RUSSIAN JOURNAL OF
SPORTS SCIENCE
2022, Vol. 1 (1)

Publication date: 01.04.2022
DOI: 10.51871/2782-6570_2022_01_01_2
UDC 159.91; 796.332; 796.015

THE LONG-TERM TRAINING PROCESS OF YOUNG SOCCER PLAYERS FROM THE POSITION OF THE DYNAMIC FUNCTIONAL SYSTEM'S FORMATION

I.N. Kalinina, V.V. Lavrichenko
Kuban State University of Physical Culture, Sports and Tourism, Krasnodar, Russia

Annotation. The purpose of this study was to characterize the long-term training process of young soccer players from the position of forming a dynamic functional system. Based on the study of individual parameters of physical development, the functional state of the cardiovascular system of the body, the physical fitness of young soccer players in the age range from 12 to 18 years, correlation matrices were calculated, taking into account which the indicators of the adaptation efficiency coefficient were established, allowing to judge the formation of the dynamic functional system of the player. The adaptation efficiency coefficient indicators at each stage of the specified age range can be used to assess the effectiveness of training influence in the long-term aspect.
Keywords: young soccer players, long-term training process, dynamic functional system, adaptation efficiency coefficient.

Introduction. Currently, rational training of young athletes becomes complicated due to an absence or inconsistency of information on the specificity of a developing body in formed environmental conditions. Considering this fact, we can form two groups of factors: objective and subjective. The first group includes social, economic and hygienic living conditions, conditions of the training process, in which an adolescent, engaged in sports, is growing up. The second group includes biological regulations of a developing body of a young athlete. Each trainer, who wants to achieve maximal results and preserve a high level of performance of athletes over a long period of their professional career, should know features of how a child's body grows and develops.

A group of researchers [1-4] has found that systematic soccer classes have a positive influence on natural processes of growth, physical and functional development of an adolescent's body. Meanwhile, soccer, from the point of motor skills and their energy support, is considered as the most complicated type of sports, requiring long-term versatile development, involving all main physiological systems and all physical qualities of a human. In conditions of many-years training, changes, taking place, have not only functional, but also structural nature. According to a number of studies [5-7], processes of the long-term adaptation of soccer players, as for many other types of sports requiring the development of endurance, are manifested through the formation of physiological reserve of the blood circulation and respiratory systems, efficiency of their work, increasing level of performance etc. Moreover, there are features that allow estimating an acquirement of specific traits of the long-term adaptation to the multiyear soccer training: a high degree of developing all energy support systems; high level of imaginative thinking and psychophysiological indicators (attention, perception etc.); significant hypertrophy of muscle groups in the lower extremities.

In order to understand physiological changes, taking place in a soccer player's body during the process of the multiyear muscle activity of high intensity and data interpretation, we need to give a clear description of terms "functional system" (FS) and "dynamic system" (DS). In this study, the body is described from the point of the functional system theory developed by P.K. Anokhin. The main point of this theory is that the FS is formed in each specific moment of time, satisfying the homeostasis's needs. In this case, the "urgent" connections appear, formed under the influence of an unknown or extreme condition, as well as the "long-term" ones, which occurred after the

system deletes unnecessary, ineffective elements of interactions between systems. Control of these processes is conducted on the autonomic and central regulation levels [8-9].

According to K.V. Sudakov – the founder of the functional system doctrine – the body, using self-regulation mechanisms, supports vital processes in limiting conditions by including and excluding the functional system's elements in a united group – the same group, which is going to contribute to the homeostasis. Therefore, a rearrangement of appropriate functioning parameters or an adjustment to changing external or internal factors are possible not only inside one system, but also with an involvement of other interacting systems. Meanwhile, according to the I.I. Shmalhausen's opinion, the body is not a mosaic of parts, organs or signs at any stage of development. It always develops as a whole, responses specifically at each stage. New correlation mechanisms of broad meaning appear. They do not disappear and remain for a long time. Such mechanisms relieve and support processes of the body's adaptation as a whole to the changing environment and contribute to a possibility of the internal structure's rearrangement. All changes and rearrangements in the body that appear due to a prolonged effect of environmental factors are of various nature. These specific traits, formed in the body in case of multiyear training, characterize an occurrence of the "dynamic functional system" that supports these exact needs, necessary for successful competitive activity.

