

Dynamics of indicators of cadets' daily motor activity in different training years

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ABSTRACT

Aim: The aim is to investigate the dynamics of indicators of daily motor activity of cadets of higher educational institutions with specific learning environment in different training years.

Materials and Methods: The research involved 226 cadets of the National Academy of Internal Affairs in the first (n = 62), second (n = 56), third (n = 60), and fourth (n = 48) training years. We used the Framingham method which involves the calculation of the motor activity index to determine the daily time spent on cadets' motor activity and their daily energy expenditure.

Results: The dynamics of motor activity indicators of cadets in different training years have been studied. The best index were found in the third-year cadets (34.12 ± 0.49 points and 2643.9 ± 36.6 kcal), and the worst – in the first (32.68 ± 0.43 points and 2537 ± 33.9 kcal) and fourth (32.85 ± 0.41 points and 2550.9 ± 31.3 kcal). At the same time, a significant difference between the indicators of motor activity per day was found only in the first- and third-year cadets ($p < 0.05$). In general, the level of daily motor activity of the first- and fourth-year cadets is assessed as insufficient (inadequate), and of the second- and third-year cadets – as proper.

Conclusions: The results obtained indicate the need to increase the daily level of motor activity of cadets by involving them in sporting and mass participation events and extracurricular physical exercises and increasing the intensity of physical training sessions.

KEY WORDS: motor activity, daily energy expenditure, cadets, healthy lifestyle

Pol Merkur Lek, 2024;53(4):433-438. doi: 10.36740/Merkur202404108

INTRODUCTION

The health of today's youth is the most important prerequisite for their comprehensive and harmonious development, successful education, active life, personal well-being, and a reliable guarantee of the country's future development [1].

Scientific research shows that the physical health of a human being is determined by conditions and lifestyle by more than 50 % [2]. The concept of a "healthy lifestyle" covers various components related to all areas of health: a rationally organized daily routine, compliance with personal hygiene rules, rational work and rest, balanced nutrition and food hygiene, optimal movement, proper breathing, appropriate sleep, cold water treatment, absence and eradication of bad habits, mastery of basic methods of self-monitoring of health, etc. [3]. Movement is the main physiological condition for maintaining and improving health. Rationally organized motor activity has a positive

effect on the overall level of well-being, prevention of non-communicable diseases, reduction of the impact of bad habits on the body, and the number of antisocial manifestations and depressions [4]. A prolonged decrease in motor activity results in persistent disorders that gradually become irreversible and cause various diseases, including hypertension, atherosclerosis, coronary heart disease, posture disorders with damage to the musculoskeletal system, etc.[5].

The problem of decreased motor activity is especially acute for students and cadets, as intensified learning activities and the introduction of distance learning are mostly accompanied by a decrease in physical effort, which, in combination with other unfavorable factors, significantly worsen the health of future professionals [6].

The analysis of recent research and publications gives grounds to state that there is a significant number of scientific works devoted to the study of the dynamics of youth motor

activity; the development of the latest teaching methods that help to increase the motivation of students to exercise, etc. [7, 8]. The concept of “motor activity” is interpreted as any movement of the human body, which is carried out due to the work of skeletal muscles and is accompanied by additional energy expenditure [9]. In the specialized literature, educational activity is equated with the labor of the first category, provided that physical training sessions are not taken into account. Scientists claim that the daily energy expenditure of representatives of this category is on average 2200–2400 kcal. At the same time, 2600–3000 kcal is considered to be the optimal limit that ensures the proper vital activity of boys aged 17–20, and 2200–2400 kcal for girls [10]. Therefore, the need to study and analyze the levels of motor activity of cadets of higher educational institutions with specific learning environment in different training years to find promising areas for improving their health and physical fitness foregrounds the chosen area of scientific research.

AIM

The aim is to investigate the dynamics of indicators of daily motor activity of cadets of higher educational institutions with specific learning environment in different training years.

