

**Hemodynamic criteria of the circulatory system in ethnic groups of students with different types of autonomic regulation of the heart rate**

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**Abstract.**

Under physiological conditions, the first years of university studies of the students of Arabic and African subgroups with moderate parasympathetic autonomous regulation (MPAR) and self-regulation (SR) were characterized by toughness, low effectiveness of the system of blood circulation, increased peripheral vascular resistance, vascular type of self-regulation of blood circulation (TSC) ; Indian and Latino-American subgroups with MPAR SR revealed the weakness and low efficiency of the circulatory system, the optimal general peripheral blood circulation (GPBC) and cardiovascular type of self-regulation of blood circulation (TSC) were revealed in Indian and Latino-American subgroups with moderate parasympathetic autonomous regulation self-regulation (MPAR SR) and subgroups with pronounced parasympathetic autonomous regulation self-regulation(PPAR SR) showed high endurance of the circulatory system. The Russian subgroup with moderate parasympathetic autonomous regulation self-regulation( MPAR SR) has the highest endurance of the circulatory system and current functional fatigue, the most marked in the subgroup with pronounced parasympathetic

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autonomous regulation( PPAR) increased general peripheral blood circulation and cardiovascular type of self-regulation of blood circulation.

**Keywords:** hemodynamic parameters, endurance and efficiency of the circulatory system, the type of self-regulation, the type of autonomous regulation of the heart rate.

**Introduction**

The adaptation of the organism to environmental factors is realized due to the rapid restructuring of the cardiovascular system activity under the control of the autonomous nervous system, which causes its functional changes taking into account the environmental factors affecting the organism [1,5]. The pressure function of the heart and muscle tone of blood vessels, their reserve capabilities, dynamics and stability of cardiovascular homeostasis are characterized by the shifts in the parameters of central and peripheral hemodynamics [2, 3]. Autonomous mechanisms of regulation of SR and blood pressure components ensure minimum consumption of energy and metabolic resources of the body in a state of relative rest and more significant in a state of intense functioning [4, 6].

**The aim of research:** a comparative analysis of the functioning of the circulatory system, taking into account the type of autonomous regulation of heart rate in first-year students of different ethnic groups.

**Materials and methods of research**

The research of the functional status of the circulatory system among the students of initial courses (101 students aged 20-25 years of five ethnic groups-Arab, Indian, African, Latin American, Russian) was carried out in October 2016 in the laboratory "Physiology of adaptation processes" of the Belgorod State National Research University. All the students gave consent to participate in the work and processing of

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personal data in accordance with the Helsinki Declaration of the World Medical Association (WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, 2013). We determined heart rate (HR, min<sup>-1</sup>) and blood pressure (BP, mm of mercury) of these students using standardized methods [1, 3]. Further, with the help of these hemodynamic parameters we calculated informative indexes of cardiovascular endurance factors (CEF, conv. un.) and efficiency (IE, conv. un.), total peripheral vascular resistance (TPVR, din. s sm<sup>-5</sup>), type of self-regulation of blood circulation (TSC, %) for each student. [1,6]. The leading type of autonomic regulation of heart rate HR was determined by two parameters of heart rate variability (HRV) – stress index (SI, conv. un. 1) and the power of the very low-frequency component of the total VLF spectrum (mc<sup>2</sup>) HRV [7]. These HRV parameters were determined by the parameters of computer ECG recorded for 5 minutes using the software module "Poly-Spectrum-Rhythm "(LLC" Neuro soft", Ivanovo) [5].

We evaluated indexes of hemodynamics of the numerical prevailing in each ethnic group students of the two subgroups:

1) with the third type – moderate parasympathetic autonomous regulation of SR (MPAR SR, with IT equal to 30-100 conv. units, VLF-more than 240 mc<sup>2</sup>);

2) with the fourth type – pronounced parasympathetic autonomous regulation (PPAR SR, at a value of IT – 30-100 conv. units, VLF – more than 240 mc<sup>2</sup>) [7, 8].

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Students with the first and second type-with moderate or pronounced central regulation of SR, in these groups were absent or were presented singly. The resulting digital material is processed using a package of computer programs "Statistica 6.0". The significance of differences was determined by the student's t-criteria, assuming a critical significance level of p equal to or less than  $\leq 0.05$ .

**Research results and discussion**

The average values of CE in students of the three subgroups (Arabic, African and Russian) with MPAR SR were reduced against the norm of 16 conv. units [6], corresponding to the increased level of training of their cardiovascular system (table.). The Indian subgroup in comparison with the Russian one CE was higher ( $p \leq 0.05$ ), indicating the weakening of their functions of the heart and blood vessels. The CE values of students with PPAR SR-African, Russian, Latin American, Indian and Arab subgroups were reduced against the norm by 6,9%, 10,4%, 11,9%, 21,9% and 30.1% respectively. This result indicated an increase in students` level of endurance and training of the cardiovascular system in this number of subgroups Table (1) .

