L. Apanasenko's rapid assessment method [16]. The method is based on anthropometric indicators and the subjects' cardiovascular condition. To assess the cadets' somatic health level (SHL), several parameters were examined:

body weight, body height, vital capacity (VC) of the lungs, handgrip strength of the dominant hand, resting heart rate, blood pressure, body mass index (BMI), vital index (VI), strength index (SI), Robinson index (RI), and Martine-Kushelevsky index (MKI). SHL was determined by the total score cadets received across the 5 indices. If the total score was less than 3 points, SHL was rated as low; 4-6 points – below average; 7-11 points – average; 12-15 – above average; 16-18 – high.

STATISTICAL METHODS

The methods of mathematical statistics were used to process the data obtained. The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as Mean ± m, where Mean is the arithmetic mean, m is the standard error. The reliability of the difference was set at $p<0.05$. All statistical analyses were performed using STATISTICA 6.1 software package (number AGAR909E-415822FA), adapted for medical and biological research.

ETHICS

The procedure for organizing the study and the topic of the article were previously agreed with the Committee on compliance with Academic Integrity and Ethics of the NAIA. Also this study followed the regulations of the World Medical Association Declaration of Helsinki. Informed consent was received from all participants who took part in this study.

AI STATEMENT

The author states that no AI tools were used in writing this article.

FRAMEWORK

This scientific article was carried out according to the plan of the research work of the National Academy of Internal Affairs for 2020-2026 "Psychological, pedagogical and sociological support of law enforcement officers» (state registration number 0113U008196).

RESULTS

The analysis of motor activity indicators revealed significant differences between the study groups ($p \leq 0.001$). The results processing showed that among SG 1 cadets, the average daily energy expenditure was 2775.8 ± 16.7 kcal (Table 1). At the same time, the motor activity index (MAI) was 35.90 ± 0.22 points, indicating a higher level of motor activity compared with participants in SG 2. For participants in SG 2, the average daily energy expenditure was recorded at 2,362.5 ± 20.1 kcal, and the MAI value was 30.30 ± 0.24 points. That is, the difference between the groups was more than 400 kcal per day, indicating significantly higher motor activity and greater physical exercise among participants who regularly engage in sports.

An important indicator of the body's functional fitness is the level of physical working capacity, which reflects the ability to perform muscular work of a certain intensity without a significant decrease in its efficiency. Assessment of physical working capacity using the Harvard step test index (HSTI) also revealed statistically significant differences between groups ($p \leq 0.001$). Among participants in SG 1, the mean HSTI score was 81.9 ± 1.02 a. u., which, according to the evaluation criteria, is characterized as a good level of physical working capacity. In contrast, for participants in SG 2, this indicator was 72.3 ± 1.28 a. u. and was assessed as an average level of physical working capacity.

The comparative analysis of the morphofunctional indicators of somatic health revealed that participants in SG 1 had superior results for most of the parameters studied. The body mass index, defined as the ratio of body mass to the square of body height, was 23.74 ± 0.10 kg/m^2 for participants in SG 1, whereas for SG 2 it was 23.21 ± 0.09 kg/m^2 ($p \leq 0.001$). Despite the statistically significant difference, the indicators for both groups fell within the average range.

The analysis of the vital index, calculated as the ratio of vital capacity of the lungs to body weight, revealed statistically significant differences between the study groups ($p \leq 0.001$) and indicated higher respiratory function in participants in SG 1. The value of this indicator was 62.22 ± 0.44 ml/kg, which corresponds to an above-average level, whereas in SG 2 it was 56.29 ± 0.49 ml/kg and was assessed as average.

A similar trend was observed for the strength index, which was defined as the ratio of the handgrip strength of the dominant hand to body weight. For participants in SG 1, the value was 72.08 ± 0.30 %, which is considered above average. In contrast, for individuals in SG 2, it was 65.44 ± 0.34 %, which is considered an average level ($p \leq 0.001$).

Indicators of the cardiovascular system's functional state also revealed significant differences between the groups. The Robinson index value for participants in SG 1 was 86.38 ± 0.41 a. u. and was classified as average, whereas in SG 2 it was 95.69 ± 0.44 a. u., which was considered below average ($p \leq 0.001$). The Martine-Kushelevsky index (MKI) for participants in SG 1 was recorded at 89.87 ± 1.33 s and was characterized as above average. For participants in SG 2, the value of

Table 1. Indicators of motor activity, physical working capacity, and somatic health among higher education cadets, SG 1 (n = 108), SG 2 (n = 132)