MATERIALS AND METHODS

The research involved 226 male cadets of the National Academy of Internal Affairs (NAIA, Kyiv, Ukraine) in the first (recruited in 2022, $n = 62$), second (recruited in 2021, $n = 56$), third (recruited in 2020, $n = 60$) and fourth training years (recruited in 2019, $n = 48$); specialty 081 “Law” (age 17–21).

Research methods: analysis of literature, Framingham method, methods of mathematical statistics. The analysis of literature was used to investigate the current state of the problem under study, systematize and generalize information obtained as a result of the research. 15 sources from the scientometric databases PubMed, Scopus, Web of Science Core Collection and others were analyzed.

We used the Framingham method which is based on the registration of activities during the day to determine the amount of cadets’ daily motor activity and their daily energy expenditure. This method provides complete information on the duration of a particular type of activity and rest, the combination of physical activity of different intensities, the total duration of different types of activities, and the amount of energy expenditure. The numerical value is represented as a motor activity index (MAI).

According to this method, human motor activity is divided into five levels: basic (BL); sedentary (SL); low (LL); average (AL); and high (HL). Each level is characterized by certain types of physical activity and, accordingly, has an energy value depending on the kcal expended, which makes it possible to calculate the daily energy expenditure of each cadet. The basic level involves the following activities: sleeping, lying luxation awake; sedentary level – traveling in transport, reading, browsing social media, playing computer games, eating, etc.; low level – personal hygiene, studying

(except for physical training), walking (to study, to a public transport stop, etc.); average level – morning gymnastics, household chores, going for a walk, low- and medium-intensity mass sports (except for physical training); high level – participation in specially organized sports (physical training sessions, self-training, etc.), active recreation (intense games, running, cycling, etc.).

According to the Framingham method, to determine the amount of time spent on each type of motor activity, each cadet performed daily timekeeping of activities that lasted more than 5 minutes. All types of motor activity were recorded in the Motor Activity Record Card (Appendix 1). There should be no gaps in the description. The day from the moment the cadet woke up after a night’s sleep to the time he fell asleep is described.

To determine the cadets’ MAI, it is necessary to multiply the time (in hours) spent on each type of motor activity by the table weighting factor [10]: for the basic level of motor activity, the coefficient is 1.0; for sedentary – 1.1; low – 1.5; average – 2.4; high – 5.0. The sum of MAI indicators at all levels corresponds to the daily motor activity index of cadets. The calculation of indicators of daily energy expenditure of cadets involved the use of appropriate table coefficients determined for each type of motor activity. It is believed that during the basic level of motor activity, a person consumes an average of 1.25 kcal per minute, sedentary – 1.4; low – 2.05; average – 3; high – 6.25 kcal per minute [10]. The sum of energy expenditures at each level will be the daily energy expenditure.

The methods of mathematical statistics were applied to correctly process the data and identify the difference between the indicators under study. The authenticity of the difference between the cadets’ indicators was determined by means of Student’s *t*-test. The statistical significance for all statistical tests was set at $p < 0.05$. All statistical analyses were performed with the SPSS software, version 21, adapted to medical and biological researches.

This study followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. The procedure for organizing this study was previously agreed with the committee on compliance with Academic Integrity and Ethics of the NAIA. The topic of the study was approved by the Academic Council of the NAIA (Protocol No. 7 dated 06.02.2023). Informed consent was received from all cadets who took part in this study.

RESULTS

The results of the study of the dynamics of indicators of daily motor activity of cadets in different training years are given in Table 1. The processing of the obtained results shows that the first-year cadets spent 626.5 ± 20.4 minutes during the day on the basic level of motor activity (sleep, lying luxation awake). Daily energy expenditures at this level amounted to 783.1 ± 25.5 kcal, and the MAI – 10.44 ± 0.34 points. The second-year cadets spent 608.2 ± 20.1 minutes for the basic level of motor activity, which is 18.3 minutes less than the first-year cadets and 29.4 minutes more than

the third-year cadets. In the third training year, the basic level of motor activity lasted 578.8 ± 12.1 minutes, at that daily energy expenditures were 723.50 ± 15.2 kcal, the MAI – 9.65 ± 0.20 points. The fourth-year cadets revealed a somewhat higher basic level of motor activity than the third-year cadets, it was 615.2 ± 19.2 minutes with daily energy expenditure of 769.0 ± 24.0 kcal, the MAI – 10.25 ± 0.32 points. The analysis of the study results showed that cadets of all training years spent an average of 470 minutes sleeping, and the rest of the time was spent lying luxation awake (browsing social networks, watching movies, playing computer games, etc.).

