

Health-improving effect of running for students of technical specialties

Yurii V. Novytskyi, Zoia V. Syrovatko, Tetiana H. Kozlova, Anna Yu. Chekhovska, Oleksandr Ye. Salamakha, Vadym M. Mykhailenko, Oksana M. Chychenova

NATIONAL TECHNICAL UNIVERSITY OF UKRAINE "IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE", KYIV, UKRAINE

ABSTRACT


Aim: To study the dynamics of indicators of the functional state and health of technical specialties students during their long-term running engagement.

Materials and Methods: The research involved 112 students (59 men and 53 women) aged 17–20 years. Two groups of students were formed: group 1 included students who, in addition to compulsory academic physical education training sessions, were not engaged in any type of motor activity on their own; group 2 included students who independently were engaged in recreational running 3 times a week in extracurricular time.

Results: It was found that during the research period, both male and female students who were independently engaged in recreational running in extracurricular time showed a significant improvement of such indicators as resting heart rate, vital capacity of the lungs, duration of breath holding during inhalation and exhalation, duration of heart rate recovery after standard exercise, level of endurance development, level of physical health.

Conclusions: The positive influence of independent running with moderate intensity on the functional state and health of students of technical specialties has been proved. The low efficiency of the physical education system in Ukraine and, accordingly, the insufficient level of motor activity, indicators of functional status, and health of students who, in addition to academic physical education training sessions, did not exercise on their own, were also confirmed.

KEY WORDS: health, functional state and, motor activity, running, students

Wiad Lek. 2024;77(6):1198-1204. doi: 10.36740/WLek202406113 

INTRODUCTION

Human life and health are the highest social values, which should be considered in determining all other values and benefits. The creation of conditions by the state for the realization of the citizen's right to health care contributes to the progressive socio-economic development of the state and strengthens its security [1, 2].

The existing system of higher educational institutions (HEIs) in Ukraine places high demands on students' mental and physical working capacity and health. High academic loads and low motor activity, irrational diet and bad habits, stressful situations, and unsatisfactory organization of physical education in Ukrainian HEIs hurt students' health [3, 4].

A significant number of scientists [5, 6] argue that the main problem of the constant deterioration of the health of Ukrainian students is the lack of daily motor activities. That is, the chronic deficiency of motor activities in the lifestyle of modern students is a real threat to their health. At the same time, according to experts [7, 8], the solution to this problem is possible by including aerobic exercises of moderate intensity in both academic physical education training sessions

at HEIs and independent physical exercises in extracurricular time.

Studies by many scientists [9, 10] have shown that regular use of aerobic exercise promotes the effective development of endurance while having a positive effect on the cardiorespiratory system and the emotional state of students. From a physiological point of view, endurance is characterized as the ability to perform work for a long time at the required level of intensity, as well as the ability to fight fatigue [11]. Endurance allows you to perform work for a long time, which places high demands on the cardiovascular system, respiratory system, and central nervous system [12]. The research by experts [13] confirms the fact that when a certain level of endurance development is reached, changes occur at the functional level in the body, primarily in the main life support systems (cardiovascular, and respiratory). The development of endurance allows to effectively form reserves of adaptation of the body and ensure their high working capacity, to form perfect mechanisms of regulation of vascular tone in conditions of nervous and emotional stress and thus to ensure prevention of cardiovascular diseases. It is believed that aerobic exer-

cises performed for a long time (10-30 minutes) help to strengthen the cardiovascular and respiratory systems; because oxygen, glycogen, and fat are processed into energy [14].

According to many scientists [15, 16], recreational running is a universal means of increasing students' motor activities. More than 100 million people of all ages on our planet use running as a health-improving means [17]. The authors point to positive changes in health through running, namely: increasing the body's resistance to adverse environmental factors, normalizing body weight, strengthening the musculoskeletal system, and increasing endurance [18]. The literature [19] considers two directions in terms of the effectiveness of running on the human body: general and special. The general effect of running is associated with changes in the functional state of the central nervous system, compensation for missing energy expenditure, functional shifts in the circulatory system (increased oxygen capacity of the blood, its protective functions), reduced morbidity (increased immunity), normalization of body weight, strengthening the body's resistance to adverse environmental factors. Many scientists emphasize the increase in creative activity and the fruitfulness of scientific research through recreational running. A special effect of running training engagement is to increase the functional capabilities of the cardiovascular system and aerobic performance (working capacity) of the body. Given the above, it is important to study the impact of running on the functional state and health of student youth in Ukraine.

AIM

The aim is to study the dynamics of indicators of the functional state and health of technical specialties students during their long-term running engagement.

