

Hemodynamic Criteria of the Circulatory System in Ethnic Groups of Students with Different Types of Autonomic Regulation of the Heart Rate

Mohammed J.I. Al-Shammari¹, Tatyana A. Pogrebnyak^{1*}, Elena N. Khorolskaya¹, Oxana V. Vorob'eva¹ and Irina V. Sagalaeva¹

1. Belgorod State University, 85, Pobedy Str., Belgorod, 308015, Russia.

Correspondence author: Tatyana A. Pogrebnyak, e-mail: pogrebnyak@bsu.edu.ru

Received: 16-05-2019, Revised: 11-06-2019, Accepted: 15-07-2019, Published online: 23-08-2019

How to cite this article: Mohammed J.I. Al-Shammari, Tatyana A. Pogrebnyak, Elena N. Khorolskaya, Oxana V. Vorob'eva and Irina V. Sagalaeva (2019) Hemodynamic Criteria of the Circulatory System in Ethnic Groups of Students with Different Types of Autonomic Regulation of the Heart Rate, *Journal of International Pharmaceutical Research* 46(4): 237-241

Abstract

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

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, 6-8, 20]. 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 [7, 9, 18, 19]. Monitoring and analysis of hemodynamic parameters allows to assess the current state of the cardiovascular system and the activity of Central and Autonomous mechanisms of regulation of its functions and the body as a whole at any time [5, 10, 21].

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 (NRU "BelSU"). All the students gave consent to participate in the work and processing of 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⁻¹) and blood pressure (BP, mm of mercury) of these students using standardized methods [1, 6, 9, 11]. 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-5), type of self-regulation of blood circulation (TSC,%) for each student. [5-7, 12, 13, 15, 16]. 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.) and the power of the very low-frequency component of the total VLF spectrum (mc2) HRV [3, 14, 17]. These HRV parameters were determined by the parameters of computer ECG recorded for 5 minutes using the

software module "Poly-Spectrum-Rhythm "(LLC" Neurosoft", Ivanovo) [3]. 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 HR (MPAR HR , with IT equal to 30-100 conv. units, VLF-more than 240 mc²);

2) With the fourth type – pronounced parasympathetic autonomous regulation (PPAR HR, at a value of IT – 30-100 conv. units, VLF – more than 240 mc²) [2, 10, 11].

Students with the first and second type-with moderate or pronounced central regulation of HR, 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 ≤ 0.05 .

Research Results and Discussion

The analysis of the average marked values of CE in five ethnic groups of students is presented in figure 1.

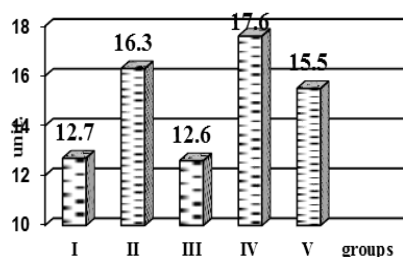


Fig. 1: Distribution of groups of ethnic students by mean values of CE (unit.):

Groups: I - Arabic, II - Indian, III - African, IV - Latin American, V - Russian.

The highest level of training of the circulatory system was found in students of Arab and African groups. Their endurance coefficients were 12.7 and 12.6 conv. units and were below normal – 16 conv. units [12]. Compared to them, the Indian and Latin American groups of students had higher than average CE ($p \leq 0.05$) norms. We noted the weakening of their activity and functionality of the heart and blood vessels. In students of three subgroups (Arabic, African and Russian) with MPAR HR values of CE were reduced against the norm and corresponded to a high level of training of the cardiovascular system and the body as a whole (table. 1) This decrease in the values of CE in the African, Russian, Latin American, Indian and Arab subgroups of students with PPAR HR was 6.9%, 10.4%, 11.9%, 21.9% and 30.1% respectively. These data indicated an increase in the level of endurance and training of the cardiovascular system in the given number of subgroups of students.

The value of CEC characterizes the efficiency of the functioning of the circulatory system on the load and is a universal indicator of resistance to it as well as a reliable criterion of its status [13]. The physiological value of CEC is comparable with the volume of blood per minute, since both indicators reflect the body's output of blood movement in the vascular channel. Normally it is equal to 2500-3000 conv. units [13]. In all groups of students, the average values of CEC exceeded the physiological norm, indicating the fatigue of the myocardium and a decrease in its systolic activity, with the activation of more economical use of the reserves of the circulatory system (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
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

The highest average CEC values were found in Arab and African students. They testified to the tension of the mechanisms of autonomous regulation of HR in these groups of students in conditions of relative rest. The revealed average values of CEC for each ethnic group of students are shown in figure 2.

