

Modern implementation approaches to high-trained football player selection on the basis of neurodynamic properties of the upper sections of the central nervous system

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Purpose: based on the characteristics of neurodynamic and sensorimotor properties, to develop a technology for the selection of football players of high qualification.

Material & Methods: neurodynamic properties of the higher sections of the central nervous system of football players-professionals were studied using a computer device called "Diagnost-1M". The functional mobility, strength and balance of nerve processes (FMNP, SNP, BNP), as well as latent periods of simple and complex sensorimotor reactions (SVMP, CMR2-3).

Results: according to the indices of neurodynamic properties and sensorimotor reactions of football players of high skill level, differences. Football players who had the best indicators of neural neurodynamic properties, characterized by high efficiency expert assessments game activity.

Conclusion: developed and substantiated estimates of the scale of neural properties and defined criteria for assessing the suitability of highly skilled players for selection in the club and national teams.

Keywords: football, selection, effectiveness of game activity, neurodynamic, sensorimotor, genetics.

Introduction

Modern football is characterized by growth of entertainment and a high level of competition among players, the technique and tactics of the game have become more complicated, the price of error has grown, requirements to the whole system of preparedness, control and correction of the training process and selection of players have increased. This requires players to identify technical, tactical, mental and physical abilities that meet the high demands of gaming [6; 8; 9]. There is a process of exhaustion of a set of tools and methods that ensure a high result of gaming activities of players. Therefore, the relevance to the development of theory and methodology, the improvement of criteria, the search for and the creation of an accessible, informative and effective step-by-step selection of high-trained football players in the Premier League and national teams. In most cases, coaching groups are interested in improving the quality of staffing teams with players, maintaining high efficiency and reliability of gaming activities, reducing training time, training and training, reducing the number of players being eliminated, increasing the stability of gaming teams, maintaining health and gaming longevity [1; 14]. The main purpose of sports selection is to ensure maximum compliance with the individual characteristics of players to those requirements that apply to them play activity [2; 11; 12].

Despite the rather high interest of researchers and coaches in the selection problem, given the high psycho-emotional and physical stress of playing activity, the quantitative and qualitative criteria and selection criteria of high-trained football

player remain insufficiently developed. The problem lies, first of all, in the absence of a unified approach to the methods of research and evaluation of results. This situation is explained by the fact that abroad, the problems of research and evaluation of neurodynamic characteristics of football players are engaged in psychology, leading to an underestimation of the biological component [15; 16; 17]. Traditionally in the countries of the former Soviet Union, particularly in Ukraine, such studies are conducted by physicians and physiologists, increased attention to physiological and underestimation of the psychological mechanisms of behavioral reactions [3; 4; 12].

At the world level and in Ukraine there is a practice and methodology for selecting players, built on the theory of individual differences in health status, physical capabilities, development of motor skills, performance of technical and tactical actions, game effectiveness, mental and constitutional features, dominance of vision, legs, asymmetry of the brain, style of competitive activity and other [1]. The presence of differences in these indicators is the basis for solving the selection problems. At the same time, researchers are showing considerable interest in the search for highly genetically determined markers, which are the most informative in the management and forecasting of gaming activities. Such criteria are distinguished by a strong and stable biological nature, and, in our opinion, they include neurodynamic, individual-typological properties of the higher parts of the central nervous system: functional mobility (FMNP), strength (SNP) and equilibrium (BNP) of nerve processes [5; 7].

Previously, using the twin method, we proved that for monozygotic and dizygotic twins, the coefficients of pair correlation (R) and heredity (H) were for FMNP – 0,65 for SNP – 0,53, and for BNP – 0,56, a high dependence of these properties on genetic and small on environmental factors. Therefore, we believed that these properties are biologically stable and, due to their genetic conditionality, can be reliable criteria in the selection of players [3; 7; 13].

Therefore, the methodology is based on the research and analysis of the parameters of sensorimotor and neurodynamic properties of the higher sections of the nervous system with the aim of developing criteria and scoring scales for the selection of high-trained football player.

The purpose of the research

Based of the characteristics of neurodynamic and sensorimotor properties, to develop a technology for the selection of football players of high qualification.

