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PECULIARITIES OF HEART RATE VARIABILITY INDICATORS IN TRACK-AND-FIELD ATHLETICS WITH MESOMORPHIC SOMATOTYPE

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Disruption of autonomic-vegetative homeostasis is a direct path to the sports, especially cardiac, pathology appearance. Membership of the mesomorphic somatotype does not reduce the differences in the magnitude of cardiointervalographic indices between groups of athletes and non-athletes. We established a certain imbalance in the regulation of heart rhythm of athletes. According to the results of spectral indices, parameters of variational pulsometry and vegetative homeostasis ambiguous data were obtained, characterizing the influence on the athletes of the parasympathetic and sympathetic borders, which indicates the adaptation-regulatory mechanisms tension on them.

Keywords: cardiointervalography, mesomorphic somatotype, field-and-run athletes, young men.

The study is a fragment of the research project "Indicators of heart rate variability in virtually healthy boys and girls with different types of hemodynamics", state registration No. 0118U003452.

Nowadays, athletes face with high professional requirements in the process of achievement their goals and desires. The development of physical fitness resistant starts to form in athletes that practice sports from their childhood, which, from the point of view of some authors, is marked by constitutional features [5]. Pphysical activity should be gradual and meet age-appropriate physiological standards. Appropriate balance between stress and recovery is significantly important for athletes to achieve continuous high-level results [12]. That regulations related to the deterioration of health indicators of people involved in sports, which were not familiarized in time to the plan of the training process, can lead to the development of maladaptation in their bodies [2]. The main problems of the development of modern sport prevention medicine are in the lack of data obtained on the regime of the training process of athletes with different anthropometric indicators and constitutional types. This question is extremely urgent, due to the fact that studying these indicators will give the opportunity to introduce individual athlete's training process evaluation maps. Such kinds of maps will to predict the level of willingness to perform the load without the health disorders occurrence [6].

Pronounced impacts on athletes, disorders of the autonomic nervous system have. Moreover, they are believed to be one of the common signs of health disorder and manifestation of formation to nosological and pathological changes of the body [8]. Detection of abnormalities in the regulation of the cardiovascular system that was taken in time, may not only prevent pre-pathological conditions, but also avoid them.

Currently, the subject of sports, physical fitness and adaptive abilities of the person to trainings has become central. Elite athletes use all their energy to achieve results and become extremely exhausted. Thereby, the question of their life expectancy arises, moreover, determination of the relationship between long-term energy training and survival appear. Such kinds of changes may be adaptive, or they can lead to heart complications. Currently, regular medical examinations of athletes are being conducted with registration of electrocardiographic, echocardiographic and other indicators, which generally reflects the state of health and morbidity of young people. Specific attention should be paid to both aspiring athletes and athletes with a high level of athletic skill. The most simple and non-invasive method in the study of cardiac activity is the study of heart rate variability [13].

The study on the adaptation of athletes has not been sufficiently studied [4], that does not allow to carry out the analysis of the variability of cardiac rhyme for the detection of maladaptation and to nosological disorders of cardiac activity and determines the relevance of this study deeply.

The purpose of the study was to establish changes in statistical and spectral indices of heart rate variability and indices of variational heart rate and vegetative homeostasis in athletes with the mesomorphic type of constitution.

Materials and methods. The study involved young men (from 17 to 21 years old). The control group consisted of 80 young men who did not play sports and were almost healthy at the time of the examination. The conclusion was made after detailed clinical and laboratory study that were performed at the research laboratory of functional morphology and genetics of the research center in National Pirogov Memorial Medical University, Vinnytsya. All examined were under: chest radiography, spirography, echocardiography, electrocardiography, tetrapolar rheocardiography, sonography of the thyroid gland and parenchymatous organs of the abdominal cavity, kidney, bladder, determination of major biochemical levels and thyroid hormone levels.

