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Cognitive Characteristics of Skilled Badminton Players

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Abstract

Study of the cognitive characteristics of qualified badminton players. 34 qualified badminton players, 12 men and 22 women were test subjects. Testing was carried out individually. Analysis of scientific and methodological literature and world experience shows that the study of psychophysiological characteristics provides additional information about an athlete's functional state during training and competitive activities. It is known that sports results largely depend on the individual typological characteristics of a person, as well as on the extent to which these features are used to realize the entire spectrum of the athlete's capabilities. Activation of higher nervous processes is present in almost all components of sports activity and provides a quick reaction, perception and processing of information, the speed of mastering technical elements and quick switching from one type of activity to another. The study of the cognitive characteristics of badminton players was organized using the hardware-software computer complex "Multipsychometer-05". In our research, the first part of Raven's advanced progressive matrices was applied. It is an express version of the test, consisting of 12 tasks and covers the entire range of possibilities diagnosed by the full test. The main informative indicator of the test is performance – the total number of correctly completed tasks for the entire time of the test (the total number of correct answers). The test execution speed, accuracy, efficiency are also determined. The analysis of Raven's progressive matrices showed that qualified badminton players have an average level of productivity, speed and accuracy, a level below the average of test performance. The study of cognitive abilities, taking into account sexual dimorphism, showed that, in terms of speed and quality indicators of cognitive tests, women demonstrate significantly better values in relation to men. General cognitive abilities can be used as diagnostic and prognostic criteria in the selection process for qualified badminton players.

Keywords: psychophysiological characteristics, Raven's matrices, cognitive abilities, badminton players

Introduction

Badminton is considered one of the three most hard sports game in relation to physical loadings and is the fastest one among the so-called "racquet sports". According to its characteristics, badminton refers to a game complex coordination sport, it is characterized by the following features: speed of movement, speed of thinking, speed of execution of techniques (Bekiari, Perkos, & Gerodimos, 2015).

Badminton is characterized by high speeds, variety and rapid changes in attacking and defensive actions, the intensity of tactical combat and extreme emotional stress. During the game, a badminton player must assess adequately the playing moment, as soon as possible determine the further development of game events, choose the best option and implement it. Decision making on the further development of a game situation is based on the perception and processing of a huge amount of information, both from the outside and from working muscles (Korobeynikov et al., 2019).

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The study of psychophysiological characteristics provides additional information about the athlete's functional state during training and competitive activities. After all, it is known that sports results largely depend on the individual typological characteristics of a person, as well as on the extent to which these features are used to implement the entire spectrum of the athlete's capabilities (Cabello, Padial, Lees, & Rivas, 2004; Lyzohub, Chernenko, & Palabiyik, 2019).

Experts point out that the assessment of athletes by psychophysiological qualities is more predictable than determining the level of development of physical qualities, because psychophysiological qualities are genetically determined and less dynamic in ontogenesis than physical qualities (Lyzohub et al., 2019; Korobeynikov et al., 2019).

The modern system of complex control in sports consists of various components, and in our opinion, psychophysiological research is one of the most important (Iermakov et al., 2016; Kozina et al., 2017). When deciding which the athlete's psychophysiological characteristics should be taken into account as qualitatively important, it is necessary to proceed from the principle of the unity of personality and activity. Therefore, those psychophysiological characteristics that correspond to the requirements of a particular sport and affect the achievement of high sports results are considered important (Fahimi, & Vaez-Mousavi, 2011; Subarjah, Gilang, Sandey, & Amanda, 2019).

The analysis of references showed that neurodynamic functions can be attributed to the main psychophysiological characteristics that affect the success of game activity. They are congenital, unchanged, change little in ontogenesis and play an important role in determining the signs of human behavior and psyche (Makarenko & Lyzohub, 2007; Korobeynikov et al., 2020; Chernenko et al., 2020).

The analysis of the psychophysiological state of badminton players forms an idea of the objective state of the players. The general functional state of the organism is an idea of the functional system that controls a specific type of activity and characterizes the level of functioning of individual systems of the organism (sensory, intellectual, motor) or the athlete's organism as a whole (Tyshchenko et al, 2020).

