УДК 613.955 : 25

CONDITION AND OPTIMISATION OF CHILDREN ATHLETES PROTEIN-ENERGY METABOLISM

Assist.prof. Shkurupiy D.A., M.D., PhD; Assist. prof. Pikul K.V., PhD.;
Assist. prof. Kushnereva T.V., PhD.; Assist. prof. Prilutsky K. Yu., PhD.
Higher state educational establishment «Ukrainian medical stomatological academy»
Poltava, Ukraine

Introduction. Modern tendencies of youth sport development are associated with relatively early specialization and reaching the high level of sport results, which requires comprehensive improvement of the youth athletes training system [1]. Mentioned above needs scientifically reasoned approach to all components of organization and program of training process, among which, not the least, are the questions of adequate supply of the energy and formative resources to the organism, according to the high energy consumption caused by sport activity [2, 3]. Optimal physical and psycho-emotional loads that are associated with systematic sports activities have a significant positive impact on the psychophysical and social development of children and adolescents, contribute to the formation and preservation of positive motivation for subsequent training, create preconditions for a gradual increase in the level of sport skills of the young athletes and reaching the high results on the next stages of training. Detailed planning of loads in training and competition process also includes medical monitoring of the physical condition and dynamics of the ability to train of young athletes.

Features of the organization of the training process at the stage of initial training and primary specialization requires the observance of the principles of systemology that leads to the need to take into account the anatomical and physiological morphometric and psychological characteristics of childhood and adolescence, such as:

- constant dynamic changes in life support systems that are associated with the growth and functional maturation of organs and systems;
- the significant expenditure of energy and for formative material on growth and physical development, as a result of which the parameters of basic metabolism and the need for source of growth materials increase;
  High oxygen demand that quickly leads to the activation of anaerobic oxidation during exercise;
- the dominant tonus of the sympathetic nervous system which is associated with both the rapid activation of compensatory mechanisms under the action of over-threshold factors and the rapid depletion of them;
- comparatively with adults, higher blood flow velocity and a larger area of the bloodstream.

Considering the high intensity of the metabolism, the high costs of growth, physical development, additional psychophysical load that is associated with the training and competitive activities of young athletes, topical issue is the development of methods for adequate energy and formative growth support for the life of adolescent athletes.

The purpose of the study is to evaluate the effectiveness of the use of additional nutritional components in the diet of children of athletes in order to ensure an adequate balance of the protein-energy component against the background of increased energy and formative consumption, which is associated with training and competitive activities.

Materials and methods of research. 27 somatically healthy male children aged from 9 to 11 years (study group) who constantly attended swimming exercises in children's Poltava sports schools with the performance of training assignments in the range of moderate and high power were examined.

Before the study, its design was submitted to parents and their consent was obtained for the participation of their children in this program. The initial state of the indicators of energy and formative metabolism was determined (ascertaining experiment) and their dynamics against the background of receiving additional specialized nutrition (forming experiment) (main group, n=14) and without it (control group, n=13) on the background of regular training.

Participants of the main group in addition to training sessions and a usual diet, additionally received a nutritive powder "Clinutren-Junior" ("Nestle", Switzerland) for one month. The daily volume of powder intake for the participants in the main group was determined taking into account the following data; age and body weight of experiment participant, additional energy request caused by swimming training.

Calculation of energy consumption during training and competitions was carried out using the given value of the metabolic equivalent [4]. It was also taken into account that the performance by athletes of this age group of training assignments that are associated with the primary development of general, strength and coordination endurance in swimming increases the energy consumption level by 2.36 times in comparison with their healthy peers who do not go in for sports[3].

To assess the state of energy supply, protein and lipid metabolism parameters were used, the studies of which were conducted on the basis of the clinical diagnostic laboratory of the children's city clinical hospital (Poltava, Ukraine). To assess the state of protein metabolism and its variability, depending on the type of enteral mixture (powder), the protein blood spectrum parameters, which are sensitive to changes in protein intake, namely, the level of the serum albumin and the nitrogen balance, were used [5, 6]. The serum albumin level was determined by diagnostic kits of the firm "Agat" Moscow, Russia. Nitrogen balance of the body was determined by the level of excretion of urea nitrogen from urine.