Indicators	Participants		Significance of the difference	
	SG 1 (n = 108)	SG 2 (n = 132)		
	Mean ± m	Mean ± m	t	p
Motor activity				
Daily energy expenditure, kcal	2775.8±16.7	2362.5±20.1	15.816	p≤0.001
Motor activity index (MAI), points	35.90±0.22	30.30±0.24	17.200	p≤0.001
Physical working capacity				
Harvard step test index, a. u.	81.9±1.02	72.3±1.28	5.865	p≤0.001
Somatic health				
Body mass index, kg/m^2	23.74±0.1	23.21±0.09	4.088	p≤0.001
Vital index, ml/kg	62.22±0.44	56.29±0.49	9.005	p≤0.001
Strength index, %	72.08±0.30	65.44±0.34	14.644	p≤0.001
Robinson index, a. u.	86.38±0.41	95.69±0.44	15.480	p≤0.001
Martine-Kushelevsky index, s	89.87±1.33	116.46±1.37	13.926	p≤0.001
Somatic health level, points	10.46±0.23	4.24±0.27	17.537	p≤0.001

Legend: Mean – arithmetic mean; m – standard error; t – Student's test value; p – level of significance of the differences between studied indicators
Source: compiled by the authors of this study

this indicator was 116.46 ± 1.37 s, which, according to the evaluation criteria, was classified as average.

The comprehensive assessment of somatic health level (SHL) revealed significant differences between the groups. For participants in SG 1, the SHL score was 10.46 ± 0.23 points, corresponding to an average level of physical health. In contrast, among participants in SG 2, the SHL was 4.24 ± 0.27 points, which was assessed as below average. The results indicate a more favorable morphofunctional state in participants with higher levels of motor activity.

DISCUSSION

According to the World Health Organization, one-third of all adults worldwide do not use their skeletal muscles enough, thereby increasing the risk of health problems and a shorter life expectancy, particularly obesity, which is the leading risk factor for overall mortality worldwide [17]. According to the study [18], 59.1 % of the population in Ukraine in 2020 was overweight, of whom 24.8 % were obese, and only 39.6 % had a normal body weight. As scientists note [19], human health is linked to high levels of motor activity; however, modern technological advancements, the mechanization of labor, and the availability of personal transportation have made our daily lives and living conditions easier but, unfortunately, have deprived our bodies of physical exertion and reduced our motor activity levels.

The results of our research confirmed a correlation among higher education cadets between motor activity, physical working capacity, and somatic health. It was found that regular exercise training sessions are associated with higher daily energy expenditure and motor activity index values. This contributes to increased functional capabilities and expanded adaptive reserves.

The data obtained regarding physical working capacity are consistent with current scientific understanding of the adaptive effects of systematic physical exercise on the cardiorespiratory system [20]. Higher HSTI values among participants in SG 1 indicate greater tolerance to physical exertion, more efficient functioning of energy-supply mechanisms, and faster recovery after work.

The observed differences in the vital and strength indices confirm the positive effect of regular motor activity on the functional capacity of the respiratory system and the development of muscle strength. At the same time, lower Robinson index values and faster heart rate recovery after exercise in participants in SG 1 indicate more efficient functioning of the cardiovascular system and a higher level of the body's adaptive reserves.

The results of the comprehensive assessment of somatic health deserve special attention. The difference between the groups on the SHL indicator indicates that insufficient motor activity is a factor contributing to a decline in the functional capabilities of today's youth. The data obtained confirm the advisability of involving higher education cadets in regular physical exercise and training sessions in sports clubs as an effective means of improving their health and physical working capacity.

CONCLUSIONS

Based on the research conducted, higher education cadets who regularly engage in sports exhibit significantly higher

levels of motor activity than their peers who limit themselves to mandatory physical training sessions ($p \leq 0.001$). It was found that the motor activity index in SG 1 was 35.90 ± 0.22 points, and in SG 2, 30.30 ± 0.24 points. The Harvard step test index in SG 1 reached 81.9 ± 1.02 a. u. (good level of physical working capacity), while in SG 2, it was 72.3 ± 1.28 a. u. (average level). A similar trend was observed for somatic health: 10.46 ± 0.23 points in SG 1 versus 4.24 ± 0.27 points in SG 2. Higher levels of motor activity are associated with better indicators of physical working capacity and somatic health. This is reflected in higher values of the vital and strength indices, more efficient cardiovascular system function, and faster recovery after physical exertion. The results confirm that motor activity is an important factor in shaping the physical working capacity and somatic health of higher education cadets, and that regular participation in sports contributes to expanding the body's functional reserves and improving its adaptive capabilities.

PROSPECTS FOR FURTHER RESEARCH

We see prospects for further research into the relationship between motor activity volume of varying intensities and indicators of psychological and physical well-being among higher education cadets.

