

PHYSIOLOGICAL INDICATORS OF STUDENTS AFTER
RUNNING A DISTANCE OF 500 METERS

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The change in the functional state of the body of first-year students under the influence of physical activity was studied. As the analysis of the obtained data showed, running at a distance of 500 *m*, both for girls and boys, leads to unidirectional shifts in all the studied indicators of varying severity. The functional systems of the organism of first-year students of the university react to physical activity by the tension of the sympathetic circuit of the regulation of adaptive mechanisms.

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Introduction. Numerous clinical studies indicate that the cause of the development of many chronic non-communicable diseases observed in recent years among students is a sedentary lifestyle [1–3]. In the conditions of modern information, social and emotional overloads caused by the complication of curricula and the introduction of new information technologies into the educational process, students develop “limited time stress”, which negatively affects the adaptive capabilities of their organism. First-year students experience special overloads in the process of educational activity. Yesterday's pupil, becoming a student, finds oneself in unusual conditions of intense educational and social activity, which ultimately causes the tension in his/her adaptive–compensatory mechanisms, contributing to the formation of symptoms of fatigue [3–5]. Hypokinesia is a powerful risk factor for the development of diseases of the cardiovascular and musculoskeletal systems of the body [2, 6]. At present, the quality of teaching physical culture in higher school is being improved with an emphasis on prevention, health correction, and individualization of physical education. Physical exercise can help increase the nonspecific resistance of the body, restore the activity of the central nervous system, and improve autonomic functions [7–10]. However, excessive motor activity, leading to “anxiety” of all functional systems of the body, can cause both stimulation

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of developmental processes and the formation of overstrain, especially in the cardiovascular system [5, 9, 11].

In this regard, changes in cardiohemodynamic parameters under the influence of running at a distance of 500 *m* were studied in first-year students of the Faculty of Applied Mathematics, who, due to the specifics of their education, are more prone to physical inactivity than students of other faculties.

Materials and Methods. The study involved 60 girls and boys – freshmen, aged 16–17 years. Monitoring of the functional state of students was carried out at the Department of Physical Education and Sports of Yerevan State University in the first academic semester. It is known that the most sensitive to the effects of adverse factors is the cardiovascular (CVS) and hemodynamic systems, which play the role of an indicator of adaptive-compensatory reactions of the body. Systolic and diastolic blood pressures (sBP, dBP) were measured using the cuff method of N.S. Korotkov, vital capacity of lungs (VC) was determined spirometrically. Anthropometric examination of students (weight, height) was carried out by generally accepted methods. According to special formulas, the following were calculated: life index (LI) as the ratio of lung capacity to body weight, mass to height ratio (MHR) (not confuse with body mass index), stroke volume (SV) and cardiac output (CO), mean dynamic blood pressure (adBP) and pulse pressure (PP). The degree of adaptation of the cardiovascular system to physical activity was assessed by the value of adaptive potential (AP). E.A. Pirogova's calculation method was used to estimate the level of the functional state (LFS) of the students' organism. Registration of all indicators was carried out in 2 stages: 10 minutes before physical activity (normal) and 5 minutes after running 500 meters (recovery period). The obtained data were subjected to statistical processing by BioStat software.

Results and Discussion. The analysis of the data obtained showed that running at a distance of 500 *m*, both for girls and boys, leads to unidirectional shifts in all the studied indicators, with a slightly different degree of severity. After physical activity, both girls and boys showed a decrease in VC and LI (see Table), due to incomplete shallow breathing, which is a consequence of an increase in heart rate (by 40–50 *bpm*). The study revealed gender characteristics of the response of some hemodynamic parameters to physical activity. The somewhat restricted limits of the increase in CO and SV observed by us in girls may be due to their smaller volumes of heart and blood compared to those of boys. At the same time, in girls, the increase in CO was mainly due to an increase in heart rate during physical activity (60.0%), and in boys, the increase in CO was due to an increase in both heart rate (58.6%) and SV (19.1%). An increase in cardiac output, mainly due to heart rate, is a less effective form of central support of blood circulation. A clearly pronounced chronotropic reaction, with a slight increase in inotropic one, which is characteristic in this case for girls, reflects to some extent insufficient myocardial power and the “high biological price” of adaptation to physical activity of a given intensity [6, 9–11].