Table (1) Hemodynamic parameters in ethnic groups of students taking into account the dominant types of autonomous regulation

CE, conv. en.	CEC, conv. en.	GPBC, conv. en.	TSC, %	CE, conv. en.	CEC, conv. en.	GPBC, conv. en.	TSC, %
The third type of regulation SR –MPAR				The fourth type of regulation SR –PPAR			
Subgroups of Arab students							
14,5± 1,65	3390± 289,1	1899± 113,9	117,3± 5,01	11,1± 1,15	3228± 263,7	1666± 69,5	114,6± 3,89
Subgroups of Indian students							
18,1± 1,69	3302± 262,4	1348± 96.	95,7± 7,93	14,9± 0,72	3331± 225	1397± 87,9	101,7± 4,08

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Subgroups of African students							
14,1± 1,00	3199± 255,1	1729± 110,9	115,8± 9,55	12,5± 0,60	3259± 280,8	1853± 156,3	117,9± 7,80
Subgroups of Latin American students							
16,6± 1,35	3311± 246,0	1432± 76,5	97,4± 4,00	14,1± 1,54	2968± 149,9	1501± 103,9	107,6± 5,60
Subgroups of Russian students							
12,7± 1,63	3066± 116,8	1822± 60,3	106,1± 2,53	14,5± 0,91	3702± 278,4	1866± 96,2	107,2± 5,5

All ethnic subgroups of students with the third type of MPAR SR had average values of CEC above the norm-2500-3000 conv. un. [6], indicating an increase in their fatigue of the circulatory system (see table.). Only in the Latin American subgroup of students with the fourth type of PPAR SR, the value of CE corresponded to the upper limit of the norm. In other subgroups of students with this type of self-regulation CE values were not significantly higher than the norm, but in the Russian subgroup it was the highest, indicating the functional fatigue of the circulatory system in its students (see table.).

Values of GPBC in two ethnic subgroups – Indian and Latino-American, MPAR and PPAR SR corresponded to the norm equal to 1200-1600 dyn.s. sm-5 [6], and at students of the African, Russian and Arab subgroups exceeded it by 18,8%, 13,9% and 8,0% respectively. In all subgroups of students with PPAR SR, the values of GPBC corresponded to its severity at students with the third type of regulation. We believe that this result was due to an increase in the sympathetic influence on the muscle tone of the vessels on the background of their enhanced parasympathetic effect on myocardial contraction.

The Arab and African subgroups of students with the third and fourth type of SR regulation were dominated by vascular TSC [6]. As the most economical and effective, it is aimed at stabilizing the functional status of the circulatory system by

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changing the tone of the walls of its vessels, while reducing the load on the contractile function of the myocardium (see table.). In other ethnic subgroups of students the regulation of functions of the circulatory system was carried out at the expense of cardiovascular TSC, the mechanisms of which are associated with changes in the functional activity of the heart and blood vessels.

**Conclusion**

The revealed informative indices of the circulatory system in students of different ethnic groups, taking into account the peculiarities of autonomous regulation of SR, allowed to evaluate its functional status and to establish that:

1. The weakness of the circulatory system was revealed in students of the Indian and Latin American subgroups in the conditions of relative physiological rest. A high level of its endurance and training was found in students with the MPAR of the Arab, African and Russian subgroups and all subgroups with the PPAR SR.

2. Exceeding the norm, the values of CEC indicated fatigue and a decrease in the circulatory system in subgroups of students of Arab, Indian and African with MPAR and PPAR SR. The highest fatigue and low efficiency of the circulatory system were found in students of the Russian subgroup, and the corresponding physiological norm – in the Latin American subgroup with PPAR SR.

3. Values of GPBC in Indian and Latin American subgroups exceeded the limit of the norms under the sympathetic influence on the components of the circulatory system with simultaneous reduction of the force of myocardial contraction, strengthening the muscle tone of vascular walls and decreasing their lumen in the systemic circulation. The values

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of the GPBC corresponded to the physiological norm in students of Arab, African and Latin American subgroups with MPAR and PPAR SR.

4. Vascular TSC determining the functional reserves and efficiency of the circulatory system dominated in the Arab and African subgroups of students with MPAR and PPAR SR. The other subgroups students with MPAR and PPAR SR were less economical cardiovascular TSC was revealed in other subgroups of students with MPAR and PPAR SR.

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MPAR- moderate parasympathetic autonomous regulation

SR - self-regulation

TSC - type of self-regulation of blood circulation

GPBC- general peripheral blood circulation

PPAR- pronounced parasympathetic autonomous regulation

HR –heart rate

BP - blood pressure

CEF - cardiovascular endurance factors

IE –index of efficiency

TPVR- total peripheral vascular resistance

HRV- heart rate variability

SI –stress index

IT- index of tension

CEC- coefficient of efficiency of blood circulation



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**معايير الدورة الدموية في الجهاز الدوري لمجاميع مختلفة من الطلبة الاجانب مع اختلافات التنظيم اللاارادي لمعدل ضربات القلب  
الخلاصة:**

في ظل الظروف الفسيولوجية، تميزت السنوات الأولى من الدراسات الجامعية للطلاب الاجانب ( العربية والأفريقية) ان لديهم تنظيم ذاتي معتدل بالدورة الدموية متميز بالصلابة وانخفاض في فعالية نظام الدورة الدموية وزيادة مقاومة في الأوعية الدموية الطرفية. في حين كشفت مجموعات من الطلبة الاجانب (هندية وأمريكية لاتينية) ذات تنظيم ذاتي معتدلة من بالدورة الدموية متميز بالضعف وانخفاض في فعالية في الدورة الدموية ، بينما كانت المجموعات الفرعية الأمريكية ذات تنظيم الحركي المعتدل في الدورة الدموية ، حيث كان التنظيم الذاتي لهذه المجموعات ذو قابلية على التحمل العالي للجهاز الدوري . اما طلاب دولة الروسية ذات التنظيم المعتدل للجهاز العصبي السمبتاوي كانت اعلى قدرة على التحمل في الدورة الدموية ، والأكثر تميزاً في المجموعة الفرعية بالتنظيم الذاتي للأعصاب ، وزيادة الدورة الدموية العامة الطرفية ونوع القلب والأوعية الدموية للتنظيم الذاتي للدورة الدموية.

**الكلمات الدالة:** الدورة الدموية، ونظام الدورة الدموية ، والتنظيم الذاتي، ومعدل ضربات القلب