Analysis of the marking of CEC values taking into account the type of vegetative regulation of HR showed that only in the Latin American subgroup of students with the fourth type of PPAR HR, the CEC value corresponded to the upper limit of the norm.

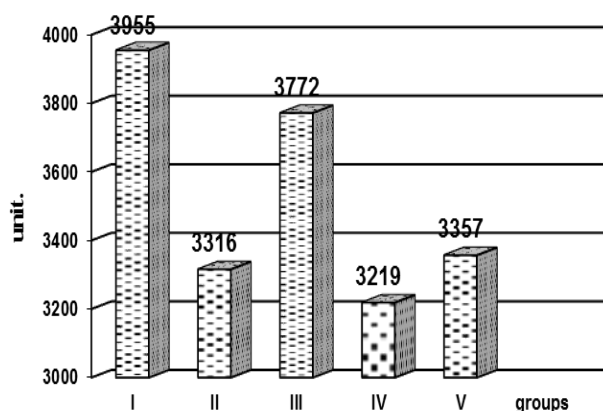


Fig. 2: Distribution of groups of ethnic students by average values of CEC(unit.);

groups: I - Arabic, II - Indian, III - African, IV - Latin American, V - Russian.

In subgroups of students with the third and fourth types of autonomous regulation of HR, average values of CEC were higher than normal, indicating a decrease in their systolic myocardial activity (see table 1). In other subgroups of students with these types of HR regulation, the HR values exceeded the norm and in the Russian subgroup it was the highest, indicating a pronounced functional fatigue of the cardiovascular system in students (see table 1).

Peripheral resistance of the walls of small arterial vessels and arterioles exerts pressure on the blood flowing in them. It is the main mechanism that provides redistribution of blood in the vessels of the circulatory system. According to the physiological norm, the values of TPVR are 1200-1600 DIN.S. sm-5 [13].

Only students of the Indian and Latin American groups had the average values of the TPVR corresponding to the norm. In other groups of students they exceeded the norm: 10% in the Arab group, 1.35 times in Russian and 1.9 times in African groups (see Fig. 3). These indicators showed that various changes in life situations are necessarily accompanied by the redistribution of blood in the blood vessels of the body. The average values of the TPVR only in two

ethnic subgroups – Indian and Latin American, with moderate and pronounced autonomous regulation of the HR corresponded to the norm.

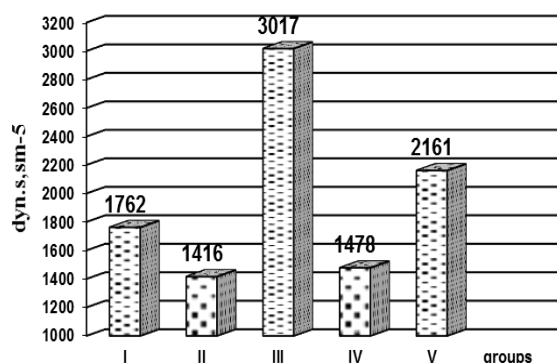


Fig. 3: Distribution of groups of ethnic students according to the average values of the TPVR (dyn.s.sm-5);

groups: I - Arabic, II - Indian, III - African, IV - Latin American, V - Russian.

The values of TPVR in other groups of students with MPAR and PPAR HR exceeded the upper limit of the norm by 12.5% and 4.1% respectively – in Arabic, 8.1% and 15.8% – in African, 14.0% and 16.6% – in Russian groups (see Fig.4).

The indices of TPVR in all subgroups of students with PPAR HR corresponded to its intensity in students with the third type of regulation of HR. We believe that this result was due to the increased against the norm regulatory activity of both parts of the autonomic nervous system ANS – the simultaneous effect of the sympathetic nervous system on the muscle tone of the vessels and parasympathetic – on the force of myocardial contraction.