The normalization of loads during physical activities such as walking and running is usually based on optimizing the processes of energy supply and oxygen regime. At the same time, the development of hypoxia and disruption in the delivery of oxygen and energy-rich substances to the place of their consumption, act as factors limiting the load.

Cardiohemodynamic indicators of students before and after physical activity

Indicators	Girls		Boys	
	before	after	before	after
HR (<i>bpm</i>)	81.14±2.57	129.86±4.47 p <0.001	80.83±4.54	128.20±2.75 p <0.001
RR (breaths per minute)	19.21±0.74	26.50±2.72 p <0.01	18.50±1.15	30.67±1.65 p <0.001
AP (arb. unit)	1.99±0.06	2.75±0.08 p <0.001	2.02±0.11	2.90±0.07 p <0.001
sBP (<i>mmHg</i>)	103.90±2.30	120.71±2.67 p <0.001	112.52±5.12	124.22±3.27 p <0.05
dBP (<i>mmHg</i>)	65.36±2.06	74.29±7.81 p 0.001	71.67±2.79	76.78±3.33
LFS (arb. unit.)	0.53±0.04	p <0.05	0.49±0.05	0.26±0.07 p <0.02
LI (<i>mL/kg</i>)	50.33±2.77	42.14±2.81 p <0.05	50.30±3.94	40.91±2.71 p <0.05
adBP (<i>mmHg</i>)	83.02±2.03	94.24±1.57 p <0.001	92.07±3.98	95.74±2.52
SV (<i>mL</i>)	64.20±2.7	65.46±2.36	58.55±7.81	69.74±7.41 p <0.001
CO (<i>L</i>)	5.06±0.49	8.50±0.36 p <0.001	4.73±0.34	8.95±0.30 p <0.001
PP (<i>mmHg</i>)	38.57±7.52	46.43±3.12 p <0.02	40.83±2.71	47.53±1.12 p <0.001
MHR (<i>g/cm</i>)	339.50±15.06		371.25±34.62	

The response of the cardiovascular system to physical activity was also manifested in changes in all types of blood pressure, which, however, was less pronounced (sBP and dBP in girls increased by 16.2% and 13.7%, in boys – by 10.4% and 7.0%, respectively). The exception was shifts in PP, which in the post-training recovery period exceeded the norm by 20.4% (p<0.02) and 16.4% (p<0.001) in girls and boys, respectively. This is also evidenced by an almost two-fold decrease in the overall level of the functional state of the body of students (LFS) and the transition of AP to the stress zone (above 2.1). The reaction of urgent and long-term adaptation with a dosed physical load is clearly manifested not only in a change in the functional state of the cardiovascular system, but also in the tension of the regulatory mechanisms that determine its functioning [8, 10]. The observed shifts may be the result of insufficient training and are due to an increase in body weight of students under the influence of a sedentary lifestyle, as evidenced by the MHR values of both boys (371.2 ± 34.6 *g/cm*) and girls (339.5 ± 15.0 *g/cm*).

Shifts in cardiohemodynamic parameters observed during exercise reflect an increase in the activity of higher vegetative centers and metabolic processes in the body. Long-term preservation in the post-exercise recovery period, both in girls and boys, of a high level of heart rate, cardiac output, respiratory rate, and other

indicators exceeding background values, in the case of repeated recurrence, can cause overstrain of the cardiovascular system and disruption of adaptation processes.

Conclusion. Thus, being in a state of hypodynamia for a long time in high school and during the period of preparation for entrance exams, the functional systems of the body of adolescents in the first year of university education react to intense physical activity due to the tension of the cardiovascular system of the body. In this regard, among first-year students in the first months of study at a university, for the initial “retracting” stage of sports training, it is necessary to use sparing training loads of moderate intensity, which will become a transitional stage to subsequent intensive loads. The identified shifts confirm the need to increase the number of physical education lessons in educational institutions, since a trained person adapts more easily to changing conditions, and physical activity causes less pronounced functional shifts in his/her organism. The study of changes in the functional parameters of the students' organism, observed after exposure to various physical loads, will make it possible to select a rational individually dosed health-improving training regimen, level the negative impact of hypodynamia and other negative social and environmental factors.