The sedentary level of motor activity, which includes traveling in transport, reading, browsing social networks, computer games, and eating, covers 240.6 ± 17.8 minutes for the first-year cadets, while daily energy expenditure at this level is 336.9 ± 24.9 kcal, and the MAI is 4.41 ± 0.33 points. In the second training year cadets spent on average 246.1 ± 18.9 minutes for sedentary motor activity, in the third year – 253.9 ± 17.5 minutes, in the fourth-year cadets this indicator reached 239.2 ± 18.1 minutes. Daily energy expenditures of freshmen were in the range of 336.9 ± 24.9 kcal, sophomores – 344.5 ± 26.5 kcal, third-year cadets – 355.5 ± 24.4 kcal and 334.8 ± 25.3 kcal, respectively, in

the fourth-year cadets. The MAI at this level in the first-year cadets was 4.41 ± 0.33 points, in the second-year – 4.51 ± 0.35 , in the third-year – 4.65 ± 0.32 , in the fourth year – 4.38 ± 0.33 points. The main share of sedentary motor activity was: preparation for training sessions – 105 minutes; eating – 53 minutes; watching social networks, and videos, working at the computer – 50 minutes, traveling in transport – 40 minutes.

The amount of low-level motor activity among cadets did not differ significantly. In particular, the first-year cadets accounted for an average of 455.6 ± 19.5 minutes, the second – 460.3 ± 21.7 minutes, the third – 449.1 ± 21.6 minutes, and the fourth – 465.8 ± 19.5 minutes. This amount is due to the specifics of educational activities, as this level includes training sessions (except for physical training), walking (to training sessions, to a public transport stop, etc.), and personal hygiene. Accordingly, the MAI is also the highest. In the first-year cadets it was 11.39 ± 0.49 points, daily energy expenditure – 934.0 ± 40.0 kcal. In the second year cadets – 11.51 ± 0.54 points, daily energy expenditure – 943.7 ± 44.5 kcal; the third year – 11.23 ± 0.53 points, daily energy expenditure – 925.9 ± 44.2 kcal, the fourth year – 11.64 ± 0.50 points and 954.8 ± 40.1 kcal, respectively. Processing of the obtained results shows that

Table 1. Dynamics of indicators of cadets' daily motor activity in different training years ($X \pm m$, $n=226$)

Training year	Levels of motor activity					Sum
	Basic	Sedentary	Low	Average	High	
Daily time spent on motor activity, min						
First (n = 62)	626.5±20.4	240.6±17,8	455.6±19.5	76.9±8.2	40.4±6.4	1440
Second (n = 56)	608.2±20.1	246.1±18.9	460.3±21.7	80.4±8.7	45.0±6.9	1440
Third (n = 60)	578.8±12.1	253.9±17.5	449.1±21.6	106.0±10.7	52.2±6.6	1440
Fourth (n = 48)	615.2±19.2	239.2±18.1	465.8±19.5	79.0±7.8	40.8±5.9	1440
Daily energy consumption of cadets, kcal						
First (n = 62)	783.1±25.5	336.9±24.9	934.0±40.0	230.8±24.5	252.2±39.9	2537.4±33.9
Second (n = 56)	760.3±25.2	344.5±26.5	943.7±44.5	241.2±26.0	281.3±39.8	2571.3±32.6
Third (n = 60)	723.5±15.2	355.5±24.4	925.9±44.2	317.9±31.9	326.3±41.4	2643.9±36.6
Fourth (n = 48)	769.0±24.0	334.8±25.3	954.8±40.1	237.1±23.3	255.2±37.1	2550.9±31.3
Motor activity index, points						
First (n = 62)	10.44±0.34	4.41±0.33	11.39±0.49	3.08±0.33	3.36±0.53	32.68±0.43
Second (n = 56)	10.10±0.34	4.51±0.35	11.51±0.54	3.22±0.30	3.75±0.52	33.09±0.44
Third (n = 60)	9.65±0.20	4.65±0.32	11.23±0.53	4.24±0.43	4.35±0.55	34.12±0.49
Fourth (n = 48)	10,25±0.32	4.38±0.33	11.64±0.50	3.16±0.31	3.40±0.49	32.85±0.41
Reliability of the difference between the motor activity index per day						
p1–p2	p>0.05					
p1–p3	p<0.05					
p1–p4	p>0.05					
p2–p3	p>0.05					
p2–p4	p>0.05					
p3–p4	p>0.05					

