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Original Article

Psychophysiological state of female handball players with different game roles

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Abstract.
Purpose: The purpose of this research was to study the psychophysiological state of female handball players with different game roles.
*Material:*to study the psychophysiological state of female handball players with different game roles. This research was carried out on the basis of the junior team of Ukraine, including participation of 34 girls aged 15-16 years. The following research methods were used to achieve this goal: the Luscher color test, the assessment of the state of neurodynamic functions (balance and functional mobility of the nervous processes), Raven's cognitive test, and the evaluation of functional brain asymmetry (J. R. Stroop 13).
Results: The analysis conducted revealed the existence of reliable differences in the indicators of psychophysiological states among female handball players of different roles (linear, semi-medium, extreme players). The estimates of the psychophysiological state and the level of general functioning, as well as the functional mobility and balance of nerve processes between players of different game rolesare showed reliable differences. This fact may testify about significant difference in the manifestation of genetically inherited functional characteristics. It has been established that high efficiency and speed of visual information processing are observed in extreme players, high level of stress in linear players and high level of nonverbal intelligence in the semi-mediumplayers.
Conclusions: The analysis of the results indicates the actuality of the chosen topic, and the results of the research can be used to select athletes in joint teams of different levels, orientation on the choice of the sport, and even on the possible forecast of success.
Key words: psychophysiological state, female handball players, game role.

Introduction.

One of the topic issues in the process of training young handball players is the selection of game roles based on the individual-typological properties of the nervous system. According to some authors (Makarenko et al., 2011; Korobeinikovaet al., 2019), locomotive development during the first two decades of life contributes to the accumulation of the body's potential of motor skills, the functional activity of various systems and, accordingly, to psychophysiological potential. The discrepancy between the intensity of physical and mental stresses and the physiological capabilities of the body leads to a decrease in the effectiveness of sports activities and the prospects for the development of young athletes (Kozina et al., 2019). For productive gaming activities, young handball players must possess not only high levels of physical fitness and ability to work, but also meet the level of manifestation of higher nervous activity, which is inherited genetically. This is especially important for optimal role formation (Valeria et al., 2017).

Recently, the priority area of research in the field of playing sports, in particular in the handball, is the assessment of the state of physiological and mental functions, depending on the game's role of athletes, in order to identify the model indicators and use them in the practice of sport at all stages of preparation (Yuriy et al., 2017). Sport activity is characterized by minimization of meaningful information that comes to the athlete, and its actions are based on variation motor stereotypes (Kozina et al., 2019). Of particular importance in handball

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are psycho-physiological properties and the cognitive sphere, namely, mental processes: perception, attention, memory, thinking, the very psycho-physiological processes that provide reception, processing of information and decision-making (Makarenko et al., 2017).

One of the components of the management system of the psychophysiological state of athletes is complex control, the main task of which is to evaluate the effectiveness of the training process. On the basis of the data of psycho-physiological control, an analysis is carried out and conclusions are drawn through which the selection in the team teams, the correction of the training process, the individualization of technical and tactical preparation, the choice of strategy and tactics of behavior at the competitions, optimization of pre-star conditions (Kostiukevych et al., 2017) are carried out.

However, the analysis of scientific and methodological literature indicates that studies of the psychophysiological state of handball players of various game roles have not been studied enough, which determines the relevance of our research.

*The purpose of the study*was to study the psychophysiological state of handball players with different game roles.

Materials and methods:

During the research, a complex of psychophysiological methods of research and methods of mathematical statistics was used. In the process of determining the psychophysiological state of girls handball players used the hardware-software psychodiagnostic complex "Multiximeter-05", which was tested for reliability, informative and valid. The equilibrium (balance) of excitation and inhibition processes in the central nervous system (CNS) was evaluated based on the results of the test "Reaction to a moving object". Functional mobility of the nervous processes (FMNP) was determined using the test for the perception and processing of visual information in reverse mode. To test the functional asymmetry of the brain and the polar dependence (field dependence) on the external environment, a modified Strip test, a version of the test ("Color & Word Test"; JRStroop, 1935) was used.

The research was conducted on the basis of junior team of Ukraine, with the participation of 34 girls aged 15-16. Protocols of experimental research have been supported by the Bioethics Commission of the National University of Physical Education and Sports of Ukraine, in accordance with the ethical standards of the Helsinki Declaration. All subjects gave written permission to participate in research, in accordance with the recommendations of the Committee on Ethics of Biomedical Research (Regional Regional 2000).

Statistical analysis

Statistical analysis of the obtained results was performed using «Statistica 8». We used discrete statistics methods to calculate the meanaand mean error. To assess the reliability of paired differences we used the parametric Student's t-distribution.

