International Journal of Biomedicine 11(2) (2021) 169-172
http://dx.doi.org/10.21103/Article11(2)_OA9

ORIGINAL ARTICLE

Sports Medicine

INTERNATIONAL JOURNAL OF BIOMEDICINE

The Peculiarities of Heart Rate Variability in Student Athletes

Andrew K. Martusevich, PhD, ScD[1,2*]; Ivan V. Bocharin[1,2]; Natalia A. Ronzhina[1]; Solomon A. Apoyan[1]; Levon R. Dilenyan, PhD[1]; Maxim S. Gurjanov, PhD, ScD[1]

[1]Privolzhsky Research Medical University
[2]Nizhny Novgorod State Agricultural Academy
Nizhny Novgorod, Russia

Abstract

Background: Currently, the assessment of heart rate variability (HRV) is one of the most common indicators of the condition of the cardiovascular system. The aim of this research was to study the peculiarities of heart rate variability (HRV) and microcirculation in students, depending on their sport specialization.

Methods and Results: Our study included the results of a survey of 96 students from 18 to 21 years of age who were the members of the national teams of their universities in athletics (n=49) and floorball (n=47). For ECG registration and analysis of hemodynamic findings, including those characterizing the HRV, we used the "Medical Soft" sports testing system ("MS FIT Pro"). For monitoring, we used the standard hemodynamic patterns (blood pressure, HR, stroke volume, cardiac output, and others), statistical and spectral indicators of the HRV, as well as an integral criterion of the state of microcirculation. The studied HRV parameters in most students generally were within the age range. At the same time, track and field athletes have large adaptive resources and, consequently, a more optimal level of myocardial fitness, in comparison with floorball players.

Conclusion: The orientation of sports training among students affects heart condition.(**International Journal of Biomedicine. 2021;11(2):169-172.**)

Key Words: heart rate • heart rate variability • athletes • students • hemodynamics

For citation: Martusevich AK, Bocharin IV, Ronzhina RA, Apoyan SA, Dilenyan LR, Gurjanov MS. The Peculiarities of Heart Rate Variability in Student Athletes. International Journal of Biomedicine. 2021;11(2):169-172. doi:10.21103/Article11(2)_OA9

Abbreviations

HR, heart rate; **HRV**, heart rate variability; **SBP**, systolic blood pressure; **DBP**, diastolic blood pressure.

Introduction

Currently, the assessment of heart rate variability (HRV) is one of the most common indicators of the condition of the cardiovascular system.[1-3] It has been shown that HRV analysis is able to verify both the intracardiac mechanisms of hemodynamic regulation and the nature of external (neurohumoral, metabolic and other) influences on the heart rate (HR).[1,2,4,5] On this basis, an integrated study of HRV has demonstrated its informative value in various diseases and pathological conditions, including directly cardiological (for example, hypertension[6]) and extracardiac pathology (in particular, severe burns [7] and alcohol withdrawal [8]).

A separate aspect of the use of the HRV examination is to monitor the state of various social groups, including the youth, who a priori should be classified as "practically healthy persons." [9,10] However, this group showed various disorders of the cardiovascular system,[3,9,10] and from the standpoint of diagnosing premorbid pathology, this problem has not been studied in depth. Another poorly covered problem is the analysis of cardiovascular reserves in most students who are actively involved in sports.[3,11,12] In this regard, there is certain information on load tolerance[12,13] and stressful situations.[11,14]

***Corresponding author**: Prof. Andrew K. Matrusevich, PhD, ScD. Privolzhsky Research Medical University, Nizhny Novgorod, Russia. E-mail: cryst-mart@yandex.ru*

Furthermore, there is indication of a connection between the progress of students in study and the level of their physical activity, according to HRV parameters.[11,14,15] At the same time, there exists only indirect evidence of the unequal state of the HR depending on the sports orientation of the student.[16,17] It is essential to mention that taking this fact into consideration can affect the degree to which negative cardiovascular incidents are detected.[18-20] This determines the necessity for more detailed examination of HRV condition in various groups of students.[21]

The aim of this research was to study the peculiarities of HRV and microcirculation in students, depending on their sport specialization.

