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Adaptation Potential of Students' Organisms During Training at a Medical University

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Abstract A study involving 32 second-year students majoring in General Medicine and Dentistry at the Fergana Medical Institute of Public Health was conducted to assess the adaptive capabilities of the cardiovascular system during higher education. The article examines the informative value of heart rate variability indices, analyzed using mathematical methods, in the comprehensive assessment of students' physiological adaptive reserves. A comparative analysis of the components of the student adaptation process is presented, and the need to study adaptation problems throughout the educational process is substantiated.

Keywords Adaptation potential, Heart rate variability, Mathematical analysis, Heart rate, Blood pressure, Systolic blood pressure, Diastolic blood pressure, Subject's age, Body weight

1. Introduction

The conditions of higher education increase the demands placed on students' adaptive mechanisms. Disruption of the adaptation process to educational conditions may result in neuropsychological and psychosomatic disorders that develop during the period of study. During the educational process, students' health status determines their adaptive reserve. Normal functioning of the student's body ensures a stable level of activity and interaction among functional systems, organs, tissues, and regulatory mechanisms. In assessing the adaptive capabilities of students' organisms, determining the functional state of the cardiovascular system is of particular importance. Autonomic regulatory mechanisms play a key role in ensuring adaptive responses of the body and maintaining homeostasis when environmental conditions change. [1]

2. Materials and Methods

The study used data obtained from an examination of 32 male students aged 18–27 years in their second year of study at the Fergana Medical Institute of Public Health. The students were divided into two groups. The main group consisted of 16 students majoring in General Medicine and 16 students majoring in Dentistry.

The diagnostic methods presented in research methodology for assessing a student's adaptation potential are relatively labor-intensive and time-consuming, which limits their application in large-scale studies of students. Therefore, it is advisable to determine adaptive capabilities using the Baevsky R. M. index, taking into account information concerning the health group of the individual student. [2]

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3. Results and Discussion

Calculation of adaptation potential (AP) using the modified formula of R. M. Baevsky. The adaptation potential (AP) was calculated using the modified formula of R. M. Baevsky [3]. The health coefficient is used as a criterion for assessing the adaptive capabilities of the organism. The following values are entered into the formula: heart rate, systolic blood pressure, diastolic blood pressure, age, body weight, and height of the subject. The R. M. Baevsky formula for determining the adaptation potential of the subject's organism is:

$$AP = (0.011 \times HR) + (0.014 \times SBP) + (0.0008 \times DBP) + (0.014 \times A) + (0.009 \times BW) + (0.004 \times S) - (0.009 \times H) - 0.273,$$

where HR is heart rate (beats/min); SBP is systolic blood pressure (mmHg); DBP is diastolic blood pressure (mmHg); A is the subject's age (years); BW is body weight (kg); S is sex (coefficient: 2 for females and 1 for males); H is height (cm). The score obtained corresponds to a specific degree of adaptation: less than 2.10 – satisfactory adaptation; 2.11–3.20 – tension of adaptation mechanisms; 3.20–4.30 – unsatisfactory adaptation; above 4.31 – breakdown of adaptation mechanisms. [4]

The study was conducted according to the principle of maximum non-interference with natural physiological processes

and compliance with bioethical principles. Accordingly, all research procedures were performed with voluntary informed consent, and painful or invasive procedures were completely excluded.

Heart rate can be determined by palpation (by feeling the pulse in the radial artery). Two or three fingers are placed on the artery while the thumb supports the wrist from the dorsal side. The pulse is counted using a stopwatch for ten seconds two or three times; the obtained value is then multiplied by 6 to determine the heart rate per minute.

Blood pressure was determined using the Korotkoff method with a phonendoscope or electronic blood pressure monitors.

Systolic (maximum) and diastolic (minimum) blood pressure correspond to the phases of the cardiac cycle (systole myocardial contraction and diastole myocardial relaxation). The difference between systolic and diastolic pressure constitutes pulse pressure (PP). [5]

Hemodynamic indicators and mean AP value

Table 1. 16 students – General Medicine

No.	Age	Weight (kg)	Height (cm)	Pulse (beats/min)	Systolic BP (mmHg)	Diastolic BP (mmHg)	AP
1	18	54	163	80	100	70	1.841
2	18	90	180	80	120	80	2.372
3	18	52	160	75	110	80	2.015
4	18	64	165	70	100	70	1.803
5	18	54	152	70	100	70	1.83
6	18	62	174	75	110	80	1.979
7	18	58	165	80	100	70	1.859
8	18	50	165	75	100	70	1.732
9	19	50	170	74	100	70	1.69
10	19	62	179	75	120	80	2.08
11	19	66	162	70	110	80	2.082
12	19	64	175	80	120	80	2.197
13	19	66	170	75	120	80	2.205
14	19	62	167	75	100	70	1.863
15	21	52	164	74	100	60	1.71
16	27	74	195	70	120	80	2.109

Table 2. 16 students – Dentistry

No.	Age	Weight (kg)	Height (cm)	Pulse (beats/min)	Systolic BP (mmHg)	Diastolic BP (mmHg)	AP
1	18	60	176	72	110	70	1.83
2	18	58	165	76	110	70	1.955
3	18	78	182	70	110	70	1.916
4	18	72	189	75	110	80	1.947
5	19	69	170	75	120	80	2.232
6	19	66	180	72	110	70	1.862
7	19	60	176	78	120	80	2.13
8	19	50	155	80	120	80	2.251
9	19	56	168	76	110	70	1.924
10	19	82	193	75	110	70	1.922
11	19	54	147	76	110	80	2.175
12	19	52	176	88	110	90	2.108
13	19	66	181	75	120	80	2.12
14	20	62	175	74	120	70	2.047
15	20	76	180	75	120	70	2.153
16	21	64	178	89	110	70	2.075

Table 3. Hemodynamic indicators in subjects with different levels of AP under conditions of relative rest

Indicators	Number of students examined (n = 32)
AP less 2,10– satisfactory adaptation	23
AP 2,11–3,20– tension of adaptation mechanisms	9
AP 3,2–4,30– unsatisfactory adaptation	-
more 4,31– adaptation failure	-

Table 4. Adaptation potential and functional capabilities of the organism

Score	Adaptation potential	Characteristics of functional state
less 2,10	satisfactory adaptation	High or sufficient functional capabilities of the organism
2,11–3,20	tension of adaptation mechanisms	Sufficient functional capabilities are provided through functional reserves
3,2–4,30	unsatisfactory adaptation	Reduction of the body's functional capabilities
more 4,31	adaptation failure	A sharp decrease in functional capabilities of the organism

4. Conclusions

The results obtained from the examination of 32 students and the data presented in the tables show that, under conditions of functional rest, the hemodynamic indicators of all subjects corresponded to age-related physiological norms. Based on the actual values of adaptation potential in the studied sample, a normative table was developed. Among the subjects with different levels of AP under conditions of relative rest, satisfactory adaptation (AP < 2.10) was identified in 23 students. According to the results, these students had high or sufficient functional capabilities of the organism. Tension of adaptation mechanisms (AP 2.11–3.20) was identified in 9 students. In these students, sufficient functional capabilities were maintained through functional reserves.

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