

# The influence of the academic performance of students on the functional state of the cardiovascular system

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**Abstract.** The article reveals the functional state of the cardiovascular system of female students with different grades in the grade book. From the evaluation of the results of our research, we can conclude that academic performance does not lead to significant changes in the indicators of the functional state of the cardiovascular system of girls. Thus, in female students with the highest academic performance, the AP value increased to 42.6 mm Hg. Art., ADsrin up to 98.8 mm Hg. Art. and IOC up to 4.79 l/min, and in the control girls it was 40.6; 92.2 and 4.66 respectively. The level of SOC decreased in the group of excellent students to 62.8 ml, and in those who achieved satisfactory results it was 64.7. The level of OPSS and CEC in the group of female students with an average score of the record book "five" increased to 1559 dyn\*s\*cm-5 and 3271, and "three" amounted to 1515 and 2945. The value of CV between the groups ranged from 17.8 to 17.9 conventional units.

## 1 Introduction

The main indicator of determining a student's competence as a learner is academic performance. Academic performance refers to the student's ability to understand, remember and, if necessary, apply acquired knowledge.

A student's academic performance is influenced not only by the knowledge, skills and abilities he has acquired, but also by the achievement of internal personal perfection, the acquisition of social competence, positive achievements in professional activities and demand in the labor market. Environmental factors also influence the efficiency of mental activity.

Many scientists have devoted their research to the problem of academic performance, including T.V. Gadai, N.F. Talyzina, B.G. Ananyev, Yu. V. Bratchikova, Yu.A. Samarina and others.

Thanks to educational activities, there is an increase in tension in the nervous system and the occurrence of physical inactivity, which negatively affects memory, thinking, perception, attention and analysis.

According to T.N. Semenкова et al. [7], the conditions of educational activity determine both mental abilities and academic performance of the student. A large amount of mental

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work and an acute shortage of time at the beginning of university studies require the student to master the culture of mental work.

Success in education, as in any type of activity, is determined by the state of the psyche and the mobility of the individual.

High mental load causes an increase in the load on the central nervous system and changes in the timing of mental processes.

According to A.A. Guminsky [2], such factors as increased mental work, high nervous tension, increased concentrations of adrenaline and norepinephrine in the blood are features of the period of taking tests and exams.

The state of health of a student's body determines his success in educational activities.

A student's performance is made up of a combination of many factors, including his mental and professional abilities, character traits, temperament, interests, abilities for various types of activities, state of consciousness and the capabilities of the physiological systems of the body.

The state of the body's systems, as well as the characteristics of the content and technology of study, determine the student's success in studies.

The main factors influencing the state of the body's systems are prolonged sitting at a table, stress, negative emotions, intense work when there is not enough time, and greater responsibility for the success of acquiring knowledge.

Due to this, identifying the functional state of the cardiovascular system of girls with varying educational success is significant.

## 2 Research Methodology

To collect experimental material, 34 clinically healthy full-time female students of the Faculty of Biology and Chemistry were used.

The subjects were divided into three groups based on their average grade book score. Each group consisted of 7 to 16 girls.

To analyze the functional state of the cardiovascular system, we used heart rate (HR), systolic (BP) and diastolic blood pressure (BP) and calculated indicators: pulse pressure (PP); average dynamic blood pressure (BPsrdin); systolic blood volume (SBV); minute blood volume (MBV); total peripheral vascular resistance (TPVR); circulatory efficiency coefficient (CEC); endurance coefficient (EF).

For biometric control of experimental material, the Biostatistics program was used.

## 3 Results and Discussions

The state of the cardiovascular system of girls with different academic performance is presented in Table 1 and Figures 1-2.

**Table 1.** Cardiovascular system of female students

Gradebook score	Indicators			
	Heart rate, beats per minute	blood pressure, mm Hg Art.	ADD, mm Hg. Art.	Age in years
Three	72,2±1,61	115,7±2,54	75,1±1,69	19,2±0,23
Four	73,9±1,35	118,2±2,13	76,9±1,40	19,5±0,23
Five	76,4±2,36	122,1±3,37	79,5±2,20	19,6±0,35

The data in the table and figures show that an increase in the average score of female students is accompanied by a slight increase in heart rate, blood pressure and blood pressure.