Material and Methods

Our study included the results of a survey of 96 students from 18 to 21 years of age who were the members of the national teams of their universities in athletics (n=49) and floorball (n=47). The study was carried out in the middle of the day, in a calm condition (in the intersessional period, the days free from tests or seminars) according to the standard rules of procedure for taking an ECG.[1,2,5,6] For ECG registration and analysis of hemodynamic findings, including those characterizing the HRV, we used the "Medical Soft" sports testing system ("MS FIT Pro", Russia). For monitoring, we used the standard hemodynamic patterns (blood pressure, HR, stroke volume, cardiac output, and others), statistical and spectral indicators of the HRV, as well as an integral criterion of the state of microcirculation.[1-5] All the values of these indicators were calculated automatically, taking into account the system software.

Statistical analysis was performed using the Statistica 6.1 software package (StatSoft Inc, USA). A probability value of $P<0.05$ was considered statistically significant.

Results

We assessed statistical indicators characterizing the HRV of students included in the formed groups (Figures 1-4). It was found that representatives of both groups do not deviate from the age standard for blood pressure.(Fig.1) At the same time, the SBP level in floorball players exceeded that in runners ($P<0.05$). On the contrary, no differences were found in the DBP level.

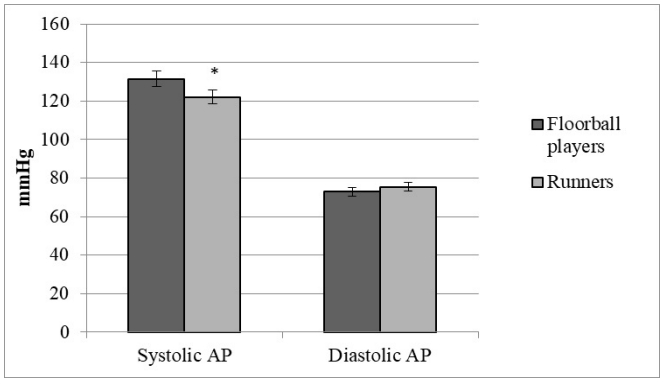

Fig. 1. *The level of SBP and DBP in students, depending on their sports specialization. * - P<0.05*

Also, the peculiarities of the HR in floorball players were relative tachycardia, compared to the group of runners (Fig.2); however, in almost all representatives of both groups, the values of the measurements were in the physiological range.[1,3,4,10] It should be noted that the visible tendency may indicate better physical fitness of runners, as it creates a reserve to increase the HR.[4,15] The same is evidenced by the patterns associated with the HR—stroke volume (Fig.2) and cardiac output (Fig.3)—which were found in runners at a lower level than in floorball players due to the adaptive restructuring of cardiohemodynamics.[11-14]

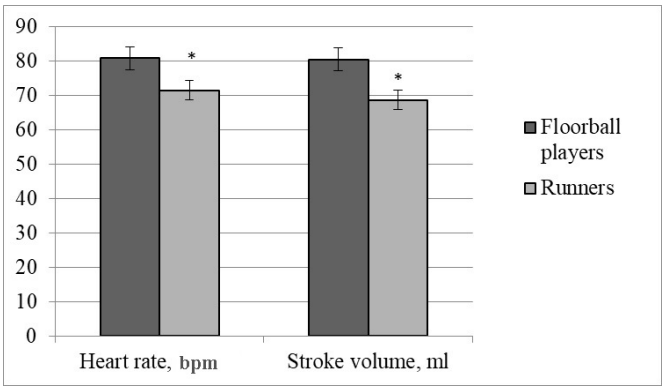

Fig. 2. *The HR and stroke volume in the students, depending on their sports specialization * - P<0.05*

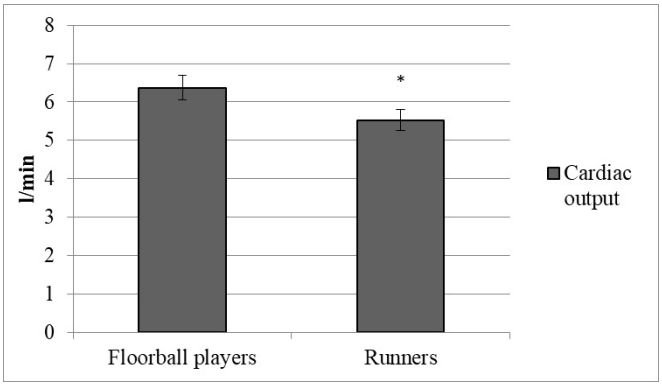

Fig 3*. The level of cardiac output in students, depending on their sports specialization.* * - P<0.05*

