



Indicators of Lipid Metabolism and Functional State of the Circulatory System in Students of Gorno-Altai State University

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Abstract

A study was conducted on 94 second-year students at Gorno-Altai State University (Altai Republic, Russia): 54 girls in the age 19.6 ± 0.2 years and 40 boys aged 19.5 ± 0.1 years. Total body fat (TBF), body mass index (BMI), total cholesterol (TC), high- and low-density lipoprotein cholesterol (HDL-C and LDL-C), and serum triglycerides (TG) were measured. Functional state of the systolic and diastolic blood pressure (SBP and DBP) in the circulatory system and heart rate (HR) were measured. To determine the adaptive potential (AP) of the students' circulatory system we used the Baevsky formula. It was revealed that female students had higher levels of TC, LDL-C and HDL-C in the blood compared to boys. In girls the TBF was higher compared to boys, while the BMI values had no gender differences. In girls the TBF was correlated with HR. Functional state of the cardiovascular system and AP of circulatory system were within the age limit and did not differ between students of different genders.

Keywords: Students; Lipid Metabolism; Cardiovascular System; Adaptive Potential

Introduction

Education at the university is associated with high intellectual and psycho-emotional stress, which can cause students functional tension of regulatory systems of the body and reduce compensatory and adaptive capabilities. The problem of adaptation of students to the educational process at the university is widely researched and includes evaluation of neurocognitive functions, vegetative regulation and degree of functional systems adaptation [1,2]. The leading role in the process of adaptation to various factors is played by the potential of the cardiovascular system [3].

Another problem of children's development is the accumulation of fat excess in children and young people, which is a consequence of wrong nutrition, lifestyle, climate, socio-economic conditions, etc. [4,5]. Obesity, which debuts in childhood and adolescence, is usually associated with lipid exchange disorders [6], which is a significant risk factor for the development of cardiovascular disease in adults [7].

Purpose of Study

To evaluate the indicators of lipid metabolism and the functional state of the circulatory system in the students of the second year of the university.

Materials and Methods

A study was conducted on 94 students of Gorno-Altai State University (Altai Republic, Russia): 54 girls (G) aged 19.6 ± 0.2 years and 40 boys (B) of 19.5 ± 0.1 years of age studying in the second year and permanently residing in Gorno-Altaysk. All participants were healthy at the time of the study and had reached the age of maturity. The study was conducted after obtaining written informed consent from each participant.

The total body fat content was determined using the diagnostic fat analyzer «TanitaBC-545N» (Japan). The content of adipose tissue was recorded in the next body segments: upper and lower extremities, trunk and the amount of visceral fat. The obtained values were combined into an indicator of total body fat content (TBF, %).

To assess the lipid profile, laboratory tests were carried out at the «INVITRO» clinic, where blood samples were taken from a vein of the students in the morning, on an empty stomach. The spectrophotometric method on a biochemical analyzer BS-380 (China) was used to determine the content (in mmol/l) of total serum cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and triglycerides (TG).

To evaluate the functional state of the cardiovascular system in students at rest, systolic (SBP) and diastolic (DBP) blood pressure (mmHg) and heart rate (HR, beats/min) were measured using a medical tonometer. Body weight (BW) was measured using floor medical scales, body length (BL) was measured using a stadiometer. Body mass index (BMI, kg/m^2) was calculated as the ratio of body weight to height.

To calculate the indicator of adaptive potential (AP, score) of the cardiovascular system, we used the formula proposed by R.M. Baevsky [8]:

$$AP = 0,011 \times HR + 0,014 \times SBP + 0,008 \times DBP + 0,014 \times A + 0,009 \times BW - 0,009 \times BL - 0,27,$$

where HR – heart rate per minute;

SBP – systolic blood pressure (mmHg);

DBP – diastolic blood pressure (mmHg);

A – age (years);

BW – body weight (kg);

BL – body length (cm).

The interpretation of the obtained results was carried out on a scale: <2,6 – satisfactory adaptation; 2,6-3,09 – tension of adaptation mechanisms; 3,10-3,6 – unsatisfactory adaptation; >3,6 – adaptation failure [8].

Statistical analysis

The calculation of the mean and error of the mean ($M \pm m$) was carried out using the «STATISTICA», version 10.0. The normality of continuous variables was tested using the Shapiro-Wilk test. The significance of differences between gender groups was assessed using the Mann-Whitney U test. Correlations between variables were assessed with Spearman's rank test ($p \leq 0,05$). The strength of the relationship between parameters of lipid balance and cardiovascular system was interpreted using the Chaddock scale [9].

Results

As can be seen from table 1, significantly higher values of total fat content ($p \leq 0.001$) were revealed in the body of girls compared to boys. No gender differences were found in BMI, but girls in comparison with boys had a wider range of parameters outside the upper limit of normal.

Significant differences in the lipid profile indicators between boys and girls were also revealed: the concentrations of total cholesterol ($p \leq 0.001$), high-density lipoprotein cholesterol ($p \leq 0.05$) and low-density lipoprotein ($p \leq 0.001$) were significantly higher in girls compared to boys. No gender differences were found in the concentration of triglycerides in the blood serum of students. The indicated biochemical blood parameters were within the reference values for all students.