Furthermore, athletes with high levels of sportsmanship (from the first adult category to masters of sports) who had sports loads of cross-country running with maximum (jogging at 100, 200, 110 m hurdles) and submaximal (jogging at 400 and 800 m) intensity of work, were surveyed.

All athletes have been engaged in sports for at least 3 years, the average sports experience in this group was 6.78 ± 2.24 years. At the time of the examination, all athletes were in the preparatory period of the training cycle. Diagnosis was performed in 12 hours after exercising. All athletes went through chest radiography, spirography, echocardiography, electrocardiography, tetrapolar reocardiography. In cases where unconventionalities from the norm were found, in particular high blood pressure, arrhythmias, insufficiency of two-leaf and three-leaf valves and severe myocardial hypertrophy, athletes did not participate in the further study. Thus, the study group was formed out of 50 athletes.

We studied heart rate variability on the cardiac computer diagnostic complex. The rhythmogram was fixed while recording the electrocardiogram in the second standard lead for 5 minutes. A pneumogram was recorded at the same time, using a nasal thermistor. Cardiac rhythm data were analyzed using a computer program of a certified cardiac diagnostic complex. The results were evaluated according to the recommendations of the European and North American Cardiac Association [14]. The definition of indicators of variational heart rate included: moda - the average value of R-R interval (MO), the moda amplitude (AMO), the average (NNM), the minimum (MIN) and the maximum (MAX) meaning of R-R intervals (including abnormal R-R intervals); variation range (VR). Among the statistical indicators of heart rate variability was determined: Standard deviation of NN intervals (SDNN), root mean square of successive R-R interval differences (RMSSD); percentage of successive RR intervals that differ by more than 50 ms (pNN50). According to the Baevsky method, the indices of vegetative homeostasis were determined: the voltage index of regulatory systems (IN); index of vegetative balance (IVR); vegetative rhythm rate (VPR). During the HRV spectral analysis, the following frequency ranges were determined: low frequency (VLF), Low Frequency (LF), High Frequency (HF). Power ratios in the low and high frequency ranges were calculated (LF/HF).

Somatotypes were determined using a calculated modification of the Heath-Carter method [10]. After somatotypological analysis, it was found that the largest number of athletes and control group members belonged to the mesomorphic constitution type: 29 athletes and 23 non-athletes. Statistical processing of the results was performed using the "STATISTICA 5.5" package (license number AXXR910A374605FA). The distributions for each variation were evaluated by the Shapiro-Wilk methodic, the mean of average and standard deviation for each trait and the significance of the difference of values were determined according to the Mana-Whitney U test.

Results of the study and their discussion. Analyzing the peculiarities of cardiac rhythm indices in highly qualified athletes and young people from the control group, who were not engaged in sports and were practically healthy by the results of the complex medical examination, it is necessary to note the significant heterogeneity of cardiointervalographic indicators in both observation groups, which is indicated by the quadruple standard values one third of the average in the sample.

It is necessary to dwell on the statistical indicators of heart rate variability. We determined that athletes had significantly less standard deviation of normal R-R intervals ($p<0.05$) than participants of control group. RMSSD did not significantly differ ($p>0.05$) between the comparison groups. The pNN50 value (%) of track-and-field athlets was significantly higher ($p<0.01$) comparing to somatotype of non-sport youngers. We have found out that individual variations in heart rate variability had significant differences between adolescents belonging to the mesomorphic somatotype, but differed in the level and specificity of motor activity. It was establish that the mean and maximum R-R interval in athletes were drastically greater than in control group (in both cases, $p<0.05$). And the moda did not have considerable differences between comparison groups, but it should be noted that the arithmetic mean of this indicator of variational heart rate in the group of athletes-mesomorphs is greater than that of non-athletes of the same constitutional type. The moda amplitude and the minimum R-R interval were not significantly different between athletes and control group. The variational span of the variations of the pulsometry in the group of athletes was significantly smaller than that of the non-athletes (table 1).