Material and Methods of the research

Studies conducted 46 high-trained football player, members of the Premier League teams and the national team of Ukraine. We studied the neurodynamic properties of the higher parts of the central nervous system and sensorimotor characteristics of varying complexity, and also conducted an expert evaluation of gaming activity.

The study of individual-typological, neurodynamic properties was carried out using a computer device «Diagnost-1M». Defined: FMNP, SNP and BNP of nervous processes, as well as latent periods of simple (SVMR), complex reactions of differentiation of two of the three stimuli (CMR2–3) [10].

The level of FMNP was determined from the processing of complex visual information in the feedback mode, which consisted in differentiating positive and inhibitory stimuli (geometric figures). The FMNP measure was the time of the test task execution. The quicker the examiner performed the task related to the differentiation of 120 stimuli, the higher he had FMNP. SNP was estimated by the indicator of the total amount of processed information for 5 minutes of work on the computer. A greater amount of processed information responded to a high level of SNP. The definition of BNP provided for recording the accuracy of reactions to a moving object. BNP was judged by the total magnitude of the reactions, ahead of or late. The smaller the sum of the deviations of motor reactions (ms), the higher the BNP.

Sensor-motor reactivity was evaluated by the value of the latent periods (ms) in response to the action of stimuli of varying degrees of complexity (a simple visual-motor reaction –

SVMR, and a differentiation reaction of two stimuli of three – CMR2–3). Smaller values of the latent periods correspond better sensorimotor reactivity [7].

Expert evaluation of the game activity of the players was conducted by a group of experienced coaches. The resulting statistical material was processed by a computer program Microsoft Excell.

Results of the research and their discussion

High-trained players have established the maximum, minimum and average values of the neurodynamic properties of the higher parts of the central nervous system: FMNP, SNP, BNP and latent periods of sensorimotor reactions: SVMR, CMR2–3 (table 1).

To develop a differentiated quantitative and qualitative assessment of the neurodynamic properties of high-trained football player, we used the technology of scales. Relative values of parameters obtained on the basis of their absolute magnitude, taking into account the characteristics of the standard deviation (σ) of the mean statistical. The calculated gradations of the \bar{X}_i value indicators for each functional class. Based on the results of high-trained football player, we have developed boundaries and scales for the distribution of players into groups that include five levels of the functional state of neurodynamic and sensorimotor properties: a high level (H), which was calculated – $\bar{X}_i \leq \bar{X} - \sigma$ and corresponds to 10 points; above average (AA) – $\bar{X} - \sigma \leq \bar{X}_i \leq \bar{X} - 0,25\sigma$, which corresponds to 8 points; average level (A) – $\bar{X} - 0,25\sigma \leq \bar{X}_i \leq \bar{X} + 0,25\sigma$ and corresponded to 6 points; lower than average (LA) was calculated as follows $\bar{X} + 0,25\sigma \leq \bar{X}_i \leq \bar{X} + \sigma$ and is equal to 4 points; and the low (L) level is – $\bar{X} + \sigma \leq \bar{X}_i$, which was 2 points. Scales of assessments of neurodynamic and sensorimotor properties of professional football players are presented in table 2.

Such diagnostics and evaluation for each indicator allows, according to the table, to determine the individual quantitative and qualitative characteristics of individual typological properties and sensorimotor reactions of football players. Thus, according to the scales proposed by us, a group with a high level of sensorimotor properties can be classified as players who have SVMR at the level – 184 ms or less, for CMR2–3 – 249 mc and the best time. According to the results of individual-typological properties of BNP, the group with a high level included players who had FMNP – 56 s or less, for SNP – 752 or more stimuli, and for BNP the deviation was – 14 ms or less. A qualitative assessment of the resulted neurodynamic properties characterized by a high level of their development and corresponded to 10 points. Corresponding scales of assessments were developed for the remaining 4 groups of players with different levels of neurodynamic functions: above aver-

Table 1
Neurodynamic and sensorimotor properties of high-trained football players