Functional parameters of the cardiovascular system of students at rest were within standard values (table 2) and had no gender differences. A moderate correlation was found ($r = 0.4$) between heart rate and total fat content in girls, while no such correlation was observed in boys (Figure 1). The adaptive potential of the

Sex	Girls		Boys	
	M ± m	Min-max	M ± m	Min-max
BMI, kg/m ²	22.8 ± 0.6	17.0-37.0	21.2 ± 0.5	17.3-32.6
TBF, %	28.1* ± 1.0	10.2-48.8	14.7 ± 0.9	6.8-31.2
TC, mmol/l	4.1* ± 0.1	3.2-4.9	3.6 ± 0.1	2.1-4.8
LDL-C, mmol/l	2.2* ± 0.1	1.3-3.3	1.8 ± 0.0	1.0-3.2
HDL-C, mmol/l	1.6* ± 0.1	0.8-2.9	1.4 ± 0.0	0.9-1.9
TG, mmol/l	0.5 ± 0.0	0.3-0.9	0.5 ± 0.0	0.3-0.8

Table 1: Body mass index and lipid metabolism parameters in the blood serum of students of different sexes.

* p ≤ 0.05 between girls and boys.

cardiovascular system did not differ among students of different sexes and corresponded to the state of the age norm of physiological adaptation (Table 2).

Sex	Girls		Boys	
	M ± m	Min-max	M ± m	Min-max
SBP, mmHg	120.4 ± 0.9	109.0-143.0	120.0 ± 1.0	109.0-134.0
DBP, mmHg	77.8 ± 0.9	54.0-96.0	78.6 ± 1.0	67.0-92.0
HR, beats/min	75.1 ± 1.6	59.0-101.0	71.9 ± 1.8	59.0-99.0
AP, score	1.9 ± 0.0	1.2-2.7	1.9 ± 0.0	1.5-2.4

Table 2: Adaptive potential and functional parameters of the cardiovascular system of students.

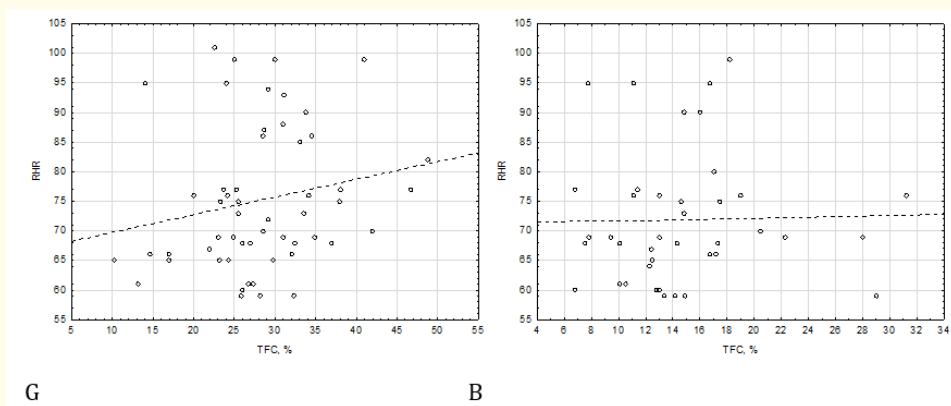


Figure 1: Correlations between total body fat and heart rate in girls (G) and boys (B).

Discussion

Excessive fat mass increases a person's risk of cardiovascular diseases, but the clinical prevalence of obesity, as well as its contribution to major risk factors, varies by gender [10].

An increased content of total body fat in girls may indicate a probable risk of developing obesity and related disorders. According to the literature, in female groups there was a possibility of an increase in the body fat component even with a normal BMI, and a more unfavorable course of dyslipemia [11,12]. Serum concentration of traditionally determined lipid spectrum compounds is a fairly reliable marker of lipid metabolism disorders [13,14]. The higher levels of TC, HDL-C and LDL-C in the blood serum that we found in female students in comparison with boys of Gorno-Altaysk State University are consistent with the results of studies in which a similar trend was observed in girls in Slovakia concerning the concentrations of TC and HDL-C [15]. The absence of gender differences and deviations from the age norm in functional parameters of the cardiovascular system indicates the sufficient adaptive reserves of the body in student youth. In the future, analysis of total fat content, indicators of lipid metabolism and functional adaptability of the cardiovascular system in students will make possible to assess the degree of disorders risks and carry out work aimed at developing recommendations for increasing the compensatory and adaptive capabilities of the body.

Conclusion

Thus, female students had higher concentrations of TC, HDL-C and LDL-C in the blood serum compared to male students. It has been established that TBF was higher in girls while BMI values had no gender differences. The amount of total body fat correlated with HR only in girls. Functional parameters and adaptive capabilities of the cardiovascular system did not differ among students of both sexes and corresponded to the age norm.

Conflict of Interests

The authors declare that there is no conflict of interests.

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