Legend: X – arithmetic mean; m – standard deviation, p – reliability of the difference between the cadets' indicators of the motor activity index per day.

among the main types of motor activity of this level, the largest percentage is accounted for by training sessions – 295 minutes; walking – 65 minutes; hygienic procedures – 55 minutes; 40 minutes – other types of motor activity, which belong to the low level of energy expenditure (moving around the dormitory, lining up, etc.).

Much less time was recorded for average-level motor activity (morning exercises, household chores, going for a walk, and low- and medium-intensity mass sports). The largest amount of the average level of motor activity was recorded in the third-year cadets – 106.0 ± 10.7 minutes, which is 29.1 minutes more than in the first-year cadets (76.9 ± 8.2 minutes). In the second-year cadets, the studied indicator was 80.4 ± 8.7 minutes, and in the fourth year – 79.0 ± 7.8 minutes. Taking into account the amount of time spent on motor activity of this level it was found that the MAI in the first-year cadets reached 3.08 ± 0.33 points, daily energy expenditure – 230.8 ± 24.5 kcal; in the second-year cadets – 3.22 ± 0.30 points, daily energy expenditure – 241.2 ± 26.0 kcal and 4.24 ± 0.43 points and 317.9 ± 31.9 kcal in the third-year cadets, respectively. For the fourth-year cadets, these indicators were 3.16 ± 0.31 points and 237.1 ± 23.3 kcal, respectively. Among the list of activities that belong to this level, the largest proportion was occupied by low-intensity mass sports, walks, etc.

A high level of motor activity involves participation in specially organized physical exercises, and active recreation (intensive games, running, training in the gym, on gymnastic grounds, cycling, etc.). The largest amount of high-level motor activity was recorded in the third-year cadets – 52.2 ± 6.6 minutes, with the MAI of 4.35 ± 0.55 points, and daily energy expenditure – 326.3 ± 41.4 kcal. The volume of high-level motor activity reached 40.4 ± 6.4 minutes in the first-year cadets. The MAI at such volume of motor activity was 3.36 ± 0.53 points, and daily energy expenditures were 252.2 ± 39.9 kcal, respectively. In the second-year cadets, the high level of motor activity accounted for 45.0 ± 6.9 minutes on average, the MAI was 3.75 ± 0.52 points, and daily energy expenditure – 281.3 ± 39.8 kcal. The fourth-year cadets spent an average of 40.8 ± 5.9 minutes for this level of motor activity, with the MAI of 3.40 ± 0.49 points and daily energy expenditure of 255.2 ± 37.1 kcal.

In general, the highest indicator of the MAI and daily energy expenditure was recorded in the third-year cadets – 34.12 ± 0.49 points and 2643.9 ± 36.6 kcal, respectively. In the first-year cadets, the studied indicators are 32.68 ± 0.43 points and 2537.4 ± 33.9 kcal. The MAI in the second-year cadets is 0.41 points higher than in the first-year cadets and amounts to 33.09 ± 0.44 points, while daily energy expenditure reaches 2571.3 ± 32.6 kcal. The fourth-year cadets' MAI is 32.85 ± 0.41 points, and daily energy expenditure is 2550.9 ± 31.3 kcal. The mathematical processing of the obtained data shows a significant difference in the studied indicators only in the first- and third-year cadets ($p < 0.05$), with no significant difference ($p > 0.05$) between other training years.