Most spectral indicators of heart rate variability in athletes with high levels of sportsmanship were smaller compared to non-athletes. Thus, the total recording power in all ranges in athletes was 31.55% fewer ($p<0.05$) than in the control group. Despite the lower average statistic sings of VLF in the track-and-field athletes group, the difference in the magnitude of this spectral indicator between the comparison groups was not considerable. We noted that the power in the low-frequency range of athletes was for 37.73% lower ($p<0.05$) compared to non-athletes. Power in the range of high frequencies in the group of

athletes had lower values by 45.96% ($p<0.05$), than in the control group. The power ratios in the low and high frequency ranges did not differ drastically between the groups of athletes and non-athletes (table 1).

Table 1.

Features of heart rate variability indicators in athletes with mesomorphic somatotype

Indices	The studied groups	M±σ	p
Statistical indices of heart rate variability			
SDNN (ms)	Non-athletes	92.50±24.21	<0.05
	Athletes	70.56±22.72	
RMSSD (ms)	Non-athletes	90.91±44.00	>0.05
	Athletes	85.60±38.21	
PNN50 (%)	Non-athletes	37.55±14.53	<0.01
	Athletes	51.95±15.71	
Indices of variational heart rate			
MO (ms)	Non-athletes	1.030±0.172	>0.05
	Athletes	1.086±0.143	
AMO (%)	Non-athletes	34.70±13.20	>0.05
	Athletes	34.21±11.58	
NNM (ms)	Non-athletes	1.013±0.141	<0.05
	Athletes	1.088±0.121	
MAX (ms)	Non-athletes	1.223±0.180	<0.05
	Athletes	1.342±0.154	
MIN (ms)	Non-athletes	0.794±0.126	>0.05
	Athletes	0.828±0.140	
VR (ms)	Non-athletes	0.351±0.069	<0.05
	Athletes	0.338±0.067	
Spectral indices of heart rate variability			
FD (ms^2)	Non-athletes	13737.9±5070.1	<0.05
	Athletes	9403.3±4760.3	
VLF (ms^2)	Non-athletes	3938.2±1965.2	>0.05
	Athletes	3679.9±1799.3	
LF (ms^2)	Non-athletes	3949.9±1988.1	<0.05
	Athletes	2459.8±1703.1	
HF (ms)	Non-athletes	5644.9±2718.6	<0.05
	Athletes	3050.4±1885.8	
LF/HF	Non-athletes	0.777±0.341	>0.05
	Athletes	0.945±0.545	
Indices of vegetative homeostasis estimation by Baevsky's method			
IN	Non-athletes	50.45±22.89	>0.05
	Athletes	50.58±24.49	
IVR	Non-athletes	90.67±30.48	<0.05
	Athletes	131.9±61.33	
VPR	Non-athletes	3.678±1.388	<0.05
	Athletes	2.929±0.861	

After collation of vegetative homeostasis indices, we establish that the voltage index of regulatory systems was practically indistinguishable between group of athletes and control one ($p>0.05$). Having estimated the indices of vegetative homeostasis, we found that the voltage index of regulatory systems is practically indistinguishable between groups of athletes and control ($p>0.05$). The index of vegetative balance of athletes was 31.26% higher (p. <0.05) compared to non-athletes. And the vegetative rhythm rate indicator of athletes with mesomorphic somatotype, on the contrary, was significantly lower ($p<0.05$) than in their peers of the control group (Table 1).

The constitutional features of the morpho-functional parameters of the human body have been proven by many studies [11]. Constitutional conditionality of cardiovascular parameters [7, 3, 6, 9] and regulation of the heart are not an exception to this list [2, 8]. It is established that the activity of the mechanisms of self-regulation of the parasympathetic autonomic nervous system is higher in the men of mature age of the mesomorphic somatotype than in the representatives of the ecto-mesomorphic type [1]. But the question remains, whether the differences in cardiovascular indices persist in representatives of one somatotype with different levels of locomotor activity. The answer to this question can be obtained by comparing the magnitude of individual indicators between groups of non-sports and highly professional athletes, whose bodies were, for a long time, affected by intense workloads that were caused by a specific