MATERIALS AND METHODS

The research involved 112 students (59 men and 53 women) of the main division aged 17-20 years who entered the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Kyiv, Ukraine) in 2022 at the Faculty of Radio Engineering, Faculty of Chemical Engineering and Faculty of Electric Power Engineering and Automatics. The research was conducted during 2022-2024. Two groups of students were formed: group 1 included students who, in addition to compulsory academic physical education training sessions at the HEI, were not engaged in any type of motor activity on their own (31 males, 29 females); group 2 included students who independently were

engaged in recreational running 3 times a week in extracurricular time (28 males, 24 females). All students in group 2 did not belong to sports clubs; the main motivations for independent running were: getting joy and pleasure, promoting health, spending extra calories, and emotional release. The volume of running load was from 2 to 7 km, the pace was slow, and the intensity was moderate (heart rate did not exceed 150 beats per minute). Groups 1 and 2 were formed at the beginning of the academic year (September 2022) at the student's request after an introductory briefing by the instructors of the Department of Health and Sports Technologies.

The methods of investigation: analysis and generalization of the scientific and methodological literature, testing, methods of mathematical statistics. 26 sources on the topic of the article from the scientometric databases PubMed, Scopus, Web of Science Core Collection and others were analyzed. The testing involved determining the following indicators of students' functional state and health: resting heart rate (RHR), blood pressure (systolic and diastolic), vital capacity of the lungs (VC), timed inspiratory (Stange test) and expiratory (Genchi test) capacity, duration of heart rate recovery after standard exercise (Martine-Kushelevsky test), 1 km run (level of endurance development), level of physical health (methodology of H. L. Apanasenko). Testing was conducted at the beginning (September 2022) and at the end (May 2024) of the research.

Statistical processing of the obtained results was carried out by methods of variation statistics using the STATISTICA 6.1 software package (number AGAR909E-415822FA). The compliance of the data distribution with the normal law (Gauss' law) was assessed using the Shapiro-Wilk *W*-test. The results were presented as $(M \pm m)$, where *M* is the arithmetic mean, *m* is the error of the arithmetic mean. The authenticity of the difference between the indicators of students of studied groups was determined by Student's *t*-test. The level of statistical significance of the research results was chosen as $p < 0.05$.

This study complies with the ethical standards of the Act of Ukraine "On Higher Education" No. 1556-VII dated 01.07.2014 and the Letter from the Ministry of Education and Science of Ukraine "On the Academic Plagiarism Prevention" No. 1/11-8681 dated 15.08.2018. Also, this study followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. Informed consent was received from all individuals who took part in this research.

Table 1. Dynamics of the functional state and health indicators of male students in groups 1 and 2 during the research (n=59, M±m)

Studied indicators	Stages	Group 1 (n=31)	Group 2 (n=28)	Significance of the differences
RHR, bpm	Beginning	69.9±0.76	70.1±0.85	t=0.18; P>0.05
	End	71.2±0.81	68.7±0.79	t=2.21; P<0.05
Systolic blood pressure, mm Hg	Beginning	119.7±0.58	119.9±0.67	t=0.23; P>0.05
	End	120.5±0.62	118.8±0.65	t=1.89; P>0.05
Diastolic blood pressure, mm Hg	Beginning	72.1±0.69	72.8±0.77	t=0.68; P>0.05
	End	72.9±0.71	71.1±0.74	t=1.76; P>0.05
VC, ml	Beginning	3896.3±65.04	3912.9±78.92	t=0.16; P>0.05
	End	4067.6±67.18	4308.1±73.70	t=2.41; P<0.05
Stange test, s	Beginning	56.8±1.12	57.3±1.18	t=0.31; P>0.05
	End	59.2±1.07	64.4±1.14	t=3.35; P<0.01
Genchi test, s	Beginning	35.9±0.62	36.1±0.68	t=0.22; P>0.05
	End	38.6±0.64	42.8±0.65	t=4.60; P<0.001
Martine-Kushelevsky test, s	Beginning	127.4±2.54	125.2±2.72	t=0.59; P>0.05
	End	122.9±2.57	114.7±2.68	t=2.21; P<0.05
1 km run, s	Beginning	257.2±2.15	251.9±2.26	t=1.70; P>0.05
	End	248.4±2.18	237.8±2.21	t=3.41; P<0.01
Level of physical health, points	Beginning	3.46±0.45	3.79±0.56	t=0.46; P>0.05
	End	4.09±0.49	6.92±0.54	t=3.88; P<0.01

Note: n – number of students, M – arithmetic mean, m – error of the arithmetic mean, t – Student's t-test value, P – significance of the difference between the indicators of groups 1 and 2.