With regard to the pNN50 indicator (the percentage of adjacent NN [normal-to-normal] intervals that differ from each other by more than 50 ms), floorball players significantly outperform runners, showing a level of about 35%, which may indicate an increased risk of arrhythmogenic incidents in students of this group (Fig.4).

The study of the spectral analysis of the HR (Fig.5) showed that the ratio of the spectrum powers in the low and high frequency ranges (LF/HF), observed as the main spectral indicator of the autonomic support of cardiac rhythm, indicates its shift in floorball players towards sympathetic stimulation of the myocardium.[2,4,6,17] This is also proved by the level of the stress index in the representatives of the study groups.

Finally, the diagnostic measures we used allowed us to make a point assessment of microcirculation in student-

sportsmen (Fig.6). It was revealed that the activity of microcirculation is significantly higher in runners than in floorball players. At the same time, in the representatives of both groups, this parameter was within the physiological limits.

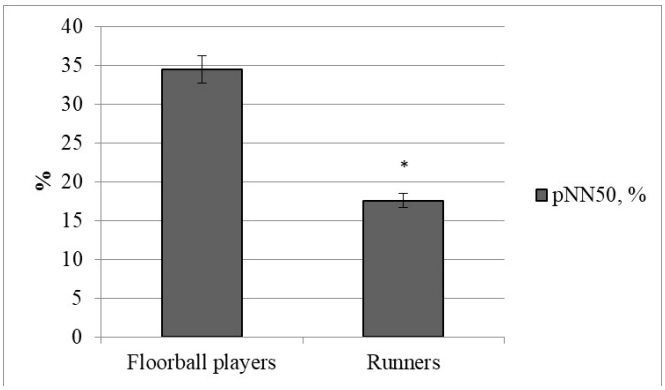

Fig. 4. *The pNN50 indicator in students, depending on sports specialization. * - P<0.05*

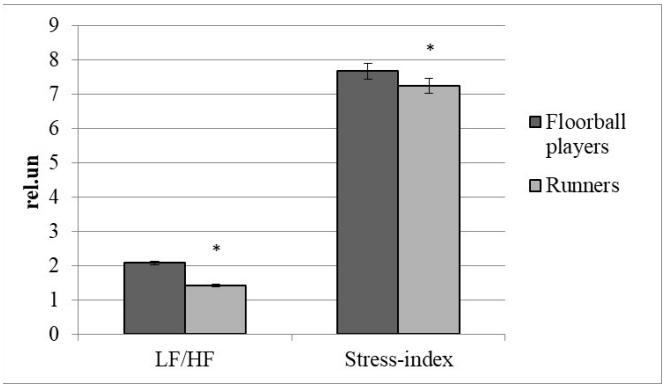

Fig. 5. *The LF/HF index and stress-index in students, depending on sports orientation. * - P<0.05*

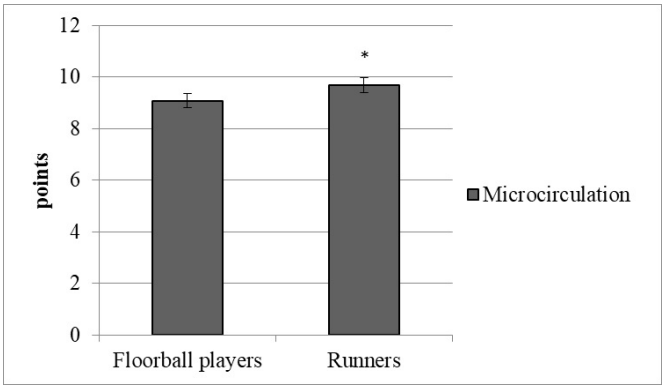

Fig. 6. *The level of microcirculation in students, depending on sports orientation. * - P<0.05*

