Physiology of Adaptation of First-Year Students to Studies at Higher Educational Institutions

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Changes in anthropometric and hematological values and parameters of cardiovascular function indicated sufficiently effective adaptation of first-year students to studies at higher educational institutions. On the other hand, a certain strain of the physiological optimum caused by examination stress was found in the students.

Key Words: *adaptation; students; physiological status; training at higher school*

The initial period of training at a higher educational institution is the key stage in the life of a student, both physiologically and socially. Realization of the mechanisms of adaptation of first-year students to studies at higher school is difficult because of the difference between the conditions of studies at higher and secondary schools. Physical and emotional strain during theoretical studies and during examinations is linked with adequate morphophysiological restructuring. On the other hand, these objective changes can cause a certain strain of adaptive restructuring [1-4]. Therefore, the development of morphophysiological state in first-year students under conditions of adaptation to studies at a higher school is an important problem of modern physiology.

We tried to detect specific features of physiological adaptation of first-year students to training conditions at a higher educational institution.

MATERIALS AND METHODS

The study was carried out at a Car Construction Faculty of the Cheboksary Polytechnic Institute (Affiliated Department of Moscow State Open University). Two series of studies were carried out at the beginning (September, February) and end (December, May) of theoretical courses of the first and second terms, respectively, and during the winter (January) and summer (June) examinations. Two groups of first-year students (17-18 years) were formed, each consisted of 15 male students. The groups were formed with consideration for students' place of residence before the Institute. Group 1 consisted of residents of Cheboksary and Novocheboksarsk, group 2 students came from rural regions of the Chuvash Republic. By the results of medical examinations, all students were healthy and referred to the basic medical group.

Physical development of the students was evaluated by anthropometrical (body weight, height, Kettle index) and hematological parameters (erythrocyte and leukocyte counts, hemoglobin level). Cardiovascular function was evaluated by systolic and diastolic BP, heart rate, pulse pressure (PP), stroke volume (SV), and cardiac output (CO) by common modern methods.

The values were processed by methods of variation statistics using Microsoft Excel 2007 software.

RESULTS

Body height of students increased from the beginning to the end of the first academic year from 176.27±3.52-176.43±2.60 to 176.75±3.50-177.15±2.58 cm during the first term and from 177.10±3.55-177.42±2.58 to 178.53±3.49-178.83±2.39 cm during the second term. The values in students of group 1 were somewhat

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higher than in their fellow-students from group 2 during all periods of the study ($p>0.05$).

Changes in body weights of students in general corresponded to changes in their body heights. By the end of the second term, body weight of group 1 students was 72.50±3.53 kg, in group 2 68.10±3.43 kg ($p>0.05$). It is noteworthy that body weights and heights in the students were normal during all periods of the study.

Kettle index characterizing body weight excess or deficit was within the normal range for men of this age category. The range of Kettle index in groups 1 and 2 were 22.65±0.89-22.82±0.89 and 21.44±0.46-21.49±0.47 for term 1 and 22.39±0.81-22.2±0.88 and 21.30±0.45-21.41±0.44 for term 2, respectively.

Erythrocyte counts in the students gradually decreased in both groups from the beginning to the end of term 1 (6.46±0.03 and 6.44±0.02 *vs.* 6.01±0.16 and 5.98±0.23×10^6/μl). During term 2 they decreased in a wave-like pattern from 5.78±0.32 and 5.99±0.50 to 5.28±0.18 and 5.55±0.19×10^6/μl, respectively. The time course of hemoglobin levels corresponded to changes in erythrocyte counts. Hemoglobin levels during terms 1 and 2 were 147.30±2.75-151.20±4.98 and 132.36±2.67-143.21±2.55 g/liter in group 1 and 146.85±3.21-149.27±3.04 and 141.01±3.52-143.58±3.23 g/liter in group 2.

Blood leukocyte counts in groups 1 and 2, by contrast, increased during term 1 from 6.92±0.47 to 7.09±0.31 and from 6.45±0.48 to 6.99±0.29×10^3/μl, respectively, while during term 2 this parameter steadily decreased (6.72±0.22-6.85±0.09 *vs.* 6.05±0.05-6.70±0.26×10^3/μl).

Cardiovascular status reflects the quantitative parameters of the defense and compensatory activity in general. Our data showed that systolic and diastolic BP in students were normal during all periods of the study. Heart rate in students of groups 1 and 2 varied in a wave-like manner throughout the year (from 70.33±4.06-85.13±7.94 to 70.87±5.42-83.27±5.00 bpm). The maximum heart rates were recorded during examination sessions (January, June).

Systolic BP was also within the normal range, increasing from the beginning of the term to its end in students of groups 1 and 2 during term 1 (108.33±4.09-139.00±5.32 *vs.* 104.33±4.19-141.67±5.70 mm Hg, respectively). During term 2 these values increased in a wave-like manner by the summer examination session from 120.00±1.44-120.00±2.96 to 125.67±1.70-128.67±2.52 mm Hg. The difference between the two groups was statistically significant ($p<0.05$) by this parameter in June.

Diastolic BP also remained normal during all periods of the study (64.67±2.72-83.33±3.32 mm Hg). Signs of tachycardia, detected during sessions, presumably indicated the mental stress of first-year students, associated with adequate compensatory adaptive reactions of the hemodynamic system.

During the first term the PP values steadily increased in both groups, while during the second term they decreased in a wave-like manner. PP values by the end of theoretical training in the second term were 38.67±0.79 and 40.60±1.69 mm Hg in groups 1 and 2, respectively, the difference being significant ($p<0.05$).

The maximum SV in the first-year students during the first term was 68.18±4.26 ml in group 1 and 70.03±1.50 in group 2. The minimum values were 59.76±1.56 in group 1 and 65.04±2.10 ml in group 2. During the second term the maximum values were 63.10±2.20 in group 1 and 66.10±2.35 ml in group 2; the minimum values were 57.28±1.99 and 55.99±2.64 ml, respectively. The time course of CO in the two groups in general corresponded to fluctuations of SV. In group 1 the parameter varied throughout the entire period from 4219.25±280.31 to 5756.82±611.89 ml/min in group 1 and from 4210.60±302.22 to 5714.21±554.29 ml/min ($p<0.05$).

Hence, regular changes in the anthropometrical and hematological parameters and in cardiovascular function were revealed, indicating sufficiently effective adaptation of first-year students to training conditions at higher school. However, the students developed a certain strain of the physiological optimum, caused by examination stresses in January and June.

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