

Special Preparedness of Football Players with Different Typological Properties of Higher Parts of Central Nervous System

V. Lizogub, V. Suprunovych, V. Pustovalov, S. Grechukha, L Uhimenko

M. Bosyi Research Institute of Physiology, Educational and Scientific Institute of Physical Culture, Sport and Health,
Cherkasy B. Khmelnytsky National University, Cherkasy, Ukraine
Corresponding author. E-mail: ViktoryS1987@ukr.net

Paper received 23.06.17; Accepted for publication 29.06.17.

Abstract. In modern football, the search of the criteria, which are characterized by sustainable biological nature and might be informative for the management and prediction of individual sport training, is of growing interest. We consider that individual-typological properties of higher parts of the central nervous system can meet these requirements. Thus, the goal of the research was to find out what individual-typological properties of higher parts of the central nervous system are fixed genetically and to determine their correlation with the indicators of special preparedness and bioenergetics of football players. We performed the investigation using “Diagnost-1M” and “D & K-Test” computer devices on 13 pairs of monozygotic (MZ) and 12 dizygotic (DZ) twins who did not go in for sport and 26 professional football players, and determined typological properties of the nervous system. Besides, we found physical and technical preparedness of the football players. We found the expressed hereditary conditionality for the functional mobility of the nervous processes (FMNP) (70%) and the relative predominance of genotypic factors (50%) for the strength of the nervous processes (SNP) and the equilibrium of the nervous processes (ENP). We determined the predominance of phenotypic factors (30%) for the indicators of sensorimotor reactions. The indicators of bioenergetics metabolism, physical and technical preparedness, expert evaluation of game activity of the highly qualified football players depended on the genetically determined properties – the functional mobility of the nervous processes.

Keywords: *neurodynamic properties, genetics, football players, bioenergetics.*

Introduction. Modern football is characterized with tremendous transformation in the techniques and tactics of the game, in the structure of physical training, the strategy of competitive struggle and planning of training process [8, 9, 16]. Under these conditions, an individual approach should be used in the organization of training process [2, 3, 11]. The indicators of physical, technical or functional preparedness of football players, player roles, body types, biological age, personal characteristics can be the criteria of this approach [16, 18, 20]. The search of the criteria characterized by sustainable biological nature or genetically determined ones, which can be informative for the management and prediction of individual sport training, is of particular interest [1, 14, 15, 17, 19]. We think that individual-typological properties of higher parts of the central nervous system: functional mobility, strength and equilibrium of the nervous processes and some indicators of sensorimotor reactions, can meet such requirements [4, 10].

It is important to study the speed opportunities of sensorimotor characteristics of the nervous system because the efficiency of football players' game activity depends mostly on physical, technical, psychological and tactic training, the functional mobility of the main systems, the bioenergetics condition of muscles, the sportsman's ability to perception, analysis and processing information [7, 16]. The study of typological characteristics of higher parts of the central nervous system and sensorimotor reactions can give additional information about the special preparedness of sportsmen. However, the typological characteristics of higher parts of the central nervous system and sensorimotor reactions of football players are insufficiently studied. The search of talented young sportsmen and the efficient methods of the management of training process and game activity of football players causes the necessity to consider individual-typological features of players.

Considering the mentioned above, the work is based on the investigation and analysis of the correlation of individual-typological properties of high parts of the nervous

system and sensorimotor reactions and their relationship with bioenergetics characteristics, technical and physical preparedness of professional football players.

The goal of the research was to find out what individual-typological properties of higher parts of the central nervous system are genetically fixed and to determine their correlation with the indicators of special preparedness and bioenergetics of football players.

Material & methods. Typological properties of the nervous system, namely, the functional mobility (FMNP), strength (SNP) and equilibrium of the nervous processes (ENP), latent periods of simple (SVMR) and complex response of choosing one (RC1-3) and two (RC2-3) signals out of three ones, were determined in 13 pairs of monozygotic (MZ) and 12 pairs of dizygotic (DZ) twins, who did not go in for sport, and 26 professional football players using the computer device of “Diagnost-1M” [12].