Taking into account the results of scientific studies of other researchers and the developed norms of daily energy expenditure, we estimate the indicators of the amount

of daily motor activity of the first- and fourth-year cadets as insufficient (inadequate), and of the second- and the third-year cadets as appropriate.

DISCUSSION

Scientists [11] argue that the needs of the human body in motor activity are always individual and depend on several physiological, socio-economic, and cultural factors and are largely determined by hereditary and genetic characteristics. Scientists [12] have also proven that physical activity with various emotional components has a positive effect on the psyche of young people, which generally improves their academic performance. Rational, systematic physical activity experienced by cadets during academic and independent physical training sessions also has a positive effect on the functional state of the body, its systems, and the musculoskeletal system, in particular, it improves posture, and joint function, and promotes their health in general.

Modern scientific studies show that modern students spend 80 % of their time sitting, and as a result, some organs and systems lose their ability to function properly [13]. Researchers identify two main reasons for the decrease in motor activity, including domestic (getting used to a sedentary lifestyle, reduced motor initiative, household comfort, dismissive attitude to physical fitness) and educational (irrational organization of the educational process, overloading with training sessions, ignoring physical education, lack of free time) [14].

The impact of exercise on the human body is determined by several factors, among which the intensity of exercise is the key one. According to the research of physical culture and sports specialists [15], the amount of physical exercise should be 12-15 hours per week. Given these data, the amount of motor activity of cadets aged 17-21 years determined in our research is insufficient for their full physical development. This issue is especially acute for the fourth-year cadets, since there is an improvement in the indicators of daily motor activity of cadets by the third training year, and in the fourth training year – their deterioration. Such dynamics of motor activity indicators are due to the increase in the intensity of physical training sessions (namely, the share of general physical training) by the third year and the increase in the amount of practical training in various academic subject areas of future law enforcement officers. The decrease in the level of motor activity and daily energy expenditure in the fourth-year cadets is due to an increase in the amount of special physical training, cadets' internships in practical units as investigators, and writing of diploma theses and preparation for graduation.

The obtained results confirm the conclusions of many scientists and extend them, in particular in the direction of a rational combination of mental and physical labor during the educational activities of cadets; the need to introduce physical exercises as part of extracurricular activities and increase the level of motivation for them and a conscious attitude to maintaining their physical health at the proper level.

CONCLUSIONS

The dynamics of indicators of motor activity of cadets of different training years have been studied including daily time spent on motor activity, daily energy expenditure, and motor activity index. It has been established that the index of motor activity of the first-year cadets is 32.68 ± 0.43 points, the second – 33.09 ± 0.44 points, the third – 34.12 ± 0.49 points, the fourth – 32.85 ± 0.41 points. The daily energy expenditures of the cadets amounted to 2537.4 ± 33.9 , 2571.3 ± 32.6 , 2643.9 ± 36.6 , and 2550.9 ± 31.3 kcal, respectively. The best motor activity index and the highest daily energy expenditure were found in the third-year cadets, and the worst – in the first- and fourth training years. At the same time, a significant difference between the indicators of the motor activity index per day was found

only in the first- and third-year cadets ($p < 0.05$). In general, the level of daily motor activity of cadets of all first and fourth training years is assessed as insufficient (inadequate), and of the second and third years – as appropriate.

It has been found that the proper (sufficient) level of cadets' motor activity is a key factor in their health, academic performance, and efficiency of life-sustaining activities. The results obtained indicate the need to increase the daily level of motor activity of cadets (especially the first- and fourth-year cadets) by involving them in sporting and mass participation events and extracurricular physical exercises and increasing the intensity of physical training sessions.

Prospects for further research are to study the motor activity and daily energy expenditure of cadets of higher military educational institutions.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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RECEIVED: 04.08.2023

ACCEPTED: 24.04.2024