sport requests. That is, the question arises: what is the primary and the most important course - belonging to a particular constitutional type or specificity of a particular sport activity? Analyzing indicators of central hemodynamics in volleyball players of the Super League of Ukraine, it was found that volleyball players with mesomorphic and intermediate somatotypes had significantly greater stroke and minute volumes, left ventricular capacity and volumetric blood flow speed, than non-sports girls with the same kind of somatotipe; in persons with ectomorphic component somatotype privalance, there are no differences in the amount of hemodynamic parameters depending on sports activity [9]. Studying the indicators of peripheral hemodynamics in the representatives of male adolescents, who professionally engaged in volleyball, athletics and wrestling, it was found that only athletes of mesomorphic somatotype had the most significant differences in the magnitude of rheovasographic parameters of the thigh, which are concomitant engaged in sports [7].

Significant differences in cardiac rhythm variability were also found between groups of mesomorph athletes and adolescents not involved in the sports of the mesomorphic somatotype, in our research. In particular, the SDNN, which characterizes changes in intervals between heartbeats of normal sinus rhythm and indirectly indicates heart rate, is considerably lower in the group of athletes. The value of this indicator, according to most authors [4, 9 14], reflects the cumulative effect of the influence of the sympathetic and parasympathetic parts of the autonomic nervous system, so smaller SDNN values may be indicative of a more regulated heart rhythm and a more pronounced effect of the parasympathetic nervous system. Higher values of SDNN in non-athletes may point out the stress of humoral regulation and central oscillator activity. The value of RMSSD had no significant differences between the comparisons groups, a slight increase in its average values in the control group can be explained by a more pronounced parasympathetic influence on the heart. This is most likely a reflection of sinus arrhythmia associated with breathing, which is more pronounced in untrained individuals. The significantly higher PNN50 value in the group of athletes confirms their overwhelming influence on the variability of the heart rate of the parasympathetic nervous system [4, 8].

According to the results of the variations of the pulsometry an ambiguous data were gotten. Those outcomes characterized the influence on the athletes of the parasympathetic and sympathetic contours. Thus, the magnitude of moda, the amplitudes of the moda and the minimum R-R interval did not differ drastically between the comparison groups, but it should be noted that the average values of MO in the group of athletes were greater than in the control. We consider this feature as a manifestation of sympathicotonia, which may be a sign of first-degree overtraining in athletes. In addition, we found that the average value of the R-R interval maximum value of the R-R intervals in mesomorphic athletes was statistically noteworthy, and therefore the influence of the parasympathetic department of the autonomic nervous system in them was more considerable [8], than in the group of control. The variational range in both groups showed a moderate preference for the parasympathetic link.

The same ambiguous data were obtained in the analysis of spectral indices. Yet, the total recording power across all ranges in athletes was significantly less than in the control, indicating less variability in heart rate athletes. Some authors have suggested that a decrease in heart rate variability was evidence of increased sympathetic activity [4, 13], in addition, it has been suggested that with a prominent increase of heart rate and a decrease of heart rate variability, sudden deaths were more commonly reported in professional sports, that is why we consided lower values of total recording power in all ranges in athletes as a sign of functional adaptation. to overtraining and to acute or chronic overstrain of the cardiovascular system. In the VLF, LF, HF control group, all three units of cardiac regulation (humoral, sympathetic, and parasympathetic) were dominated. Thus, significantly greater importance in adolescents who did not engage in dispute, the mid-frequency spectral range indicated a more pronounced sympathetic-parasympathetic regulation of vascular tone. In previous studies [7, 9] central and peripheral hemodynamics showed that athletes had vascular tone greater than non-athletes, and depending on the development of skeletal muscle, we can assume that they have a more stable figure. The HF spectral index, which reflects the power at high frequencies (0.15-0.4 Hz), was higher in the control group boys and was a confirmation of greater vagal control in their heart rhythm and more pronounced influence on the heart rhythm of respiratory movements. The LF/HF ratio was more important in athletes in favor of the predominance of the parasympathetic nervous system.