TSC values reflect the phenotypic characteristics of the body and are objective prenosological integral indicators at the individual level. They allow us to assess the level of tension of the nervous mechanisms and adaptive reactions of the cardiovascular system in the body. Thus, the change in the activity of the mechanisms of regulation of blood circulation in the direction of the predominance of the vascular component indicates its economization and increase of functional reserves [13]. The Arab and African subgroups of students with the third and fourth type of autonomous regulation of HR were dominated by vascular TSC (see table 1). As the most effective and economical, it is mainly aimed at changing of the muscle tone of the walls of blood vessels while simultaneously reducing the load on the contractile function of the myocardium. This mechanism is aimed at stabilization, economization and increase of functional reserves of the functional status of the circulatory system. The Indian, Latin American and

Russian groups were dominated by cardiovascular type. It provides stability of functioning of myocardium and vascular system to various unexpected or short-term irritating influences of environmental factors.

Figure 4 shows the distribution of students in groups based on their type of self-regulation of blood circulation.

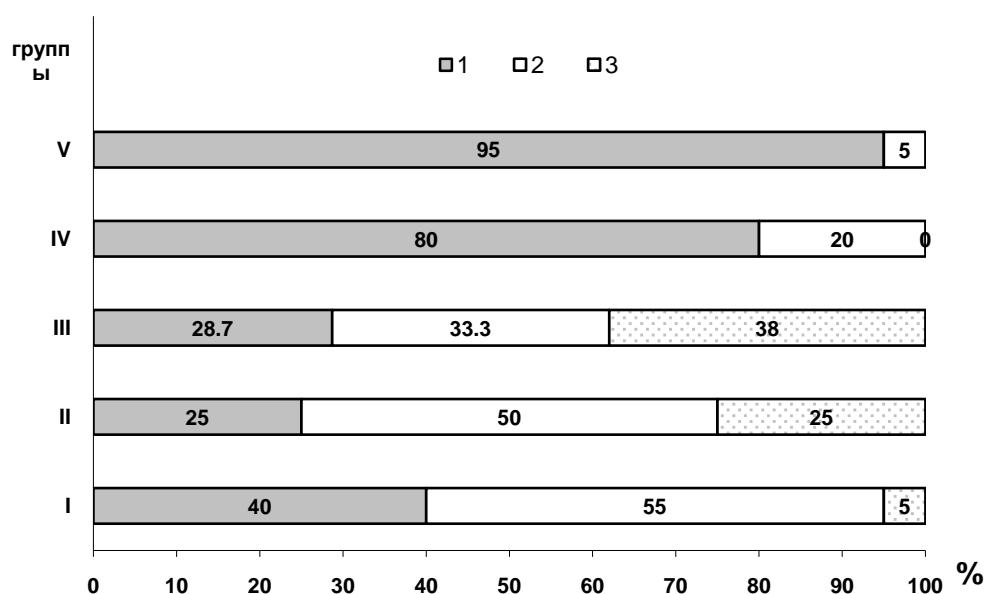


Fig.4: Distribution of students (in %) by individual values of TSC (cont. unit: 1 – cardiac, 2 – cardiovascular, 3 – vascular; I-V groups of students).

According to individual values of TSC in most of the students of groups IV and V – 80% and 95%, respectively, HR was active, which in conditions of relative rest determined the value of blood pressure and systolic volume of blood due to a higher heart rate and indicated the maladaptation of the circulatory system in students of these groups to the conditions of relative physiological rest. This type of self-regulation was least represented in the Arab and Latin American groups.

Cardiovascular TSC prevailed in the majority of students of the Arab group, half of the Indian and third part of the African. Its mechanisms can simultaneously change the functional activity of the heart and blood vessels. Only one third of African students, one fourth of Indian students and one Arab had active vascular TSC (see Fig. 4). This part of the students has been most adapted to the current conditions and loads.

Conclusion

The revealed informative indices of the circulatory system in students of different ethnic groups, taking into account the peculiarities of autonomous regulation of HR, 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 HR.

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 HR. 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 HR.

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

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 HR. The other subgroups students with MPAR and PPAR HR were

less economical cardiovascular TSC was revealed in other subgroups of students with MPAR and PPAR HR.