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REFERENCES

1. Galstyan H.G., Minasyan S.M. The Role of Biological and Socio-Hygienic Factors on the Mechanism of the Change of Somatometric and Hemodynamic Indices of Students. *Hygiene & Sanitation (Russian Journal)* **95** (2) (2016), 181–184. <https://doi.org/10.18821/0016-9900-2016-95-2-181-184>
2. Ermakova N.A., Melnichenko P.I., et al. Lifestyle and Health of Students. *Hygiene & Sanitation (Russian Journal)* **95** (6) (2016), 558–563. <https://doi.org/10.18821/0016-9900-2016-95-6-558-563>
3. Koposova T.S., Chikova S.N., Chikov A.E. Heart Rate Variability in Students with Different Levels of Physical Activity. In: *Scientific Works of the I Congress of Physiologists of the CIS*. Sochi, Dagomys (2005), 274–275.
4. Buduk-ool L.K., Khovalyg A.M. Peculiarities of the Psychological Status of First-Year Students in Terms of University Education. *Hygiene & Sanitation (Russian Journal)* **95** (6) (2016), 568–572. <https://doi.org/10.18821/0016-9900-2016-95-6-568-572>
5. Domrachev A.A., Mikhailova L.A. Methodological Approach to Assessing the Functional State of the Body According to the Degree of Fatigue. *Human Physiology* **36** (1) (2010), 106–111.
6. Gorkavaya A. Yu., Trigorlyi S.N., Kirillov O.I. The Indices of Physical Development and Cardiovascular System Adaptation in Vladivostok Medical University Students. *Hygiene & Sanitation (Russian Journal)* **88** (1) (2009), 58–60.
7. Butyaeva V.V. Evaluation of the Functional State of Students with Different Levels of Physical Activity. In: *Proceedings of III all-Russian Scientific-Practical Conference “Functional Status and Health”*. Rostov-on-Don (2010), 222–225.
8. Vanyushin M.Yu., Vanyushin Yu.S., Khairullin R.R. The Influence of the Exercises' Focus and Age on the Reaction of the Pumping Function of the Sportsman's Heart. *Fundamental research* **9** (part 2) (2011), 220–222.

9. Malyarenko Yu.E., Bykov A.T., et al. Modern Ideas About Motor Activity as a Function of Ensuring Health. In: *Proceedings of III all-Russian scientific-practical conference "Functional Status and Health"*. Rostov-on-Don (2010), 77–79.
10. Pankova N.B., Bogdanova E.V., Lyubina B.G. Influence of Motor Load on the Age-Related Dynamics of the Functional Maturation of the Autonomic Regulation of the Cardiovascular System of Adolescents. *Human physiology* **35** (3) (2009), 64–73.
11. Vdovina L.N. Motor Activity as a Method of Prevention and Tecovery. In: *Proceedings of all-Russian Congress on School and University Medicine*. Moscow (2010), 124–126.

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ՈՒՍԱՆՈՂՆԵՐԻ ՖԻԶԻՈԼՈԳԻԱԿԱՆ ՑՈՒՑԱՆԻՇՆԵՐԸ 500 Մ ՀԵՌԱՎՈՐՈՒԹՅՈՒՆ ՎԱԶԵԼՈՒ ՀԵՏՈ

Ուսումնասիրվել է ֆիզիկական ակտիվության ազդեցության տակ առաջին կուրսի ուսանողների օրգանիզմի գործառական վիճակի փոփոխությունը: Ստացված տվյալների վերլուծությունը ցույց է տվել, որ վազքը 500 մ հեռավորության վրա, ինչպես աղջիկների, այնպես էլ տղաների մոտ հանգեցնում է ուսումնասիրված բոլոր ցուցանիշների տարբեր ընդգծվածության միակողմանի տեղաշարժերի: Համալսարանի առաջին կուրսի ուսանողների օրգանիզմի գործառական համակարգերը ֆիզիկական ակտիվությանը արձագանքում են հարմարվողական մեխանիզմների կարգավորման սիմպաթիկ շղթայի լարվածությամբ:

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ФИЗИОЛОГИЧЕСКИЕ ПОКАЗАТЕЛИ СТУДЕНТОВ ПОСЛЕ БЕГА НА ДИСТАНЦИЮ 500 МЕТРОВ

Изучено изменение функционального состояния организма первокурсников под влиянием физической нагрузки. Анализ полученных данных показал, что бег на дистанцию 500 м, как у девушек, так и у юношей, приводит к односторонним сдвигам всех исследованных показателей разной степени выраженности. Функциональные системы организма студентов на первом году вузовского обучения реагируют на физическую нагрузку напряжением симпатического контура регуляции адаптационных механизмов.