It is known, that performance in game sports depends substantially on the level of physical development, functional state and physical fitness of athletes [10-12]. The motor system of a young athlete is a tool, with which they learn different forms of movement in the set space. The training process of young athletes is connected to performance of different locomotions in various modes of intensity. In the age of 11-12 years, effectiveness of the competitive activity is mostly because of physical fitness of young soccer players, since they have to participate in full-size formats of competitive soccer matches [13-15]. The post-puberty, being one of the most stable periods of individual human development due to the cessation of intensive growth against the background of sufficient maturity of energy support systems, nervous and humoral regulation of the body's functions is still characterized by a weakness of functions in a number of organs and systems [5, 16, 17]. Insufficiently strong liver barrier function, activity of the immune system do not support high resistance of the body and reliability of adaptation to the influence of higher physical loads. Adequate systematic physical effect causes the long-term adaptation, accelerates formation of organs and systems of a young athlete and shortens the period of delay in the development of internal organs from the tempo of physical development. This is the reason why, in case of planning these loads, we need to consider these facts, and their distribution by volume and intensity in separate training cycles should take into account still limited adaptation capabilities of the body.

Based on the above, it becomes obvious that in the case of soccer, when assessing the body functioning level, it is necessary to take into account the age aspect, since in addition to the features of the development of the body of soccer players, there are also features of the muscular activity's specificity. For example, puberty in soccer players is noted by some experts as a stage of transitioning to sports professionalization, the duration of which can take several years [18-20]. During this period, it is extremely important to organize the process of training for young soccer players in a way, that they, on the one hand, could promptly integrate in the training process of a professional team, on the other hand – preserve health and possibility to continue regular and purposeful individual development.

The purpose of this study was to define substantial criteria of the adaptation efficiency coefficient of 12-18 year old soccer players from the point of the forming dynamic functional system.

Methods and organization. The study included 500 soccer players from sports schools

of the Southern Federal District: the "Academy of Soccer" in Krasnodar, the "Rostov" school in Rostov-on-Don, the "Academy of Soccer "Alania" in Vladikavkaz.

In order to achieve the set goal, we used methods of scientific research that allow assessing physical development, physical fitness and functional state of the cardiovascular system of young soccer players. The anthropometric methods included the measurement of body length, body mass, and chest girth. Based on the data obtained, we calculated the body mass index, the Erismann index, which characterizes the development's proportionality and allows you to judge the physique type of an athlete. Using dynamometry, we identified muscle strength of the right and left wrists of players. We also calculated the strength index, characterizing a percent ratio of the wrist's muscle strength to body mass. In order to identify features of the blood circulation system's function, we assessed following hemodynamic parameters: stroke volume, cardiac output, double product, pulse pressure, mean blood pressure, blood circulation efficiency coefficient, self-regulation type. Control pedagogical tests were conducted to define indicators of physical fitness in young soccer players from seven age groups (12 years, 13 years, 14 years, 15 years, 16 years, 17 years, 18 years). A set of test tasks for assessing physical fitness was carried out considering training programs and recommendations given by experts, engaged in scientific and methodological support of the sports reserve training. To identify structural elements, as well as to reveal an amount and quality of correlations between main indicators, we used the adaptation efficiency coefficient (AEC), suggested by N.V. Bondar' (2000) and successfully applied in works of physiological field, that characterizes ratio of a number of "strong" correlations to a total number. Low AEC values characterize satisfactory (effective) adaptation, related to a prolonged influence of external factors. In our opinion, it also shows that the body systems are ready for further, stronger stimuli, causing improvement of fitness.