Discussion

On the one hand, the health of the youth has been researched in a significant number of studies,[3,10,11] but, on the other hand, it continues to deteriorate due to a lifestyle that is not always correct, an increasing academic load and a decrease in physical activity.[3,5,16] This is especially true for students studying at a medical university, who experience a high level of psychoemotional stress associated with a large volume of assimilated material and extensive practical training.[5,10] It has been shown that the decline in health does not stay the same but progresses during the academic year.[10,14,15] In this regard, the program "Sport is the second profession of a doctor," which is currently being implemented, seems to be timely. At the same time, strict medical monitoring of the basic functional systems of students while they are playing sports is obligatory.[11-16,18-21] From the indicated positions, the evaluation of systemic hemodynamics was monitored by assessing the HRV,[10,11,13-16,19] which serves as an informative indicator of the direction of the influence of sports activity on the organism of students.

Currently, the study of HRV is the common way to test the functional reserves of the cardiovascular system of athletes;[12-20] however, in relation to students who systematically go in for sports, such data are few. Therefore, within the framework of our research, hemodynamic evaluation was assessed using the "Medical Soft" sports testing system, on the basis of which not only the HRV features in the student-sportsmen were established, but it was also demonstrated that the chosen sport affects the features of cardiovascular adaptation to loads. So, under conditions of physiological rest, in runners relative to floorball players, a lower level of SBP, HR, and, as a consequence, decreased values of stroke volume and cardiac output were recorded. Moreover, runners had a higher level of the indicator characterizing microcirculation. Such data indicate that although all measurements are within the age range for representatives of both groups, runners have larger resource for adapting the cardiovascular system to intensive activities.

In conclusion, the studied HRV parameters in most students generally are within the age range. At the same time, track and field athletes have large adaptive resources and, consequently, a more optimal level of myocardial fitness, in comparison with floorball players. Thus, the orientation of sports training among students affects heart condition.

Competing Interests

The authors declare that they have no competing interests.

References

1. Baevskiĭ RM. Analiz variabel'nosti serdechnogo ritma v kosmicheskoĭ meditsine [Analysis of variability of cardiac rhythm in space medicine]. Fiziol Cheloveka. 2002 Mar-Apr;28(2):70-82. [Article in Russian].
2. Nozdrachev AD, Shcherbatykh IuV. Sovremennye sposoby otsenki funktsional'nogo sostoianiia avtnomnoĭ (vegetativnoĭ) nervnoĭ sistemy [Current methods of evaluation of functional status of the autonomic nervous system]. Fiziol Cheloveka. 2001 Nov-Dec;27(6):95-101. [Article in Russian].
3. Pichon A, Nuissier F, Chapelot D. Heart rate variability and depressed mood in physical education students: a longitudinal study. Auton Neurosci. 2010 Aug 25;156(1-2):117-23. doi: 10.1016/j.autneu.2010.03.019.