During the study of any psychophysiological state, it is necessary to study all levels and make conclusions about the human condition based on a set of indicators characterizing each of the levels.

Numerous criteria for the elements of a functional system that affect the result of activity determine the psychophysiological mechanisms of human activity (Isaychev et al., 2012). Therefore, it is important to assess the methods of perception and processing of information at the decision-making level (Wu et al., 2013). Many authors have substantiated and proven that the properties of nervous processes are genetically determined (Korobeynikov et al., 2006; Kozina et al., 2018).

This theory is of decisive importance in the further devel-

opment of the conceptual foundations of studies of the psychophysiological properties of behavior and remains the basis for substantiating the biological foundations of individual behavior. However, there is no idea about the nature of the manifestation of cognitive functions in qualified badminton players.

The purpose to study the cognitive characteristics of qualified badminton players.

Methods
Subjects
34 qualified badminton players: 12 boys and 22 girls (aged 14-16) were examined. All athletes had badminton training experience from 4 to 6 years and level of qualification of candidates for master of sports. Testing procedures were carried out individually.

Testing Procedures
The study of the cognitive characteristics of badminton players was organized using the hardware-software computer complex "Multipsychometer-05". In our research, the first part of Raven's advanced progressive matrices was applied. It is an express version of the test, consisting of 12 tasks and covering the entire range of possibilities diagnosed by the full test. Raven's test is known as measurements of the general nonverbal intelligence. The success of this test is interpreted as an indicator of the ability to learn. The test contains 60 tasks, distributed over five series. The test includes five series (12 tasks), each next task in the series is more complex than the previous one. The test result is the total number of correctly solved problems.

The main informative indicator of the test is performance – the total number of correctly completed tasks for the entire time of the test (the total number of correct answers). The speed of the test execution, accuracy and efficiency are also determined.

Statistical analysis
Statistical processing of the research results was carried out on a PC using special software (MS EXCEL, STATISTICA 6.0). The main statistical characteristics of the studied indicators have been determined in the research. The median, lower quartile, upper quartile, and coefficient of variation were calculated. The statistical significance of the differences between the indicators was assessed using the Wilcoxon test.

Ethical clearance on this research was provided by Commission on Biomedical Ethics of the National University of Ukraine on Physical Education and Sport (on 12/16/2020, minutes No. 2), in accordance with the ethical standards of the Helsinki Declaration.

Results
Table 1 presents the results of testing the general cognitive abilities of badminton players. Badminton players have an average level according to the main informative indicator

Table 1. The level of general cognitive abilities of qualified badminton players in mixed gender group (n=34)

Test	Characteristic	Statistical parameters			
		Median	Lower quartile	Upper quartile	CV (%)
Raven's Advanced Progressive Matrices	Productivity, beeps	9.00	6.00	10.00	25.95
	Speed, beep per minute	4.12	3.43	6.07	58.57
	Accuracy, conventional unit	0.75	0.50	0.83	26.77
	Efficiency, %	53.57	21.42	67.46	52.79

(productivity) (Me = 9), the range of values is from medium to high, the group is heterogeneous (CV = 25.95%).

The test execution speed in the sample corresponds to the average level (Me = 4.12 beeps per minute), the scatter of the indicators ranges from the average to the high level, the group is heterogeneous (CV = 25.95%).

The quality (accuracy) of the test is at an average level (Me = 0.75), the range of values is from low to medium, the group is heterogeneous (CV = 26.77%).

Badminton players have a level below the average in terms of efficiency (Me = 53.57%), the range of values is between low and medium levels, the group is heterogeneous.

If we compare the general cognitive abilities of men and women who play badminton at a high level (Table 2), then the analysis of the Raven's Progressive Matrices test showed that women demonstrate significantly the best values in terms of the main informative indicator of productivity, with the best indicators of the spread (lower and upper quartiles).