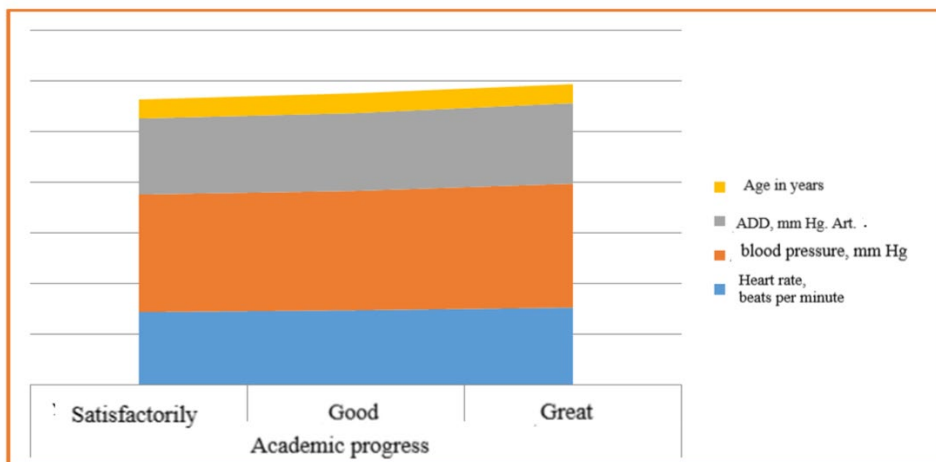


Fig. 1. Cardiovascular system of girls with different academic performance

Thus, the heart rate of female students with good and excellent academic performance is higher by 1.7 and 4.2 beats per minute relative to the level of the control group.

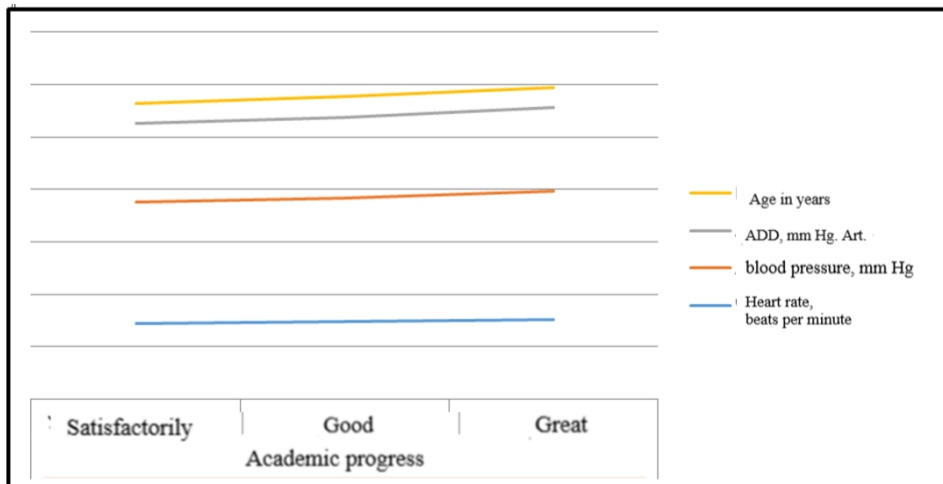


Fig. 2. The state of the cardiovascular system of female students depending on their academic performance.

The blood pressure level in female students with good and excellent academic performance is higher by 2.5 and 6.4 mmHg. Art. regarding the students' values are satisfactory.

The ADD value is 1.8 mmHg higher in girls who achieve “4” grades. Art., and “five” – 4.4 compared to the level of control students.

Indicators of the functional state of the cardiovascular system of female students with different academic performance are shown in Tables 2-3 and Figures 3-4. Analysis of the results obtained shows that the indicators of the functional state of the cardiovascular system between the groups of girls do not differ significantly. Average PD levels are within

the physiological norm. The value of blood pressure in the group of excellent students is higher than the physiological norm.

**Table 2.** Level of HR, APsrdir, SBV and IOC in female students with different academic performance

Gradebook score	Indicators			
	PD in mm Hg. Art.	BPsrdin in mmHg. Art.	SBV (ml)	MBV (l/min)
Three	40,6±0,88	92,2±2,05	64,7±0,64	4,66±0,065
Four	41,3±0,72	94,2±1,71	63,4±0,54	4,67±0,047
Five	42,6±1,17	98,8±2,16	62,8±0,70	4,79±0,103

In the group of female students who performed well and excellently, the PP level was higher by 0.7 and 2.0 mm Hg. art., blood pressure by 2.0 and 6.6 mm Hg. Art., MBV by 0.01 and 0.13 l/min relative to the initial values.