In both groups, the comparison of the values of the Bayevsky index, which reflects the level of tension (stress) of the regulatory mechanisms, the activity of the mechanisms of sympathetic regulation, the state of the central circuit, corresponded to the values of rest and characterized the equilibrium of the sympathetic nervous system. Indicators of IVR, which were significantly higher in athletes, indicated a shift in the autonomic equilibrium index towards the activity of the sympathetic autonomic nervous system, which could also indicate signs of central nervous system overstrain occurring under the influence of

systematic high physical activity. The value of VPR indicated that the athlete's autonomic rhythm was lower, and therefore the vegetative balance was more shifted to the parasympathetic side.

Thus, we found a certain imbalance in the regulation of heart rhythm in athletes. Disruption of vegetative homeostasis leads to the development of pre-pathological and pathological conditions, especially in the body of athletes. Most scientists [2, 8, 13] associate cardioprotective effect of physical activity influence with the tendency of parasympathetic activity increase, which reflects in the vagus-associated cardiointervalographic indexes raise. The autonomic regulation of the heart rhythm has the character of complex reciprocal interaction of the sympathetic and parasympathetic departments of the autonomic nervous system and has a direct dependence on the type of sports activity of an individual.

Conclusions

1. Despite belonging to one constitutional type - mesomorphic, we have found significant differences in cardiointervalographic parameters between groups of athletes and non-athletes.

2. Significant changes in statistical indicators of heart rate variability were revealed: in athletes of mesomorphic somatotype smaller values of SDNN and greater values of PNN50, which confirms their predominant influence on the heart rate variability of the parasympathetic nervous system, compared with non-athletes of the same somatotype.

3. According to the results of variational pulsometry and spectral indices, ambiguous data were obtained, characterizing the influence on the athletes of the parasympathetic and sympathetic lineaments.

4. Estimation of the vegetative homeostasis sings indicates an imbalance in the regulation of heart rhythm of athletes, which is the evidence the tension in them of the adaptive-regulatory mechanisms.

5. The use of the cardiointervalographic method provides an opportunity for early recognition of signs of regulatory systems overstretching and inadequacy of the athlete's reaction to training and competitive loads, which will allow for the introduction of correctness in sports activities.

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Реферати

ОСОБЛИВОСТІ ПОКАЗНИКІВ ВАРІАБЕЛЬНОСТІ СЕРЦЕВОГО РИТМУ У ЛЕГКОАТЛЕТІВ МЕЗОМОРФНОГО СОМАТОТИПУ

Сарафинюк Л.А., Сивак А.В., Радьога Р.В., Сарафинюк П.В., Мацейко І.І.

Порушення вегетативного гомеостазу – це прямий шлях до виникнення спортивної патології, особливо до кардіальної. Належність до мезоморфного соматотипу не зменшує відмінностей у величині кардіоінтервалографічних показників між групами

ОСОБЕННОСТИ ПОКАЗАТЕЛЕЙ ВАРИАБЕЛЬНОСТИ СЕРДЕЧНОГО РИТМА У ЛЕГКОАТЛЕТОВ МЕЗОМОРФНОГО СОМАТОТИПА

Сарафинюк Л.А., Сивак А.В., Радега Р.В., Сарафинюк П.В., Мацейко И.И.

Нарушение вегетативного гомеостаза - это прямой путь к возникновению спортивной патологии, особенно кардиальной. Принадлежность к мезоморфному соматотипу не умаляет различий в величине кардиоинтервалографических показателей между группами легкоатлетов и

легкоатлетів і неспортсменів. Нами виявлений певний дисбаланс в регуляції ритму серця у легкоатлетів. За результатами спектральних показників, параметрів варіаційної пульсометрії та вегетативного гомеостазу отримано неоднозначні дані, що характеризують вплив на легкоатлетів парасимпатичного і симпатичного контурів, що свідчить про напруження у них адаптаційно-регуляторних механізмів.