Results

The concept of "game role" should be interpreted as the functional responsibilities of the athlete on the site, due to the tactical placement of team members to solve the tasks of the game. The handball has a clear specialization of the players in the attack and in defense of the tasks that they must perform as part of the team (Rannou et al., 2001; Lisenchuk et al., 2019). In an attack - playful, semi-medium, linear, extreme. In defense - the central, semi-medium, extreme, forward defender. The investigated contingent refers to adolescence, which is characterized by further improvement of higher nervous activity, an increase in the level of analytical and synthetic activity of the cerebral cortex, an increase in the functions of generalization, the growth of the role of verbal signals, the improvement of the latent period of reaction to verbal stimuli, the process of balance in the central nervous system, the ending the process of forming the electrical activity of the cerebral cortex.

Table 1 shows the average group results of the psycho-emotional state of girls handball players with different game roles (according to the Luscher color test). The results indicate a significant difference between the groups of athletes with different roles in terms of performance and fatigue. The highest level of performance is observed in the extreme players, this indicates a connection between the psychological state of the athletes and the role of the girls handball players. In extreme and semi-medium players, the fatigue is significantly higher than that of linear players.

The presence of a reliable value of the index of deviation from the autogenic norm in linear players and high average group anxiety indicates the process of growth of the stress state, as a consequence of a decrease in the level of general capability. There is no significant difference between the indicators of the vegetative coefficient, heteronomy and autonomy between the players of different game roles (Table 1). However, the presence of higher values of vegetative coefficient and autonomy in linear players indicates the tendency toward autonomous functioning, with an increase in the activation of the sympathy-adrenal system of the organism.

Table 1.Luscher test results in handball players with different game roles (n = 34)

Explored indicators	Game roles			p 1 i 2	p 1 i 3	p 2 i 3
	Linear players (1) n=10	Semi-medium players (2) n=11	Extreme players (3) n=14			
Capacity,c.u.	6,67±1,80	8,75±1,58	10,60±1,43	<0,05	<0,01	<0,05
Fatigue, c.u.	3,33±2,50	3,50±2,45	6,40±2,37	>0,05	<0,01	<0,05
Anxiety, c.u.	4,00±3,46	2,75±2,19	3,60±1,96	>0,05	>0,05	>0,05
Deviation from autogenous norm, c.u.	22,67±5,00	18,00±2,62	12,80±3,16	<0,05	<0,01	<0,05
Eccentricity, c.u.	6,00±1,50	7,25±1,58	8,80±0,42	>0,05	<0,01	<0,01
Concentricity, c.u.	6,67±2,18	6,50±3,16	5,00±3,46	>0,05	>0,05	<0,05
Vegetative coefficient, c.u.	22,00±6,00	18,75±5,92	16,60±6,95	>0,05	>0,05	>0,05
Geteronomy, c.u.	4,00±1,50	5,50±3,16	7,40±0,52	>0,05	<0,01	>0,05
Autonomy, c.u.	8,67±2,78	8,25±2,66	6,40±3,10	>0,05	>0,05	>0,05

The study of balance of excitation and inhibition processes in the central nervous system was performed on a test, which is a kind of complex sensory-motor reaction, which, in addition to determining the sensory and motor periods, allows determining the period of complex processing of the sensory signal in the central nervous system (Table 2).

An analysis of the results suggests that there are significantly lower accuracy and excitement rates for the extreme players. The highest average-group result of excitation was observed in welterweight players, while the highest average group stability result was from linear players (Table 2).

According to the results of the study of the functional mobility of the nerve processes, it was found that the extreme players have the highest average group dynamics and throughput of the visual analyzer and the lowest - the limiting time of information processing and impulsivity - of reflectivity. (Table 2). The obtained result indicates the predominance of processes of excitation of the nervous system in the welterweight players. At the same time, the extreme players exhibit higher impulsiveness of the nervous processes and the best speed of perception and processing of visual information.

Table 2 Indicators of neurodynamic functions in handball players with different game roles (n = 34)

Explored indicators	Game roles			p 1 i 2	p 1 i 3	p 2 i 3
	Linear player (1) n=10	Semi-medium player (2) n=11	Extreme player (3) n=14			
Balance of nervous processes						
Accuracy, c.u.	2,88±0,88	3,38±0,83	2,44±0,25	>0,05	>0,05	<0,01
Stability (cV), %	5,20±1,50	4,78±0,98	4,29±0,73	>0,05	>0,05	>0,05
Excitement, c.u.	0,19±0,21	0,61±1,22	0,03±0,03	>0,05	<0,05	>0,05
FMNP (functional mobility of the nervous processes)						
Dynamism, %	59,13±3,18	59,37±11,20	62,91±8,07	>0,05	>0,05	>0,05
Capacity of the visual analyzer, c.u.	1,31±0,07	1,36±0,20	1,63±0,19	>0,05	<0,01	<0,01
Limit processing time, ms	480,00±122,8	455,00±102,68	362,00±88,54	>0,05	<0,05	>0,05
Impulseveness-reflectivity, c.u.	-0,40±0,07	-0,40±0,08	-0,17±0,11	>0,01	<0,01	<0,01

The technique of Equal was used in order to investigate the intellectual abilities of girls handball players whose results had been presented in Table 3. Analysis of the results shows that statistically significant differences are observed only in the accuracy indicator between linear and semi- medial players. The results indicate that higher levels of performance, accuracy, and efficiency are in the welterweight players. The lowest speed result was observed in linear players (Table 1). This points to a better level of nonverbal intelligence in the welterweight players, compared to other roles.