FMNP was determined according to the results of processing complex visual information in “the imposed rhythm” mode consisting in the differentiation of positive and inhibitory stimuli (geometric shapes). The maximum rate of processing signals in which the examinee had not more than 5.0-5.5% of errors served as a quantitative indicator of FMNP. The higher the rate of information processing was, the higher FMNP was. SNP was evaluated according to the indicator of cerebral cortex performance which was estimated by the number of errors (%) committed by an examinee while performing the whole task. The determination of ENP provided the registration of response accuracy on moving object. ENP was estimated according to the total value of response deviation, advancing or delaying. The lower the time of total deviation of motion response was (in ms), the higher ENP was.

The role of hereditary and environment factors in forming FMNP, SNP, ENP and SVMR, RC1-3, RC2-3 was determined according to Holzinger's hereditary coefficient (H). We calculated the coefficients of interclass correlation (r) for MZ (rMZ) and DZ (rDZ) twins and then determined H according to the formula:

$$H = (rMZ - rDZ) : (1 - rDZ) [1, 15].$$

Physical preparedness of football players was determined according to the indicators of test tasks to show agility, speed and speed-strength abilities and endurance [9, 15]. The level of technical preparedness was assessed using control exercises: dribbling, throwing the ball, kicking the goal on accuracy and complex exercise [9]. We determined bioenergetics indicators using express-diagnostics of functional state and reserve opportunities of a body by the computer device "D & K- Test" [5]. The group of the experienced coaches performed expert evaluation of the game activity of football players [8].

The obtained statistic material was processed using the computer program Microsoft Excell.

Results. First of all, we tried to figure out which individually-typological features of higher parts of the CNS and sensorimotor reactions were genetically dependent, and the development of which was mostly stipulated by the environment factors. The results showed that the average values of the typological properties of higher parts of the central nervous system in the MZ and DZ groups were practically the same, except the differences in the indicators of FMNP, which were slightly higher than in MZ twins ($p < 0.05$). We found that in the pair similarity of the MZ and DZ groups, the typological properties were characterized with higher level of correlation in the MZ pairs than in the DZ ones indicating the expressed genetic influence on these indicators ($p < 0.05$). The hereditary coefficient of Holzinger (H) shows the differentiated influence of genotypic and environmental factors on the indicators of different individual properties of the nervous system; the coefficient higher than 0.5 shows relative dominance and higher than 0.6 – absolute dominance of genetic factors [1, 4, 14]. In our study, the coefficient of H was high (0.65) only for one indicator, the FMNP. The correlation was slightly lower (0.56 – 0.52) for the SNP and ENP. The value of H was still lower for the SVMR and RC1-3 and RC2-3 (0.29 – 0.20); it showed the dominance of the dependence of these indicators from the environment [10].

Thus, the research results of the same twins group showed that the participation of genetic and environmental factors in the formation of individual features of sensorimotor and typological properties of higher parts of the central nervous system was found in different proportions. We found the expressed hereditary conditionality for the FMNP (70%) and relative dominance of genotypic factors for the SNP and ENP. We determined the dominance of phenotypic factors for the indicators of the SVMR and RC1-3, RC2-3. The coefficient of Holzinger did not exceed 30%.

The found high dependence from the genotype of the FMNP helped us to proceed to the study of the dependence of special preparedness and bioenergetics of the highly qualified football players from the individual and typological properties of the nervous system. We studied the connection of indicators of physical and technical preparedness, bioenergetics and expert evaluation of players' game activity with the FMNP. There was a correlation of some indicators of bioenergetics, physical, technical and game training with the FMNP ($r = 0.30 - 0.38$).

To check the obtained correlations according to the research results of FMNP, we divided the football players into 3 groups: medium, upper-medium and pre-medium

levels. We analyzed and compared the indicators of bioenergetics, physical, technical and game preparedness in the respective groups of football players.

The analysis showed that the football players with upper-medium level of the FMNP were mostly characterized with better indicators of power supply systems, physical, technical and game preparedness, if compared with the players with medium and pre-medium levels of individual-typological properties of the CNS. Reliable differences were found between the groups of football players with upper-medium and pre-medium levels of FMNP in terms of bioenergetics indicators, anaerobic threshold (AT) ($p < 0.05$). These differences of the indicators of football players' power supply were confirmed by the correlation between AT and FMNP; its value was $r = 0.35$ ($p < 0.05$). The reliable differences between the groups of football players with different level of the FMNP were found according to the results of physical and technical training (standing long jump and dribbling for 30 m) ($p < 0.05$). The analysis of expert estimation of football players' game activity in the groups with the different levels of the FMNP showed that the football players with the upper-medium level of the FMNP were characterized with better marks ($p < 0.05$). Respectively, the players with the medium and pre-medium level of the FMNP got lower marks. The correlation indicator was $r = 0.30$ ($p < 0.05$).