Indicators	SVMR (ms)	CMR2–3 (ms)	FMNP (s)	SNP (stimuli)	BNP (ms)
Maximum	157,0	276,0	52,0	830,0	11,0
Minimum	236,0	359,0	66,0	610,0	28,0
Medium, $\bar{X} \pm s$	196,6 \pm 4,1	317,4 \pm 6,8	59,3 \pm 0,9	720,6 \pm 7,4	19,2 \pm 0,8

Table 2

Differential scales for assessing the level of neurodynamic properties of high-trained football players

№ c/u	Indicators	Level of properties under study				
		L	LA	A	AA	H
		2 points	4 points	6 points	8 points	10 points
1	SVMR, ms	≥231	230–216	215–200	199–185	≤184
2	CMR2–3, ms	≥311	310–290	289–270	269–250	≤249
3	FMNP, s	≥67	66–64	63–60	59–57	≤56
4	SNP, stimuli	≤659	660–684	685–719	720–751	≥752
5	BNP, ms	≥33	32–27	26–21	20–15	≤14

Table 3

Integral index of neurodynamic and sensorimotor properties for high-trained football players

№ c/u	Level of neurodynamic and sensorimotor properties	Integral index of the properties studied, points
1	High	≥41
2	Above average	31–40
3	Average	21–30
4	Lower than average	11–20
5	Low	≤10

Table 4

Evaluation of the game activity of of high-trained football players

№ c/u	Level of game activity	Index of game activity of football players, points
1.	High	9–10
2.	Above average	7–8
3.	Average	5–6
4.	Lower than average	3–4
5.	Low	1–2

age (AA), average (A), lower than average (LA) and low (L).

The general conclusion about the functional state of neurodynamic and sensorimotor properties was carried out according to the integral index, which was calculated by the sum of the points scored by the player (table 3).

Table 3 shows the classification of the integral index of the functional state of neurodynamic and sensorimotor properties in high-trained football players. The maximum score – 50, minimum – 2. We analyzed the distribution of high-trained football players according to the level of the functional state of the neurodynamic and sensorimotor properties. Low values of the integral index – ≤10 points and below the average 11–20 points, among qualified players were absent. Of the total number of players – 9% football players (4 people), were assigned to the group with a high integrated index of neurodynamic and sensorimotor properties. Their integral index was higher than 41 points. Among all athletes, 9 players (19%) found above the average level of the integral index, which was in the range of 31–40 points. Most of the players of the national team of Ukraine and the Premier League, and this is 72% (33 people), entered the group with an average value of the integral index of the functional state of neurodynamic and sensorimotor properties. They had an integral index of 21–30 points.

In order to confirm the assumption that the individual typological neurodynamic and sensorimotor properties are related to the game activity of the players, we, with the help of a group of experienced coaches, conducted an expert evaluation of the game activity and developed evaluation scales (table 4).

The experts belonged to the group of players with a high level of gaming activity – 11% of players (5 people), of the above-average level – 24% (11 people), the average level included

the majority of players – 57% (26 people). According to this indicator, it was found that 8% of players (4 people) were assigned to a group with a lower than average level of gaming activity. Football players with a low score of gaming activity (1–2 points), the experts did not sing out.

Consequently, the distribution of football players on the quantitative and qualitative indicators of gaming activity and the integral index of neurodynamic and sensorimotor properties in our study coincided. Football players with high and above average gaming performance in most cases were characterized by high or above average values of the investigated neurodynamic properties of FMNP, SNP, BNP, a complex sensorimotor CMR2–3 differentiation reaction, which indicates a connection between the individual typological properties of GNI and gaming activity.

In order to establish the connection between the effectiveness of gaming activity and the functional state of neurodynamic and sensorimotor properties, we performed a correlation analysis. It was found that the correlation of the evaluation of the game activity of professional football players with sensorimotor and individual-typological properties (CMR2–3, FMNP, SNP, BNP) were within ($r=0,29-0,35$; $p<0,05$). This indicates that football players with a high and above average score of gaming activity were characterized in most cases by high values of the investigated typological properties of FMNP, SNP, BNP and differentiation reaction CMR2–3. Between rated players playing activity with indicators latent periods simple sensorimotor responses (SVMR) probable correlation is not established ($p>0,05$).

