PREDICTIVE CRITERIA FOR ASSESSING THE PHYSICAL PERFORMANCE OF ADOLESCENTS INVOLVED IN DIFFERENT SPORTS

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The purpose of this study was to study the content of free and bound carnitine in the blood of young athletes involved in various sports. 101 young athletes of various sports qualifications at the age from 15 to 17 years old were examined. For the research, young men were divided into two groups: I - types of sports of complex impact (football) - 38 people, II - cyclic type (rowing) - 31 people. Girls (32) are divided into three groups: I - types of sports of complex impact (football) - 14 people, II - a cyclical sport that predominantly develops endurance (rowing) - 6 people, and III - a complex coordination sport (rhythmic gymnastics) - 12 person. It was revealed that the assessment of carnitine metabolism indices allows predicting the degree of physical working capacity of athletes involved in various sports. At the same time, it was found that indicators of carnitine metabolism, body composition, have prognostic value in assessing the physical performance of young athletes.

Key words: adolescents, various sports, free and bound carnitine.

Introduction

Medical and biological support for the training of young athletes includes determining the state of health and physical development of adolescents, as well as diagnostics, treatment and prevention of diseases and injuries associated with

physical education and sports. The main goal of the medical and biological support of young athletes is the harmonious development of adolescents within the framework of the chosen sport, taking into account its age characteristics, functional capabilities, physical development, including puberty. Coaches, pediatricians, sports doctors should be interested in this. In this situation, a sports doctor, together with a coach, must participate in biomedical selection for specific sports, as well as in the organization of training and recovery processes, taking into account the specifics of the exercises performed. Solving this problem helps a sports doctor, coach and the youngest athlete to outline the most rational ways to improve sports skills. To achieve the best results and maintain health in sports, it is necessary to develop physical performance. Physical performance is a multifactorial phenomenon, defined as the ability of a person to perform a given job with the lowest physiological costs with the highest results. The faster the athlete reaches the required level of fitness, the easier it is for him to maintain the level of performance. The efficiency of all organs and systems, in particular, cardiovascular and respiratory, determines the endurance of the athlete's body. When an athlete's body is exposed to intense physical activity, the course of metabolic processes undergoes certain changes. In recent years, the concept of mitochondrial pathology has acquired particular importance, since the processes of energy exchange in the body are carried out at the expense of universal organelles - mitochondria. The main pathway of ATP resynthesis is oxidative phosphorylation using carbohydrates and lipids as an energy substrate (10-20). Carnitine is required for metabolic processes in mitochondria. Most cells in the body have the ability to synthesize endogenous carnitine throughout life. During physical exertion, a deficiency of carnitine may occur in mitochondria, which is primarily reflected in its intracellular content. The need for L-carnitine depends on age, type of sport and increases with physical and psycho-emotional stress by 4-20 times. Since physical exertion requires a more intensive supply of energy to muscle activity, this leads to depletion of the

body's resources, overwork and the development of an energy deficit state (1-10). It becomes obvious that the state of energy deficiency requires additional synthesis or introduction of carnitine, since carnitine plays the role of a transporter of long-chain fatty acids through the inner mitochondrial membrane with the participation of a special enzyme system for the production of ATP. This system reversibly transfers acyl on the outer side of the membrane from CoA to carnitine, and on the inner side from carnitine to intramitochondrial CoA. As you know, a decrease in the level of free carnitine leads to a deterioration in the energy supply of muscle activity, which can lead to a state of overtraining, fatigue, and also lead to injuries. Such changes lead to a deterioration in sports performance, and sometimes to an early end of a sports career. In this regard, the question of the use of carnitine during intense physical activity is widely discussed in sports medicine. It is from these positions that the study of the content of free and bound levels of carnitine, as well as the ratio of acetyl-CoA / CoA in the blood of young athletes against the background of physical activity, become relevant. The purpose of this study was to study the content of free and bound carnitine in the blood of young athletes involved in various sports.