Results and discussion. The analysis of the main indicators for the age groups of soccer players revealed that heterochronous changes in the structure of correlation matrices are observed with age (table). The least amount of total correlations was found at the age of 13, the most – in 18-year old soccer players. At the same time, at the age of 13 and 18, the largest number of "strong" correlations were observed, and the lowest indicators of the strength of correlation matrices were found in 15-year-old and 17-year-old soccer players. In our opinion, data presented in the table show inertia of the dynamic functional system at the age of 13, because there is no increase in a number of total correlations (306 versus 402 in 12-year-old players). However, the strength of the already present correlations slightly increases (170 versus 136 in 12-year old soccer players). This age can be characterized from the point of improving motor skills by a certain period of stabilizing the results obtained early and achieved functional changes.

Table

Adaptation efficiency in soccer players in the age range of 12 to 18 people

№	Indicators	Age of examined players						
		12 years	13 years	14 years	15 years	16 years	17 years	18 years
1	Total number of correlations	402	306	372	374	440	347	429
2	Number of "strong" correlations	136	170	148	110	120	112	168
3	AEC (c.u.)	0.32	0.55	0.39	0.29	0.27	0.32	0.39

Note: AEC – adaptation efficiency coefficient

We also discovered the highest AEC indicator (0.55 c.u.) in this age period (13 years), which confirms the aforementioned data and indicates strained adaptation of the body. When analyzing the training process and study programs for soccer training in the examined group, we have found that at this age-related stage, basic simple technical skills of movements with the ball are learned, such as receiving and passing the ball, leading the ball, curved pass, hitting the goal, taking into account the pubertal spurt. It seems that puberty, regardless of rational arrangement of the training, brings imbalance in the formation of the dynamic functional system.

Another period of inertia, from the point of expanding the search for the formation of new functional correlations in the conditions of the formation of more complex motor skills that are formed in this age range, can be considered the age of 17 years. During this period, there is a small number (347) of total correlations with a smaller number of "strong" correlations. It is notable that at the age of 17, AEC amounts to 0.32 c.u., which can be described as the satisfactory adaptation level without strain of adaptation mechanisms. Based on the above, we can assume that the age of 17 is not a stagnation period due to low efficiency of the training process in examined selections of soccer players and a necessity to expand and complicate motor skills and abilities. Possibly, irrationally lowered or forced loads in terms of magnitude and degree of complexity take place in the training process. It is suggested that the training program needs corrections at this stage, since that would contribute to the transition of the body's systems to a higher level of function.

Conclusion. Taking the results obtained into account, we can conclude that the dynamic functional system of a soccer player is formed under the influence of a wide variety of factors related to conditions of training and competitive activity. The AEC indicators reliably evidence changes in composition and quality of correlations that make the structure of the dynamic functional system, formed in constantly changing conditions of training and competitive loads of soccer players at stages of the multiyear sports training. According to the obtained values of the AEC (c.u.), we can also conclude that each age period has its own features of the body function, causing inclusion of adaptation responses of certain indicators that support homeostasis, into the group. In general, it can be noted that in the age range from 12 to 16 years, adaptive changes occur that correspond to the established general patterns of the body development, indicating a rationally constructed training process that does not make a certain imbalance in the body formation. In 13-year-old soccer players, the AEC reaches the highest values, which indicates a pronounced strain on adaptive systems. The age range from 17 to 18 years proceeds without the necessary stress of adaptation processes, which implies the stabilization of sports results, as well slowed down growth of athletic skills of soccer players due to insufficiently effective exercise stimuli.

REFERENCES

1. Grigoryan S.V., Grigoryan M.S. Dynamics of morphofunctional indicators in young soccer players of different somatic types and variants of biological development. *Modern Soccer: State, Problems, Innovations and Prospects of Development*. Kazan', 2018, pp. 146-150. (in Russ.)

2. Dranitsyn O., Popov V., Dryukov S. Functional capabilities diagnosis: manual for soccer trainers. Moscow: the "National Soccer Academy" Fond, 2015, pp. 156-161. (in Russ.)

3. Efimov S.D. Features of functional capabilities of young soccer players, taking into account their personality. *Theory and Practice of Physical Culture*, 2010, no. 2, P. 69. (in Russ.)

4. Iordanskaya F.A. Monitoring of physical and functional fitness of soccer players in conditions of the training process. Moscow: Sovetskij Sport, 2013. 180 p. (in Russ.)