The level of SOC and TPSS in all groups corresponds to the norm. In girls who achieve “five”, the COC value is 1.9 ml less compared to those who achieve “three”.

The OPSS value for the group of female students with excellent academic performance is higher by 44 dyn·s·cm-5, and the KEC level is 326 higher compared to the level of girls with satisfactory academic performance.

For all experimental groups of girls, the average value of the EEC exceeds the upper level of the norm, which is an indicator of the presence of fatigue.

The difference in the level of EF between the groups is only 0.1. An indicator of the detrainning of the cardiovascular system of female students is that the average CV values for the experimental groups are higher than normal.

**Table 3.** The influence of academic performance on the functional state of the cardiovascular system of girls

Indicators	Average grade book score		
	Three	Four	Five
TPVR in dyn s cm-5	1515±16,4	1547±13,5	1559±16,6
CEC	2945±127,6	3067±108,9	3271±187,4
EF	17,8±0,07	17,9±0,03	17,9±0,11

In the group of female students who performed well and excellently, the level of pulse pressure (PP) was higher by 0.7 and 2.0 mm Hg. art., blood pressure by 2.0 and 6.6 mm Hg. Art., minute blood volume by 0.01 and 0.13 l/min relative to the initial values.

The level of systolic blood volume (SBV) and total peripheral vascular resistance (TPVR) in all groups corresponds to the norm. In girls who achieve “five”, the SBV value is 1.9 ml less compared to those who achieve “three”.

The value of total peripheral vascular resistance (TPVR) in the group of female students with excellent academic performance is higher by 44 dyn·s·cm-5, and the level of circulatory efficiency coefficient (CEC) is 326 higher compared to the level of girls with satisfactory academic performance.

For all experimental groups of girls, the average value of the EEC exceeds the upper level of the norm, which is an indicator of the presence of fatigue.

The difference in the level of endurance coefficient (EF) between the groups is only 0.1. An indicator of the detraining of the cardiovascular system of female students is that the average CV values for the experimental groups are higher than normal.

**Table 4.** Impact of academic performance on the functional state of the cardiovascular system of girls

Indicators	Average grade book score		
	Three	Four	Five
TPVR in dyn s cm-5	1515±16,4	1547±13,5	1559±16,6
CEC	2945±127,6	3067±108,9	3271±187,4
EF	17,8±0,07	17,9±0,03	17,9±0,11

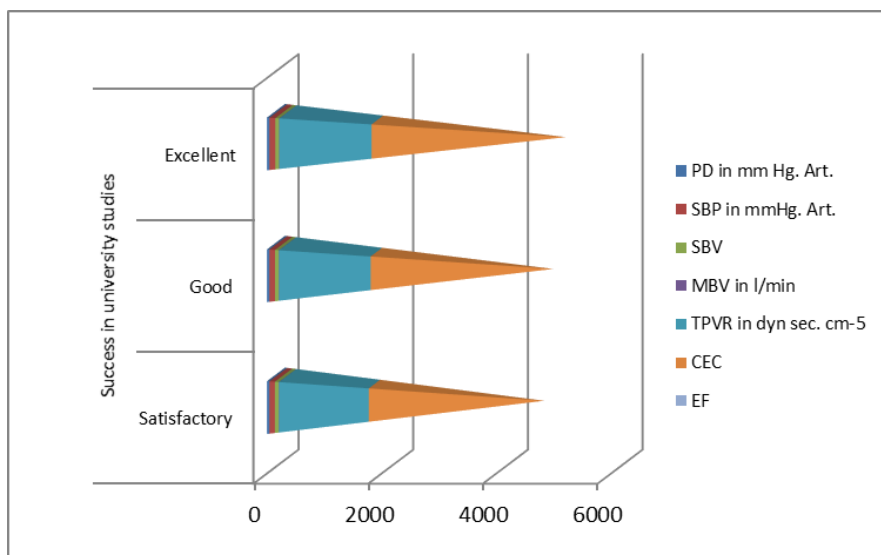
Other authors obtained the same results in their studies. So, according to N.Ya. Prokopiev et al. [5], educational activity is accompanied by an increase in heart rate, blood pressure and blood pressure.