Materials and methods of the study

The study of adolescents of athletes was carried out during an in-depth medical examination from 2017 to 2019 at the Republican Scientific and Practical Center for Medical Medicine at the NOC RUz. The study included all adolescents, various sports, residents of the city of Tashkent and regions of the republic aged 15 to 17 years. The study was conducted in compliance with the principles of bioethics. Each adolescent participating in the study received an information letter about the need to study health status. The comparison group consisted of (14) adolescents from the city of Tashkent, aged 15 to 17, who do not attend sports clubs. The study involved representatives of six cyclic sports: academic rowing, rowing and canoeing, football and gymnastics. The survey was

conducted as part of the current ULV survey. For these studies, young men were divided into two groups: I - types of sports of complex impact (football) - 38 people, II - cyclic type (rowing) - 31 people. Girls (32) are divided into three groups: I - types of sports of complex impact (football) - 14 people, II - a cyclical sport that predominantly develops endurance (rowing) - 6 people, and III - a complex coordination sport (rhythmic gymnastics) - 12 person.

The content of free fatty acid (FFA) of blood plasma was determined by thin layer chromatography on plates with silica gel "Sorbffl". Extraction of lipids from blood plasma was carried out according to the Folch method in a chloroform-methanol mixture (2: 1). The concentration of carnitine in the mitochondria of the rat heart was determined according to the method of L. Wan and RW Hubbard (1998), based on the formation of free KoASH, which reacts nonenzymatically with 5,5-dithiobis-2-nitrobenzoate (DTNB) with the formation of colored 5-thio-2-nitrobenzoate , the color intensity of which was measured spectrophotometrically at $\lambda = 410$ nm.

The data obtained were processed statistically. The work compared two or more groups. The results were processed using the applied programs Excel, Statistica, version 6.0, using descriptive statistics and ANOVA. The significance of differences was assessed by Student's t-test. The indicators obtained with the probability of a possible error in evaluating the results, starting with a value of $p < 0.05$, were considered reliable.

Research results and discussion

As part of the study, the level of free and bound carnitine was determined, as well as the bound carnitine / free carnitine ratio was calculated in young athletes. The main characteristics of carnitine metabolism are free and bound carnitine, as well as their AA / C0 ratio. The results obtained (M ± m - mean values and mean error) are presented in the table. All indicators obtained during the study in the groups were within the age norm. The analysis of the obtained research results presented in table 1 showed significant differences in the AK /

C0 index. This indicator is statistically significantly higher among the athletes of the 1st group, which indicates a more efficient cellular energy in the representatives of the main study group. The statistical significance of the differences in the content of bound carnitine was found relative to the athletes of the 2nd group, where its indicator is 19% lower than the initial values, while relative to the athletes of the 1st group, it is lower by 40%. Indicators of bound carnitine are determined by the total content of acylcarnitines. Its main function is to transport activated acetate directly into the mitochondrial matrix for the formation of acetyl-CoA, which is involved in the tricarboxylic acid cycle

Table 1

Content of free and bound carnitine, the value of the index AK / C0

(boys)

Indicators	Control group n=14	Group 1 sportsmen n=38	Group 2 sportsmen n=31
Free fatty acids (g / L)	0,27±0,04	0,56±0,05*	0,64±0,07*
Free carnitine (C0), μmol / l	34,51±2,04	36,83±2,46	41,38±3,05*
Bound carnitine (AA), μmol / l	20,26±0,78	29,43±0,98*	19,81±0,97
AK / C0 index	0,59±0,04	0,80±0,05*	0,48±0,03*

Note: * - reliability of differences P <0.05

As you know, free carnitine is used to transport long-chain fatty acids from the cytosol of the cell to the mitochondrial matrix for energy production during the beta-oxidation process. When performing aerobic activity, more energy is needed. According to the results of a survey of two groups of adolescents (Table 1), it was found that the content of free carnitine is statistically significantly higher in athletes of the 2nd group, i.e. this group of adolescents uses more long-

chain fatty acids in the mitochondrial matrix for energy production in the form of ATP.