5. Gorbaneva E.P. Physiological mechanisms and characteristics of a man's functional capabilities within the process of adaptation to specific muscle activity: an author's abstract. Volgograd, 2012. 25 p. (in Russ.)

6. Pshebyl'skij V. Methodology of studying issues of training the sports reserve in soccer, based on the nature-aligned strategy for organizing years-long training of a young soccer player. Theory and Practice of Physical Culture, 2007, no. 4, pp. 8-10. (in Russ.)
7. Sorokin O.O. Functional training of young soccer players of different specialization during the competitive period: an author's abstract. Volgograd, 2006. 25 p. (in Russ.)
8. Baevskij R.M., Ivanov G.G. Heart rate variability: theoretical aspects and possibilities for clinical use. Ultrasound and functional diagnostics. Moscow: Nauka, 2001. pp. 106–127. (in Russ.)
9. Kalinina I.N. Physiological aspects of adapting cardiovascular system of men and women with signs of chronic venous disease in postnatal ontogenesis: an author's abstract. Cheboksary, 2009. 46 p. (in Russ.)
10.Kuz'min A.A. Influence of sporting physical loads on the morphofunctional development and regulatory-adaptive capabilities of young soccer and basketball players: an author's abstract. Majkop, 2011. 21 p. (in Russ.)
11.Levin V.S., Tikhomirov A.K. Volume of motor movements of elite soccer players during the process of competitive activity. Theory and Practice of Physical Culture, 2012, no. 2, pp. 79-81. (in Russ.)
12.Sergienko L.P. Sports selection: theory and practice: a monograph. Moscow: Sovetskij Sport, 2013. 1048 p. (in Russ.)
13.Malina R.M., Ribeiro B., Aroso J., Cumming S.P. Characteristics of youth soccer players aged 13-15 years classified by skill level. *British Journal of Sports Medicine*, 2007, vol. 41, pp. 290-295.
14. Vaeyens R.A., Malina R.M., Jenssens M.A multidisciplinary selection model for youth soccer. The Ghent youth soccer project. *British J. Sports Med*, 2006, vol. 40, pp. 928-934.
15. Wong D.P., Wong S.H.S. Physiological profile of Asian elite youth soccer players. *Journal of Strength and Conditioning Research*, 2009, vol. 23, pp. 1383-1390.
16.Abramova T.F., Nikitina T.M., Kochetkova N.I. Morphological criteria – indicators of eligibility, general physical fitness and control of the current and long-term adaptation to training loads: a study guide. Moscow: TVT Divizion, 2010. 104 p. (in Russ.)
17.Kozhevnikov V.S. Differentiated planning of main means of training soccer players aged 15-16 years during the preparatory period, taking into account their bioenergetics types: an author's abstract. Naberezhnye Chelny, 2011. 19 p. (in Russ.)
18.Matveev L.P. Theory and methods of physical education. Fizkul'tura i sport, 1991. 540 p. (in Russ.)
19.Platonov V.N. Division of sports training into periods. General theory and its practical use. Kyiv: Olimpijskaya literatura, 2013. 624 p. (in Russ.)
20.Suchilin A.A. Training of the Olympic reserve: a textbook. Volgograd: Print, 2017. 236 p. (in Russ.)

INFORMATION ABOUT THE AUTHORS:

Irina Nikolaevna Kalinina – Doctor of Biological Sciences, Professor, Kuban State University of Physical Culture, Sports and Tourism, Krasnodar.
Vladislav Valer'evich Lavrichenko – Candidate of Biological Sciences, Senior Lecturer, Associate Professor of the Department of Theory and Methods in Soccer and Rugby, Kuban State University of Physical Culture, Sports and Tourism, Krasnodar, e-mail: football.70@mail.ru.

For citation: Kalinina I.N., Lavrichenko V.V. The long-term training process of young soccer players from the position of the formation of a dynamic functional system. *Russian Journal of Sports Science: Medicine, Physiology, Training*, 2022, vol. 1, no. 1. DOI: 10.51871/2782-6570_2022_01_01_2