To demonstrate the differences between the groups of football players according to bioenergetics indicators, game and special preparedness, we built profiles of model characteristics of players and their average meanings for the groups with the different level of the FMNP (Fig. 1).

Fig.1 shows that the profiles of bioenergetics indicators, special preparedness and expert evaluation of football players in the groups with different level of FMNP were different. The closest results to the model characteristics were in the group of football players with the upper-medium level of the FMNP.

Greater differences of the results were in the group of players with pre-medium level of the FMNP. An intermediate position was in the group of football players with medium values of the FMNP. It shows the characteristic features of neurodynamics, bioenergetics properties and the results of physical, technical and game training of the football players with the different level of individual-typological properties of the nervous system.

Discussion. Thus, we found that the indicators of bioenergetics metabolism, physical and technical preparedness of football players depended on the FMNP. The correlation of genetically determined individual-typological properties of higher parts of the nervous system with the features of bioenergetics metabolism, physical, technical preparedness and the expert evaluation of game activity allowed us to conclude that typological properties of the main nervous processes of the FMNP showed genetic influence on the performance of motor tests in physical and technical training of football players, their bioenergetics potential, and created conditions for effective game activity. Considering our data and the theoretical analysis of scientific sources [6, 9, 11, 13, 16], we can affirm that the football players with high level of the FMNP have high reserve body opportunities allowing them to achieve high results in special preparedness and game activity.

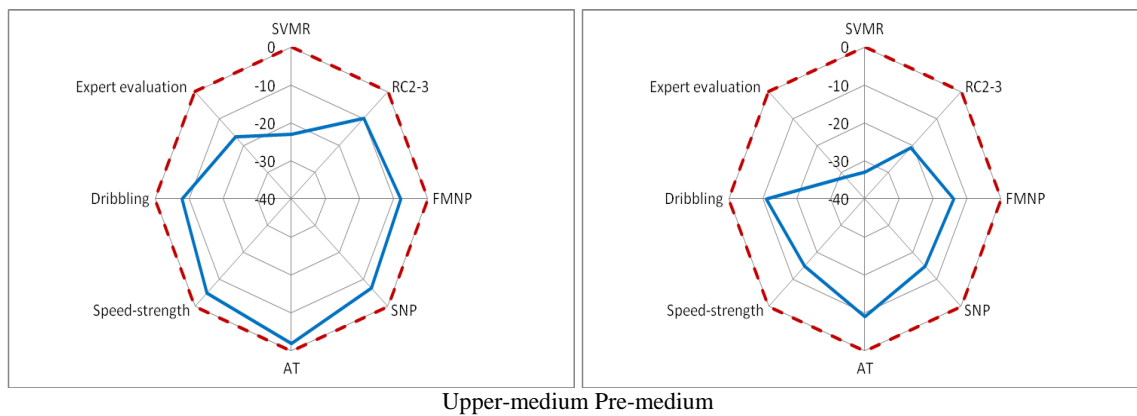


Fig. 1. Profiles of neurodynamics, bioenergetics indicators, expert evaluation and special preparedness of the football players with upper-medium and pre-medium level of the FMNP model, preparedness of players

Conclusions:

1. The research results on twins found the participation of genetic and environment factors in forming individual features of sensorimotor and typological properties of higher parts of central nervous system. We found the expressed hereditary conditionality for the FMNP (70%) and relative dominance of genotypic factors (50%) for the ENP and SNP. The dominance of phenotypic factors (30%) was found for the indicators of sensorimotor reactions.

2. The indicators of bioenergetics metabolism, physical

and technical preparedness, expert evaluation of game activity of highly qualified football players depended on genetically determined properties, functional mobility of nervous processes.

3. The found dependence of individual-typological properties of higher parts of the central nervous system on physical, technical preparedness, bioenergetics metabolism and expert evaluation of game activity has prognostic value and can be used in the selection of promising youth and optimization of sport training.

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