Since medium-chain triglycerides are considered to be the main energy-intensive component of nutritional support, serum triglyceride levels were determined in the examined children. The content of triglycerides in blood serum was determined by the enzymatic method on a blood analyzer Stat-fax-1904, USA, using the Likuick Cor-tg 120 kit by "Cormai Diagnostyka", Poland.

In addition, the dynamics of general and special training of young swimmers was evaluated according to indications of physical capacity for work with a pulse rate of 170 beats per minute (Physical Working Capacity, PWC-170), the duration of the imitation work and the blood lactate level.

The statistical processing of the results was carried out using the Microsoft Excel software package. The choice of methods of statistical processing was based on recommendations [7]. Under the condition of maintaining the normal Gaussian distribution, estimates of the arithmetic mean (M) and representation error (m) were used for the estimation of parametric criteria, both for the arithmetic mean and for integral indicators. In determining the significant difference between the groups, the minimum level of error-free forecast was $P = 0.95$ and, correspondingly, the error probability level was - $p \leq 0.05$.

The determination of the reliable difference between the parametric criteria of the study groups was carried out using the Student's reliability criterion (t). Statistical estimation of the difference in nonparametric criteria was carried out using the Pearson correspondence test using a four-field table.

Results of the study and their discussion. A study of the dynamics of indicators of general and special training of young swimmers is given in Table 1.

A comparative analysis of the results of the study showed that the inclusion of the powder "Clinutren-Junior" in the usual food ration of the examined children helped to significantly increase the static-dynamic speed rate of endurance in the study group compared to the control group ($p < 0.05$). At the same time, there was no significant increase in the level of cardiorespiratory and special high-speed endurance ($p < 0.05$). Results of laboratory studies are given in table 2.

Table 1

A comparative characteristic of indicators of the dynamics of general and special training in the individuals surveyed.

Indicators, units	Results of the indicators of the general and special training level of study participants. stages of the study; number of participants (n)		
	Ascertaining	Forming	
	Group of study (n = 27)	Main group (n =12)	Control group (n = 13)
PWC 170, kgm/min./kg	18,21±2,11	19,31±1,29	19,03±1,07
Duration of the imitation work, sec	17,07±3,46	26,65±2,46* **	18,17±3,06
Level of serum lactate, mmol/l	16,33±2,78	14,87±1,97	15,19±2,31

Notes:

* - p<0,05 relatively to the parameters of the group of study at the stage of the ascertaining experiment.

** - p<0,05 relatively to the parameters of main and control groups at the stage of forming experiment.

Table 2

Comparative characteristic of the parameters of protein and lipid metabolism in 9-11 years old swimmers, depending on the type of the diet.

Meanings, g/l	Physiological meanings	Results of laboratory analysis of examined athletes; Study stages; number of participants (n)		
		Observational	Forming	
		Group of study (n = 27)	Main group (n = 12)	Control group (n =13)
Albumin, g/l	47,1±2,9	45,5±3,1	43,2±3,5	44,0±2,8
Triglycerides, g/l	1,43±0,23	1,28±0,24	0,99±0,1	1,52±0,15**

Notes:

1. Source of physiological meanings [8];
2. * - p<0,05 relatively to the parameters of the group of study at the stage of the ascertaining experiment.
3. ** - p<0,05 relatively to the parameters of main and control groups at the stage of forming experiment.

Based on the results of the ascertaining experiment, the participants in the study group had no violations of protein-energy metabolism. Levels of albumin and triglycerides of blood serum were located within the boundaries of the age normatives (Table 2). The tendency towards anabolic orientation of metabolism in the children surveyed should be noted, which is indicated by the tendency to the formation of a positive nitrogen balance. In carrying out the ascertaining experiment, a positive

nitrogen balance was established in 24 children, in 3 children it was zero. Such indicators can be explained by the characteristics of pediatric physiology: unlike adults (which are characterized by zero nitrogen balance), the intake of proteins in children should dominate over excretion, as they are actively used as formative material to ensure growth and physical development of the organism [9].