REFERENCES

1. Rodríguez-Romo G, Acebes-Sánchez J, García-Merino S et al. Physical Activity and Mental Health in Undergraduate Students. Int J Environ Res Public Health. 2022;20(1):195. doi:10.3390/ijerph20010195. DOI
2. Rosales-Ricardo Y, Ferreira JP. Effects of Physical Exercise on Burnout Syndrome in University Students. MEDICC Rev. 2022;24(1):36-39. doi:10.37757/MR2022.V24.N1.7. DOI
3. Taylor CE, Scott EJ, Owen K. Physical activity, burnout and quality of life in medical students: A systematic review. Clin Teach. 2022;19(6):e13525. doi:10.1111/tct.13525. DOI
4. Huang K, Beckman EM, Ng N et al. Effectiveness of physical activity interventions on undergraduate students' mental health: systematic review and meta-analysis. Health Promot Int. 2024;39(3):daae054. doi:10.1093/heapro/daae054. DOI
5. Zhao X, Zhang Y. Degree of Myopia and Reduced Physical Activity in 3600 College Students in China. Med Sci Monit Basic Res. 2022;28:e934807. doi:10.12659/MSMBR.934807. DOI
6. Pfisterer J, Rausch C, Wohlfarth D et al. Effectiveness of Physical-Activity-Based Interventions Targeting Overweight and Obesity among University Students-A Systematic Review. Int J Environ Res Public Health. 2022;19(15):9427. doi:10.3390/ijerph19159427. DOI
7. Yang H, Fu C, Zhang X, Li W. Association between physical activity levels and anxiety or depression among college students in China during the COVID-19 pandemic: A meta-analysis. Medicine (Baltimore). 2023;102(49):e36524. doi:10.1097/MD.0000000000036524. DOI
8. Barroso CS, Chapman J, Garza P, Mantey DS. Physical activity and tobacco use among high school students in the United States, 2015-2021. Drug Alcohol Depend. 2024;265:112493. doi:10.1016/j.drugalcdep.2024.112493. DOI
9. Szabó L, Piko BF. Maintenance of Mental Health: The Role of Physical Activity Among Young Adults. Healthcare (Basel). 2025;13(22):2901. doi:10.3390/healthcare13222901. DOI
10. García-Pérez L, Padial-Ruz R, Cepero-González M, Ubago-Jiménez JL. Healthy Pills: A Physical Activity and Meditation Program to Enhance Mental Health and Well-Being in Spanish University Students. Behav Sci (Basel). 2025;15(4):549. doi:10.3390/bs15040549. DOI
11. García-Pérez L, Atencia-Rodriguez ME, Cepero-González M, Padial-Ruz R. Effectiveness of physical activity, mindfulness and mind-body therapies in improving mental health of university students: a systematic review of RCTS. J Am Coll Health. 2026;74(4):1085-1100. doi:10.1080/07448481.2025.2492174. DOI
12. Azzi DV, Melo J, Neto AAC et al. Quality of life, physical activity and burnout syndrome during online learning period in Brazilian university students during the COVID-19 pandemic: a cluster analysis. Psychol Health Med. 2022;27(2):466-480. doi:10.1080/13548506.2021.1944656. DOI
13. Raditya M, Sutarina N. Relationship between burnout and physical activity level among pre-clinical medical students. J Pak Med Assoc. 2021;71(2):S62-S68.
14. Mendoza A, Hidalgo S, Oviedo L. Cardiovascular Risk Factors Evaluated Using the Framingham Method in a University Community Setting. Biomedicines. 2025;13(5):1017. doi:10.3390/biomedicines13051017. DOI
15. Ragazzoni GL, Cavigli L, Boncompagni A et al. Cardiovascular responses to a 3-minute Harvard step test in Paediatric competitive athletes. Int J Cardiol. 2026;448:134097. doi:10.1016/j.ijcard.2025.134097. DOI
16. Rusanivskyi SV, Fedchenko OS, Kruk OM et al. Health status of instructional staff of higher education institutions with special training conditions. Wiad Lek. 2021;74(1):122-127.
17. Bull FC, Al-Ansari SS, Biddle S et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451-1462. doi:10.1136/bjsports-2020-102955. DOI

18. Dereń K, Wyszyńska J, Nyankovskyy S et al. Assessment of body mass index in a pediatric population aged 7-17 from Ukraine according to various international criteria-A cross-sectional study. PLoS One. 2020;15(12):e0244300. doi:10.1371/journal.pone.0244300. DOI
19. Wu Y, Van Gerven PWM, de Groot RHM et al. The Association between Academic Schedule and Physical Activity Behaviors in University Students. Int J Environ Res Public Health. 2023;20(2):1572. doi:10.3390/ijerph20021572. DOI
20. Kljajević V, Stanković M, Đorđević D et al. Physical Activity and Physical Fitness among University Students-A Systematic Review. Int J Environ Res Public Health. 2021;19(1):158. doi:10.3390/ijerph19010158. DOI DOI

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Vladyslav A. Danylchenko
National Academy of Internal Affairs
1 Solomyanska Square, 03035 Kyiv, Ukraine
e-mail: 54984@ukr.net

ORCID AND CONTRIBUTIONSHIP

Vladyslav A. Danylchenko: 0000-0003-4828-1481 A
Roman M. Perkatyi: 0000-0003-1512-7664 B D
Valerii O. Kryzhanovskyi: 0000-0003-4044-8582 B
Vadym L. Shvets: 0000-0003-0083-7495 B D
Andriy V. Nadutiy: 0000-0002-0272-3005 C
Iryna I. Shaposhnikova: 0000-0003-1020-6486 E
Yurii M. Korniichuk: 0000-0002-7058-3534 F

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

RECEIVED: 18.03.2026
ACCEPTED: 29.08.2026

CREATIVE COMMONS 4.0