So, based on the data obtained, it was established that football players who had better indices of neurodynamic and sensorimotor properties were characterized by high estimates of the effectiveness of gaming activity, this is confirmed by

the presence of reliable correlations. Therefore, the criteria for selection can be as indicators of physical, technical, functional preparedness of football players, the playing role of players, body type, biological age, individual characteristics [2; 8; 6], and the special importance of coaching teams in the selection should provide highly genetically determined markers, which are the most informative in the management and forecasting of the game activity of players [3; 5; 7]. Such criteria, according to the results of our work, correspond to the neurodynamic, individual-typological properties of the higher sections of the central nervous system: functional mobility, strength and balance of nervous processes, as well as complex sensorimotor differentiation reactions that differ in strong and stable biological nature.

The results of a survey of football players of high qualification and their comparison with the success of gaming activities became the basis for the development and justification of criteria and recommendations regarding the gaming suitability of each candidate. Establishment of criteria for suitability is one of the important stages of our work and recommendations on selection. Based on the results of our study, it is suggested to select the contingent in the national teams and the Premier League with the distribution of football players into 4 groups: they are certainly suitable, suitable, conditionally suitable and unsuitable.

The first group should consist of unquestionably suitable football players of high qualification, capable of successfully performing technical and tactical tasks and installing a coach for the game. Such football players have a full correspondence of a high level of sensorimotor properties and neurodynamic functions and capabilities with the requirements of the game activity, presented to them by the coach. The integral index of the neurodynamic and sensory characteristics of these football players should be at least 41 points.

To the second group – suitable players can be classified as football players who were characterized above the average level of neurodynamic and sensorimotor properties. In the process of game activity, these football players can make minor mistakes that do not significantly affect the effectiveness of the team's playing activity. Errors, in general, can be associated with changes in working conditions, the performance of unusual functional tasks for the football player, the complication of game situations. For such football players, there is some decrease in the reserve capacity of the body. The integral index of these players on the complex of neurodynamic properties should be in the range of 31–40 points.

By the third group we included conditionally suitable football players. For them, a prerequisite is to increase the time for preparation and recovery, as well as the introduction of special training in the mode of increased workload. Purpose football players such demanding tasks associated with a significant probability of errors during their gaming activities permitted them in acute shortage of time and space. Such

football players, according to our results of neurodynamic and sensorimotor studies, were characterized in most cases by an average level. The integral index of the neurodynamic properties of these football players on the set of indicators should correspond to the average level and be in the range of 21–30 points.

The fourth group consisted of unsuitable football players, whose qualification and playing activity did not meet the requirements of the re-measure league and the national team of Ukraine. These include football players who have an integral indicator of neurodynamic and sensorimotor properties below 20 points, and most of the indicators studied are classified below their average level. Additional training for unsuitable individuals were unproductive.

Thus, we have proved that the main targets, provided that selection and prediction of high-trained football players are made, should be the characteristics of genetically determined neurodynamic properties of the higher parts of the central nervous system, including FMNP, SNP, BNP and sensorimotor differentiation CMR2–3. The use of genetic approaches for the purpose of sports selection and prediction will certainly help to reduce the percentage of marriage in coaching activities, free specialists from performing unproductive work, ensure high efficiency of training football players and reserve.

Conclusions

1. It has been proved that the main targets, provided that selection and prediction of high-trained football players are made, should be the characteristics of highly genetically determined neurodynamic properties of the higher parts of the central nervous system, including FMNP, SNP, BNP and sensorimotor differentiation reactions CMR2–3.

2. Football players who had better indices of neurodynamic and sensorimotor properties were characterized by high expert estimates of the effectiveness of gaming activity, which is confirmed by the presence of reliable correlations between the studied indicators and the evaluation of gaming performance ($p < 0,05$).

3. The results of the study of the neurodynamic properties of players of high qualification and the evaluation scales developed on their basis allow us to substantiate the criteria and recommendations regarding the game activity of players during the selection to the teams of masters and to the teams of Ukraine.

Directions for further research

The prospect of further research is to further study the individual-typological properties of the higher sections of the central nervous system and sensorimotor sets of varying degrees of complexity of players of high skill level depending on the playing positions.

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