After carrying out the forming experiment, the protein maintenance indices did not differ significantly from the physiological norm, but the dynamic changes had a significant difference depending on the nutritional nature of the diet. Table 2 shows that athletes who received an adjusted dietary intake noted the activation of protein anabolism. The corresponding regularity was confirmed by us also with regard to the level of blood serum triglycerides. Given the correspondence of the triglyceride levels in the study groups with age norms, the dynamics of their changes significantly differed depending on the type of the diet. A higher content of albumins and triglycerides in the blood serum of athletes who received an additional dietary intake may be associated with a high content of energy-consuming and easily digestible medium-chain triglycerides and proteins in the "Clinutren-Junior".

It should be noted that the trend towards the formation of a positive nitrogen balance of athletes who received a traditional diet is low. Thus, at the stage of the formation experiment in the main group, 10 children had a positive nitrogen balance, zero or negative - two children. In the control group, a positive nitrogen balance was found in six children, zero or negative - in seven (χ=3,96; $p<0,05$). Such data indicate a low level of satisfaction of protein needs against the background of traditional nutrition, with their high level among athletes.

Conclusions.

1. In adolescents, in the absence of pathological processes, protein metabolism is anabolic, which is due to the inclusion of proteins to ensure growth and physical development.
2. High intensity training reduces the level of protein assimilation and increases the rate of use of energy-intensive materials, which must be taken into account when developing training programs.
3. To ensure an adequate balance of the protein-energy component in adolescents, athletes food ration should be corrected with the inclusion of additional nutritional components which characteristics and elements ratio meets age needs and additional energy requirement, which are associated with swimming training.
4. Using a powder mixture developed for the age-related needs of children of this category allows us to correct the adequacy of the intake of protein and lipid components of the diet, which in turn ensures a reliable increase in the stato-dynamic high speed endurance of 9-11 years old children athletes.

LITERATURE

1. Bulgakova N.Zh. Selection and training of young swimmers. - Moscow: Physical training and sports, 1996. - 190 p.
2. Bulgakova N., Volkov N., Popov O., Samborskiy A. Normalization of training loads using energy cost indicators of exercise 1. Bulgakova N.Zh. Selection and training of young swimmers. - Moscow: Physical training and sports, 1996. - 190 p.
2. Bulgakova N., Volkov N., Popov O., Samborskiy A. Normalization of training loads using indicators of the energy cost of exercise // Science in the Olympic sport. - K .: The Olympic literature, 2006. - № 2. - P. 56-59.
3. Nutrition in the system of athletes training / Pod. Ed. VL Smulsky, V.D. Monogarova, M.M. Bulatova. - K .: Olympic literature, 1996. - P. 167-176.
4. Athletes nutrition / Ed. K.A. Rosenblum. - K .: Olympic literature, 2006. - P. 527-535.
5. Laboratory methods of research in the clinic: Reference book / Menshikov VV, Delektorskaya LN, Zolotnitskaya RP, Andreeva ZM, Ankirskaya AS And others. / Pod. Ed. V.V. Menshikov. - Moscow: Medicine, 1987. - 368 p.
6. Vretlind A., Sujyan A. Clinical nutrition. - Stockholm-Moscow: Kabi Vitrum, Ingevord AB, 1990. -

401 p.
7. Lapach SN, Chubenko AV, Babich PN Statistical methods in biomedical research using Excel. - K .: Morion, 2000. - 320 with.
8. Doskin VA, Keller H., Muraenko NM, Tonkova-Yampolskaya RV Morphofunctional constants of the child's organism: Reference .- M .: Medicine, 1997. - 288 p.
9. Rasin M.S., Kajdashev I.P. The role of nuclear transcription factors in modern syntropy internal pathology (review). Ukrainian medical journal. - 1 (99) – I/II 2014. P.17-21.