RESULTS

The results of the assessment of functional state and health indicators of students in groups 1 and 2 are presented in Table 1 (men) and Table 2 (women). It was found that at the beginning of the research, all indicators in groups 1 and 2, both among male and female students, did not differ significantly ($P > 0.05$). This indicates the homogeneity of the groups and the absence of any special selection for groups 1 and 2. Heart rate and blood pressure indicators were used to study the functional capabilities of the cardiovascular system of students. The analysis of resting heart rate showed that at the end of the research, this value was significantly better in group 2 than in group 1, by 2.5 beats/min among men ($P < 0.05$) and by 2.8 beats/min among women. At the same time, in group 2 there is a tendency to improve heart rate during the research period, and in group 1, on the contrary, to deteriorate. It was also found that all values of heart rate in students of group 2 (males, females) were in the range of 60-80 beats/min. That is, students who were engaged in recreational running did not show signs of tachycardia, unlike group 1. It testifies to the economic activity of the cardiovascular system of students in group 2 that is characteristic for representatives of sports with predominant development of endurance in which sports

activity is carried out in an aerobic mode of energy supply.

The study of blood pressure (systolic and diastolic) shows that the indicators of functional capabilities of students in group 2 at the end of the research were slightly better than in group 1, but no significant difference was found between them ($P > 0.05$). The VC indicators characterize the maximum amount of air exhaled by students after the deepest breath and the state of the external respiratory apparatus. Thus, the analysis of the VC indicators showed that at the end of the research, male students in group 2 had a value significantly higher than in group 1, by 240.5 ml ($P < 0.05$), and female students – by 233.8 ml ($P < 0.05$). It is also worth noting that during the research period, both groups improved their VC indicators, but the changes were not significant ($P > 0.05$) in group 1, and they were significant ($P < 0.01$) in group 2. This confirms the fact that students engaged in recreational running have a higher level of functional state of the respiratory system. These conclusions are also confirmed by the results of breath-holding tests, where students of group 2 (both men and women) revealed significantly better indicators at the end of the research compared to group 1 ($P < 0.05-0.001$). This allows us to talk about the ability of students engaged in running to work effectively in

Table 2. Dynamics of the functional state and health indicators of female students in groups 1 and 2 during the research (n=59, M±m)

Studied indicators	Stages	Group 1 (n=31)	Group 2 (n=28)	Significance of the differences
RHR, bpm	Beginning	69.2±0.82	69.3±0.91	t=0.08; P>0.05
	End	70.3±0.83	67.5±0.86	t=2.34; P<0.05
Systolic blood pressure, mm Hg	Beginning	117.4±0.64	118.1±0.75	t=0.71; P>0.05
	End	118.8±0.66	118.0±0.74	t=0.81; P>0.05
Diastolic blood pressure, mm Hg	Beginning	70.3±0.76	70.5±0.81	t=0.18; P>0.05
	End	70.7±0.75	70.2±0.79	t=0.46; P>0.05
VC, ml	Beginning	2919.2±78.52	2925.2±84.47	t=0.05; P>0.05
	End	3055.8±80.06	3289.6±82.90	t=2.03; P<0.05
Stange test, s	Beginning	49.5±1.29	50.2±1.36	t=0.37; P>0.05
	End	50.4±1.33	55.8±1.31	t=2.89; P<0.05
Genchi test, s	Beginning	32.7±0.73	31.9±0.84	t=0.72; P>0.05
	End	34.1±0.74	38.3±0.82	t=3.80; P<0.01
Martine-Kushelevsky test, s	Beginning	136.1±2.79	134.7±2.94	t=0.35; P>0.05
	End	132.8±2.65	123.7±2.86	t=2.33; P<0.05
1 km run, s	Beginning	304.1±2.35	298.8±2.49	t=1.55; P>0.05
	End	295.8±2.33	276.2±2.42	t=5.83; P<0.001
Level of physical health, points	Beginning	3.85±0.81	4.03±0.94	t=0.15; P>0.05
	End	4.61±0.79	7.15±0.83	t=2.22; P<0.05

Note: n – number of students, M – arithmetic mean, m – error of the arithmetic mean, t – Student's t-test value, P – significance of the difference between the indicators of groups 1 and 2.

conditions of insufficient oxygen in the body. Studies of the duration of HR recovery to baseline values after a standard test load indicate that in students of group 2 of both sexes, this value was significantly better at the end of the research than in students of group 1, by 8.2 and 9.1 s, respectively ($P < 0.05$). At the same time, the time of heart rate recovery in students of group 2 improved significantly ($P < 0.001$) during the research period, in contrast to group 1.

The analysis of students' results in the 1 km run showed that the level of endurance development was significantly better in group 2 than in group 1 at the end of the research, by 10.6 s among men ($P < 0.01$) and by 19.6 s among women ($P < 0.001$). Moreover, group 2 revealed a more pronounced significant improvement in results in the 1 km run during the experiment ($P < 0.001$). This proves the effectiveness of aerobic exercise during recreational running in improving the level of students' endurance. According to the results of the physical health assessment, it can be concluded that students of group 2 had significantly better health levels than in group 1 at the end of the research, by 3.13 points among men ($P < 0.01$) and by 3.12 points among women ($P < 0.05$). During the research period, the level of health in group 2 improved significantly ($P < 0.001$), while it did not change significantly ($P > 0.05$) in group 1. All this shows the positive impact of indepen-

dent running training sessions with moderate intensity on the improvement of the functional state and health of student youth.