Table 3 Ravena test results in handball players with different game roles (n = 34)

Explored indicators	Game roles			p 1 i 2	p 1 i 3	p 2 i 3
	Linear player (1) n=10	Semi-medium player (2) n=11	Extreme player (3) n=14			
Productivity, c.u.	8,00±2,29	8,75±2,05	9,80±1,55	>0,05	>0,05	>0,05
Speed, c.u.	3,61±1,72	4,83±1,88	6,54±4,38	>0,05	>0,05	>0,05
Accuracy, c.u.	0,72±0,26	0,73±0,17	0,81±0,13	<0,01	>0,05	>0,05
Efficiency, c.u.	50,26±30,18	53,27±25,30	66,27±20,19	>0,05	>0,05	>0,05

Analysis of the results of the dependency test points to a significantly higher average group indicator in the linear players and a significantly higher functional asymmetry in the welterweight players (Table 4). The study of the index of left-sided domination and overall efficiency indicates that there are no significant differences between players with different game roles. The obtained fact indicates the absence among players of persons with explicit functional asymmetry of the brain. Exception is the players in the middle, in which there is a pronounced functional asymmetry of the brain. Due to the lack of significant differences in the indicator of the left-half domination between players with different roles, we can state that there is a right-hand domination in the welterweight players (Table 4).

Table 4 Test results of field dependence in handball players with different game roles (n = 34)

Explored indicators	Game roles			p 1 i 2	p 1 i 3	p 2 i 3
	Linear player (1) n=10	Semi-medium player(2) n=11	Extreme player (3) n=14			
Field dependence, c.u.	0,93±0,19	0,76±0,10	0,78±0,03	<0,05	<0,01	>0,05
Left hemisphere dominance,c.u.	1,01±0,11	1,04±0,23	0,97±0,10	>0,05	>0,05	>0,05
Functional asymmetry, c.u.	8,62±5,19	18,21±10,45	7,85±6,65	<0,05	>0,05	<0,05
Overall efficiency,c.u.	1803,4±425,37	2003,2±428,38	1796, 8±471,48	>0,05	>0,05	>0,05

Consequently, the results of research on the psychophysiological state of girls aged 15-16 indicate that there is a significant number of statistically significant differences between players of different game roles.

Having information on the discrepancy and similarity of the individual-typological characteristics of the nervous system of young handball players who perform various roles in game, the coach will understand what technical, tactical and psychological arsenal to choose for each group of players.

Discussion.

The analysis of scientific and methodological literature points to the need to study the psychophysiological state of young athletes. Experts in the field of psychophysiology of sports believe that the practical application of psychophysiological diagnostics can reduce the time for sports training, increase its efficiency, raise the level and stability of sporting results (Kozina et al., 2017; Korobeynikov et al., 2019). Research of the psychophysiological state of handball players with different game roles, whose activity requires constant attention, rapid response, and stable operation of all functional systems, is actual
(Jarraya et al., 2014). Distribution of players for the role - one of the basic principles of gaming activities. The development of sports games is based on two, at the first glance of the processes - universalisation and player specialization (Imas et al., 2018). Universalization involves expanding the scope of action, but in no way excludes improvements in the performance of individual game functions. It should be keep in mind that speed and endurance, intelligence and athletic motivation, as well as a certain set of personality characteristics of athletes, manifest themselves in different ways (Sarrazin et al., 2002). Therefore, a single player performs more productive actions, the other is destructive. One player is more organizer, the other is prone to planning, while the third is a good performer. That is, each player has a predisposition to a certain role (Tyshchenko 2016).

The players are distinguished not only by the game techniques of the alley location on the site, but also by psychophysiological features. The problem of the psychological specificity of the sporting role is becoming more acute, since the reserves of the human psyche are one of the promising directions for further enhancement of sporting achievements and a decrease in the duration of the training of highly skilled players.

In our studies, it was determined that the differences between young handball players with different role in psychophysiological indicators reflect the peculiarities of each role. The presence of stress state in linear players was revealed, which influenced the decrease of the general workability. At the same time, it has been established that linear players tend to operate autonomously. Extreme players showed high impulsiveness of nerve processes and the speed of perception and processing of visual information. The pronounced right-hemispherical functional asymmetry of the brain in semi-medium players causes a high level of excitation of the nervous system. At the same time, this group of players finds the best level of non-verbalintelligence.

Conclusions.

According to the results of the estimating of the psycho-physiological state and the level of general functioning, as well as the functional mobility and balance of nerve processes between players of different game roles, there are significant differences, this fact may indicate to a significant difference in the manifestation of genetically inherited functional characteristics. It has been established that high efficiency and speed of visual information processing are observed in extreme players, high level of stress in linear players and high level of nonverbal intelligence in the welterweight players. The analysis of the results points to the relevance of the

chosen topic, and the results of the research can be used to select athletes in teams of different levels, orientation on the choice of sport, and, even, on the possible forecast of success.

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