References

- Al-Shammari, M.YA., Pogrebnyak, T.A., 2013. Assessment of the physiological status of students by hemodynamics indicators. "The scientific community of students of the XXI century. Natural Sciences": materials of the XII student international scientific-practical conference. (October 10, 2013) - Novosibirsk ed. SibAK: 7-11. (In Russian)
- Gorst, V.R., Gorst, N.A., 2004. The level of adaptation of the cardiovascular system in adolescence and dysregulation processes. *Almanac «New Studies»*, 1-2 (6-7): 133-134. (In Russian)
- Mikhailov, V.M., 2000. Heart rate variability: Experience of practical application: medical. *Academy*:5-240.
- Melnikov, A. Kh., 2000. Indicators of heart rate variability in assessing the level of adaptation of young people. *Bulletin of Arrhythmology*, 16: 53-55.
- Yavorovskaya, L.N., 2003. The problem of the adaptation of first-year students to the process of learning in a higher school. *Actual problems and non-continuous studies: materials of all-env. sciences. prak conf. Kharkiv*:106-107.
- Al-Shammari, M.YA., Pogrebnyak, T.A., 2015. Comparative analysis of the adaptation of the circulatory system in foreign students under physiological conditions. *Scientific Research*, 1 (3): 48-55.
- Deepa Padmaja, Manikandan Palanivelu, Babu Ganesan, Seena, Arunraj Natarajan. "Formulation, Evaluation and Validation of Newly Formulated Laportea Arishta." *International Journal of Pharmacy Research & Technology* 4.2 (2014), 10-17.
- 8 Surendar, A. "Letter from the desk of editor's" (2018) *International Journal of Pharmaceutical Research*, 10 (1).
- Kosovanova, L.V. Melnikov, M.M., Aizman, R.I. , 2003. Screening diagnosis health schoolchildren and students. *Novosibirsk: Sib. univ publishing house*: 119-127, 195-206.
- Shlyk, N.I., Zufarova, E.I., 2013. Standards of indicators of heart rate variability in the studied 16-21 years with different predominant types of vegetative regulation. *Bulletin of Udmurd University*, 4: 97-105.
- Chuyan, E.N., Biryukova, E.A., Rawaeva, M.Yu., 2008. A comprehensive approach to assessing the functional state of the body of students. *Uchenye zapiski Tavricheskogo Natsionalnogo Universiteta im. V.M. Vernadsky*, 21 (60). 1: 123-139.
- Khomyakov, G.K., Utyasheva, I.M., 2011. Index of efficiency of blood circulation as an indicator of functional condition of heart-vascular system. *Scientific-theoretical journal "Uchenye zapiski"*, 5 (75): 125-128.
- Tkachenko, B.I., 2009. Systemic hemodynamics. Selected lectures on modern physiology. *Under the editorship of M. A. Ostrovsky and A. L. charges. The Art Café*: 138-139.
- Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996. Heart Rate Variability. Standards of measurement, physiological interpretation, and clinical use. *Eur. Heart J.*, 17 (3): 354-381.
- Mohammadi N, Gupta R. Investigation of Emulgen Possibility of Piroxicam and Developing of the Method. *Medbiotech Journal*. 2017;01(02):73-8.
- Salah M, Jonbu S. Investigation of Verpamil Effect as Adjuvant Anaesthetic Drug. *Medbiotech Journal*. 2017;01(01):42-7.
- Mirzaei B. Investigation of Antibacterial Effects of Medicinal Plants on Bacterial Pathogens of Patients. *Medbiotech Journal*. 2017;01(02):85-9.
- Waheed S, Kafaei J. A review on Medication Heavy Metals and Current Assay Methods. *Medbiotech Journal*. 2018;02(04):136-41.
- Eslami S, Sarlak M. Forced Degradation Tests of Ampicillin in Medication Forms. *Medbiotech Journal*. 2018;02(03):113-7.
- Abdulhameed AA, Al-Hamdi KE, Mathkooor MA. Clinical Evaluation of Efficacy and Safety of Combined Topical Timolol and Oral Propranolol in Children with Infantile Hemangioma. *J Clin Exp Invest*. 2018;9(1):1-8.
- Htwe, O., Lloyd, S., Ng, M. H., Richard, A., Rashid, A., Halim, A., ... & Ibrahim, S. (2018). Urine hydroxyproline correlates with progression of spasticity in cerebral palsy. *European Journal of General Medicine*, 15(1).

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