In the course of the analysis of the obtained data, a tendency of differences in the content of free carnitine, as well as the AK / C0 index, taking into account sports requiring various kinds of sports skills, was noted. Acetylcarnitine is a substrate for triggering energy-dependent metabolic processes in mitochondria. In the first group of athletes, the bound carnitine was higher than the indicators of the comparison group and athletes of the 2 groups. It seems important to study the ratio of bound carnitine / free carnitine. This indicator is used for additional characterization of the content of acylcarnitines (AA) and free carnitine (C0) and reflects the efficiency of cellular energy: the lower this coefficient, the more efficient energy exchange. Normal values of this indicator are less than 0.7. The value of the bound carnitine / free carnitine index is inversely related to the level of free carnitine and in direct relation to the level of bound carnitine. An increase in this ratio reflects an increase in the proportion of bound forms of carnitine in the structure of the total carnitine indicator. As a result of our research, this index turned out to be statistically significantly higher in athletes of the 1st group in comparison with the control group and especially athletes of the 2nd group, which indicates an effective energy exchange in this group of teenage athletes.Of particular interest is the study of the ratio of bound carnitine / free carnitine in female athletes. As mentioned above, this indicator is used to further characterize the content of acylcarnitines (AA) and free carnitine (C0) and reflects the efficiency of cellular energy, in particular, the lower this coefficient, the more efficient energy exchange. Normal values of this indicator are less than 0.7.

Table 2

Content of free and bound carnitine, the value of the index AK / C0 (girls)

Indicators	Control group n=14	Group 1 sportsmen n=14	Group 2 sportsmen n=6	Group 3 sportsmen n=12
Free fatty acids (g / L)	0,27±0,04	0,35±0,04*	0,41±0,04*	0,56±0,04*
Free carnitine (C0), μmol / l	30,74±2,34	29,45±1,89	36,37±2,39*	41,35±3,39*
Bound carnitine (AA), μmol / l	19,91±1,04	17,27±0,56	15,32±1,31*	14,25±1,27*
AK / C0 index	0,65±0,05	0,59±0,04	0,42±0,04*	0,35±0,04*

Note: * - reliability of differences P <0.05

An increase in this ratio indicates a lack of free carnitine, which reflects imperfect cellular energy. As indicated in Table 2, in all groups of girls the studied index was lower in comparison with the indicators of the control group, which indicates the high efficiency of cellular energy in the representatives of this sport. As can be seen from the obtained research results, the cellular energetics is more effective in young athletes, canoeing and gymnasts. At the same time, intense physical activity where all joints are involved and the respiratory system requires high energy costs from the child's body, which allows the tissue respiration process to function more efficiently. This assessment is based on the AK / CO index. The level of free carnitine is also higher in groups 2 and 3 of female athletes, which indicates a high intake of fatty acids for energy production in the form of ATP in the mitochondria.

Thus, the data on the peculiarities of carnitine metabolism and physical performance in young athletes involved in various sports and the level of

physical activity are presented. In representatives of cyclic sports, the content of free carnitine is significantly higher than in adolescents involved in game sports. The ratio of bound carnitine / free carnitine is significantly lower in young athletes involved in cyclic sports, which indicates a high mitochondrial potential. Consequently, the assessment of indicators of carnitine metabolism in young athletes of different sports allows predicting the degree of physical performance of athletes. It was found that the assessment of the mitochondrial potential involved in energy production in the form of ATP by studying the state of carnitine metabolism makes it possible to predict the degree of aerobic performance of athletes.

Conclusions

1. In boys, the AK / C0 indicator is statistically significantly higher among athletes of the 1st group, which indicates a more effective cellular energy, while the content of bound carnitine was found relative to athletes of the 2nd group, where its indicator is 19% lower than the initial values, relative to the 1st group is lower by 40%. The latter is involved in the transport of activated acetate directly into the mitochondrial matrix for the formation of acetyl-CoA, which is involved in the tricarboxylic acid cycle.

2. More effective cellular energetics was noted in young sportswomen, canoeing and gymnasts. This assessment is based on the AK / C0 index. The level of free carnitine is also higher in groups 2 and 3 of athletes, which indicates a high intake of fatty acids for energy production in the form of ATP in the mitochondria.

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