Table 2. The level of general cognitive abilities of qualified badminton players accounting for gender differences

| Test | Characteristic | Statistical parameters | | | |
| | | Men (n=12) | | Women (n=22) | |
		Median	Lower quartile; upper quartile	Median	Lower quartile; upper quartile
Raven's Advanced Progressive Matrices	Productivity, beeps	8.00	6.00; 9.00	10.00*	7.00; 10.00
	Speed, beep per minute	3.95	3.13; 5.35	4.35	3.47; 6.53
	Accuracy, conventional unit	0.67	0.50; 0.75	0.83*	0.58; 0.91
	Efficiency, %	42.06	21.42; 53.57	67.46*	30.55; 82.93

Legend. * - the difference is statistically significant in relation to men at the level p=0.05

The speed of the test in men and women is at an average level and does not have a statistically significant difference, although the tendency for better results remains in women, both in the median and in the lower and upper quartiles.

The results of Table 2 indicate that, women have significantly better values in terms of the quality (accuracy) of the performance of cognitive abilities testing, both in terms of the median and the range of indicators. Summarizing the results of the study of the cognitive characteristics of badminton players, we can conclude that athletes who play badminton at a high level have an average level of general cognitive abilities, and women show significant differences in speed and quality indicators of cognitive tests.

Discussion

In modern sports science, much attention is paid to the development of methodological approaches that allow assessing the functional state of the athlete's nervous system (Bekiari et al., 2015; Kozina et al., 2017).

In team sports, efficiency and performance depend on high speed qualities, an unexpected alternation of attacking and defensive actions, an abundance of tactical decisions and extreme emotional stress (Ivaskevych et al., 2020; Petrovska et al., 2020).

Considering that the effectiveness of qualified badminton players depends on the athlete's ability to perceive, analyze and process information, the study of psychophysiological functions in order to monitor the athlete's functional state and correct the training process is very important (Kostiukevych et al., 2020).

The study of psychophysiological characteristics provides additional information about the functional state of an athlete during training and competitive activities. After all, it is known that sports results depend largely on the individual typological characteristics of a person, as well as on the extent to which these features are used to implement the entire spectrum of an athlete's capabilities (Klymovych et al., 2020).

Modern elite sports can be classified as extreme conditions of life, requiring constant physical, mental and emotional ef-

forts. It is under such conditions that the innate properties of the nervous system are clearly manifested (Makarenko & Lyzohub, 2007; Korobeynikov et al., 2020).

The manifestations of higher nervous processes are present in almost all components of sports activity and provide a quick response, quick perception and processing of information, the speed of mastering technical elements and a quick switch from one type of activity to another (Lyzohub et al., 2019; Chernenko et al., 2020).

Badminton is characterized by high speeds, variety and rapid changes in attacking and defensive actions, the intensity of tactical combat and extreme emotional stress. During the game, a badminton player must adequately assess the playing moment, as soon as possible determine the further development of game events, choose the best option and implement it. The basis for making a decision on the further development of a game situation is the perception and processing of a huge amount of information, both from the outside and from working muscles (Romanenko et al., 2020).

Like any game activity, badminton game goes in the form of solving tactical problems related to the perception of moving objects (shuttlecock, contestant), the assessment of movement parameters, provided for the development of the game situation and the adoption of operational decisions. In the process of training, specialized psychomotor functions reach a particularly high level, which determine the effectiveness of preventive responses to a moving object, as well as the speed of perception and processing of information. The success of motor activity is provided by a high level of processes of perception, analysis, comparison and generalization based on visual-motor coordination, fine differentiation of muscle-motor sensations, spatial and temporal perception of various movements (Tyshchenko et al., 2020; Petrovska et al., 2020).

At the same time, cognitive abilities are considered as individual stable features that determine the originality of the strategy of perception and processing of information, problem solving, learning and other types of cognitive activity.

The analysis showed that qualified badminton players have an average level of productivity, speed and accuracy of per-

ception and processing of non-verbal information. In terms of speed and quality indicators of cognitive tests, female badminton players demonstrate significantly better values in relation

to men. General cognitive abilities can be used as diagnostic and prognostic criteria in the selection process for qualified badminton players.

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