Ключові слова: кардіоінтервалографія, мезоморфний соматотип, легкоатлети, юнаки.

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неспортсменов. Нами обнаружен определенный дисбаланс в регуляции ритма сердца у легкоатлетов. По результатам спектральных показателей, параметров вариационной пульсометрии и вегетативного гомеостаза получены неоднозначные данные, характеризующие влияние на легкоатлетов парасимпатического и симпатического контуров, что свидетельствует о напряжении у них адаптационно-регуляторных механизмов.

Ключевые слова: кардиоинтервалография, мезоморфный соматотип, легкоатлеты, юноши.

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OPTIMIZED MEASURES FOR CORRECTION OF DENTAL STATUS IN PROFESSIONAL ATHLETES

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The clinical state of the oral cavity, the functional state of the salivary glands, and the effectiveness of therapeutic and preventive measures using propolis-based medicine (Balsam Pomegranate) were studied in 122 professional wrestlers aged 18 to 34 years. In the course of our observations it has been ascertained fact in digital values and a significant reduction of unfavorable background unstimulated salivary secretion in subjects athletes at the studied length of stay in prolonged intense psycho-emotional and physical condition. Status of oral hygiene and periodontal tissues in the study group of athletes who have practically healthy periodontium, deteriorated after an intensive training process at almost 1.5 times. Preparation "Balsam Pomegranate" has a very important, especially with the preventive point of view, antiinflammatory, organoleptic properties, as based on the natural stimulation help to improve the hygienic condition of the oral cavity, the state of periodontal tissues, as well as a pronounced stimulation of salivation and increasing salivary flow rate.

Keywords: periodontitis, saliva, hygiene, intense exercise, prevention.

The work is a fragment of the doctoral dissertation "Development of differentiated approaches to the prevention of inflammatory periodontal diseases in professional athletes".

Based on the results of clinical and epidemiological studies, the importance of close cooperation of specialists of various fields, including a dentist, a therapist, a sports doctor, a cardiologist, as well as a personal trainer, was determined for the successful development and increase of the effectiveness of medical and preventive measures in the field of sports medicine, which ultimately creates the conditions for choosing the optimal therapeutic tactics and further conducting a professional athlete with pathologies of various organs and systems of the body [1, 3, 7]. At the same time, according to scientists, the development and implementation of practical recommendations to improve the general condition, quality of life, health, increase efficiency with the subsequent increase in sports performance of the highest achievements should be carried out taking into account the period and correction of the training process, as well as the degree of development and pathogenicity of chronic infection [2, 6].

The most frequent periods of the training cycle, favorable for the occurrence and development of pathological processes in the periodontal soft and hard tissues among professional athletes, as indicated in some literary sources, are the pre-competitive and competitive periods, because during these periods the number of cases of occurrence and exacerbations of inflammatory diseases in periodontal tissues sharply increases, they against the background of deterioration of vital physical and emotional indicators, can cause certain disorders in the organs of the gastrointestinal tract, in the state of the local immune system, and thus increase the severity of somatic pathology [4, 5, 8].

The purpose of the work was increasing the level of dental care for professional athletes on the background of intense physical and psycho-emotional stress with the use of biologically neutral medicine.

Materials and methods. The prevalence of periodontal disease among 200 athletes aged 18–25, 26–30 and 31–38 years was determined using the CPITN (Community Index of Periodontal Treatment Need, WHO, 1980). Also, 122 professional athletes-wrestlers aged from 18 to 34 years old took part in these scientific studies to study the functional state of the salivary glands and the effectiveness of therapeutic and preventive measures. Salivation indicators were expressed in ml / min. Then a comparative statistical analysis was obtained by comparing the amount of saliva excreted in all experimental groups, excreted at rest and after completion of intense physical exertion and complex therapy.