At rest, the heart rate is higher than normal in 69.1% of girls and 42.2% of boys, reports E.A. Zakharin [4]. Increased exposure to stress causes an increase in heart rate [11].

According to G.M. Guseva [3], in the process of educational activities in students, high blood pressure increases from 116.5 to 122.4 mm Hg. Art.

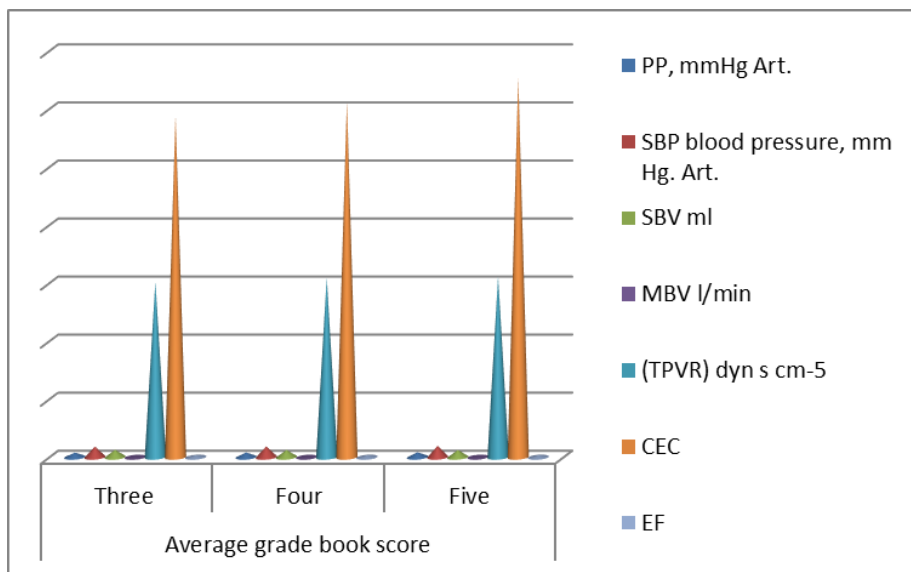
Apparently, the increase in the activity of the cardiovascular system of students with an improvement in their academic performance is due to an increase in neuropsychic stress and a decrease in motor activity. According to A.A. Artemenko [1] and E.A. Shtrikh [10], physical inactivity, low physical fitness and poor health are widespread among students.

According to A.N. Sharapova [9], the state of the cardiovascular system of students significantly improved with an increase in physical activity in the process of their adaptation to mental activity.



**Fig. 3.** Functional state of the cardiovascular system of girls with different success rates in university studies

Solovyova V.N. [8] established a decrease in the tension of adaptation mechanisms and an increase in the adaptive reserves of systems supplying oxygen to the body with an increase in physical activity.



**Fig. 4.** Dependence of the functional state of the cardiovascular system on the performance of female students.

In the process of educational activities, students' functional capabilities of the cardiovascular and respiratory systems decrease [6].

Thus, the research results show that in the process of improving the academic performance of girls, there is a slight increase in the level of pulse pressure (PP), average dynamic blood pressure (ADsrdin), minute blood volume (MBV), vascular resistance (OPSS) and circulatory efficiency coefficient (CEC), an insignificant decrease in the value of systolic blood volume (SBV), and the value of the endurance coefficient (EF) does not change.

## 4 Conclusions

1. The level of heart rate, blood pressure and blood pressure in girls with maximum academic performance exceeds by 5.8%, 5.5 and 5.9, respectively, compared to the values of students with satisfactory performance.

2. The increase in PP value among female students with maximum academic performance was 4.9%, and the average dynamic BP was 7.2%, relative to the initial level.

3. In girls who perform excellently, the value of systolic blood volume (SBV) is 2.9% lower compared to the value of those who perform satisfactorily.

4. The value of minute blood volume (MBV) and vascular resistance (VRV) in female students with the maximum average grade book score is higher by 2.8 and 2.9%, respectively, relative to the level of control girls.

5. The increase in the value of the circulatory efficiency coefficient (CEC) and the endurance coefficient (EF) among excellent students was 11.1 and 0.6% compared to the initial value.

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