DISCUSSION

In recent years, against the background of the intensification of the educational process in Ukrainian HEIs, there has been a tendency to reduce the amount of motor activity of students, which negatively affects their physical condition, and therefore the issues of formation, preservation, and strengthening of the health of student youth are of particular social importance [20]. A significant role in optimizing this situation is played by the use of simple, affordable, and, at the same time, adequate and effective means of physical education in the everyday life of students, not only in academic physical education training sessions at HEIs but also during independent training sessions, to compensate for the deficit of their daily motor activity [21].

In recent years, many researchers [22–24] have addressed the problem of improving the process of physical education and increasing the effectiveness of physical education and health training sessions with students. To date, approaches to the organization of physical education training sessions for students focused on the formation of valeological values based on the use

of adequate means and methods of physical culture have been proposed; models of sports and recreational activities of students based on the correction of the organization of the process of physical education in HEIs have been suggested; theoretical and methodological support for physical education of students of HEIs has been developed; several methods for normalizing loads of different directions based on individual interests and the level of the physical condition of students have been substantiated; approaches to the division of students into groups for physical education based on model characteristics of different levels of physical health have been proposed. At the same time, experts continue to note the deficit in students' motor activity, low levels of physical fitness, and physical health of modern students [6, 8]. Our research confirms the conclusions of many scientists about the insufficient level of indicators of the functional state and health of students who, in addition to academic physical education training sessions, did not exercise on their own. Instead, the positive effect of independent running on the health of students, both men and women, has been proven.

According to scientists [25], the main motivations for young people to engage in recreational running are: promoting health and disease prevention; increasing working capacity; enjoyment of the running process; desire to improve their running results (sports motivation); tribute to fashion (aesthetic motivation); desire for communication; desire to know their body, their capabilities; motivation for creativity, motivation for education and strengthening of the body. According to experts [19], running is a natural tranquilizer that works much better than medications. When examining middle-aged men and women engaged in recreational running, scientists found a significant increase in the content of red blood cells, hemoglobin, and lymphocytes in the blood, which increases the oxygen capacity of the blood and its protective functions [16]. In addition,

an increase in immunoglobulins was found in the blood, which helps to reduce the incidence of disease. When analyzing the ability to work and the incidence of diseases among employees of various enterprises, it turned out that among people engaged in recreational running, the number of days of disability decreased from an average of 18 to 2 days per year [26]. The results of our research confirm the existence of a direct relationship between the level of motor activity (running) and the state of health of students. Particularly noticeable changes were observed in the performance of the cardiovascular and respiratory systems of the body, as well as the level of endurance development of students.

CONCLUSIONS

The positive influence of independent running with moderate intensity on the functional state and health of students of technical specialties has been proved. It was found that during the research period, both male and female students who were independently engaged in recreational running 3 times a week in the amount of 2 to 7 km at a heart rate of up to 150 beats per minute in extracurricular time showed a significant ($P < 0.05-0.001$) improvement of such indicators as resting heart rate, vital capacity of the lungs, duration of breath holding during inhalation and exhalation, duration of heart rate recovery after standard exercise, level of endurance development based on the results of the 1 km run, level of physical health. The low efficiency of the physical education system in Ukrainian HEIs and, accordingly, the insufficient level of motor activity, indicators of functional status, and health of students who, in addition to academic physical education training sessions, did not exercise on their own, were also confirmed.

Prospects for further research are aimed at studying the effectiveness of swimming training sessions on students' health.

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This research was carried out according to the research work of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" for 2018-2023 on the theme of "Information technologies for assessing and correcting the state of health of students in higher educational institutions" (state registration number 0117U006954).

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Zoia V. Syrovatko

Igor Sikorsky Kyiv Polytechnic Institute
37 Beresteyskyi Prospect, 03056 Kyiv, Ukraine
e-mail: szoyavolleyball@ukr.net

ORCID AND CONTRIBUTIONSHIP

Yurii V. Novytskyi: 0000-0002-5011-7034 **A**

Zoia V. Syrovatko: 0000-0002-5752-9445 **B D**

Tetiana H. Kozlova: 0000-0003-3096-3687 **B C**

Anna Yu. Chekhovska: 0000-0002-0675-5004 **D**

Oleksandr Ye. Salamakha: 0000-0002-4798-9800 **B D**

Vadym M. Mykhailenko: 0000-0002-1001-1999 **E**

Oksana M. Chychenova: 0000-0003-1551-9799 **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: 07.02.2024

ACCEPTED: 19.05.2024