4. Kotel'nikov SA, Nozdrachev AD, Odinak MM, Shustov EB, Kovalenko IIu, Davydenko VIu. Variabel'nosti ritma serdtsa: predstavleniia o mekhanizmakh [Variability in heart rhythm: approaches to mechanisms]. Fiziol Cheloveka. 2002 Jan-Feb;28(1):130-43. [Article in Russian].
5. Sztajzel J. Heart rate variability: a noninvasive electrocardiographic method to measure the autonomic nervous system. Swiss Med Wkly. 2004 Sep 4;134(35-36):514-22.
6. Ostroumova OD, Mamayev VI, Nesterova MV, Kuzmichev IA, Martynov AI. [SPECTRAL ANALYSIS OF HEART RATE FLUCTUATIONS IN PATIENTS WITH ESSENTIAL HYPERTENSION]. Russian Journal of Cardiology. 2000;(6):60-64. [Article in Russian].
7. Peretyagin SP, Martusevich AK, Borisov VI. [Investigation of heart rate variability in patients with burns]. Vestnik Anesteziologii i Reanimatologii. 2011;8(4):10-14. [Article in Russian].
8. Martusevich AK, Zhukova NE. [Heart rate variability in the dynamics of the alcohol abstinence syndrome reduction]. Voprosy Nakrologii. 2011;4:11-16. [Article in Russian].
9. Bocharin IV, Martusevich AK, Guryanov MS, Kiseliv YaV, Kanatyev KN, Polebentsev SN. [Results of screening examination of the cardiovascular system of students of Nizhny Novgorod]. International Journal of Medicine and Psychology 2020; 3(1):118-121. [Article in Russian].
10. Pershina TA, Spitsin AP. [Peculiarities of hemodynamics in junior students with a hereditary history of arterial hypertension during examination stresses]. Gig Sanit. 2013 May-Jun;(3):80-5.[Article in Russian].
11. Britton DM, Kavanagh EJ, Polman RCJ. Validating a Self-Report Measure of Student Athletes' Perceived Stress Reactivity: Associations With Heart-Rate Variability and Stress Appraisals. Front Psychol. 2019 May 9;10:1083. doi: 10.3389/fpsyg.2019.01083.
12. Misigoj-Durakovic M, Durakovic Z, Prskalo I. Heart Rate-Corrected QT and JT Intervals in Electrocardiograms in Physically Fit Students and Student Athletes. Ann Noninvasive Electrocardiol. 2016 Nov;21(6):595-603. doi: 10.1111/anec.12374.
13. Boettger S, Puta C, Yeragani VK, Donath L, Müller HJ, Gabriel HH, Bär KJ. Heart rate variability, QT variability, and electrodermal activity during exercise. Med Sci Sports Exerc. 2010 Mar;42(3):443-8. doi: 10.1249/MSS.0b013e3181b64db1.
14. Deschodt-Arsac V, Lalanne R, Spiluttini B, Bertin C, Arsac LM. Effects of heart rate variability biofeedback training in athletes exposed to stress of university examinations. PLoS One. 2018 Jul 26;13(7):e0201388. doi: 10.1371/journal.pone.0201388.
15. Hulka OV. [DYNAMICS OF SPECTRAL INDEXES OF HEART VARIABILITY RATE OF THE STUDENTS WITH DIFFERENT CHARACTER OF THE EDUCATIONAL LOADING]. Fiziol Zh. 2015;61(4):98-104. doi: 10.15407/fz61.04.098. [Article in Ukrainian].
16. Redondo B, Vera J, Luque-Casado A, García-Ramos A, Jiménez R. Associations between accommodative dynamics, heart rate variability and behavioural performance during sustained attention: A test-retest study. Vision Res. 2019 Oct;163:24-32. doi: 10.1016/j.visres.2019.07.001.
17. Wang X, Yan C, Shi B, Liu C, Karmakar C, Li P. Does the Temporal Asymmetry of Short-Term Heart Rate Variability Change during Regular Walking? A Pilot Study of Healthy Young Subjects. Comput Math Methods Med. 2018 Apr 30;2018:3543048. doi: 10.1155/2018/3543048.
18. Drezner JA, Peterson DF, Siebert DM, Thomas LC, Lopez-Anderson M, Suchsland MZ, Harmon KG, Kucera KL. Survival After Exercise-Related Sudden Cardiac Arrest in Young Athletes: Can We Do Better? Sports Health. 2019 Jan/Feb;11(1):91-98. doi: 10.1177/1941738118799084.
19. Perkins SE, Jelinek HF, Al-Aubaidy HA, de Jong B. Immediate and long term effects of endurance and high intensity interval exercise on linear and nonlinear heart rate variability. J Sci Med Sport. 2017 Mar;20(3):312-316. doi: 10.1016/j.jsams.2016.08.009.
20. Sharashdze NS, Pagava ZT, Saatashvili GA, Agladze RA. [Heart rhythm abnormalities in middle-aged veteran elite athletes]. Georgian Med News. 2008 Jun;(159):31-4. [Article in Russian].
21. Adams JA, Patel S, Lopez JR, Sackner MA. The Effects of Passive Simulated Jogging on Short-Term Heart Rate Variability in a Heterogeneous Group of Human Subjects. J Sports Med (Hindawi Publ Corp). 2018 Oct 1;2018:4340925. doi: 10.1155/2018/4340925.