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COORDINATION AND ORIENTATION ABILITIES IN CHILDREN WITH CEREBRAL PALSY DURING FOOTBALL

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Abstract

The purpose of the study was to study the effect of a special complex of physical exercises (SKFU) on the indicators of spatial and temporal orientation and coordination abilities in children with cerebral palsy during indoor football. Materials and research methods. The study was conducted in the State Educational Institution “Boarding School No. 5” in the Samara Region, Togliatti, with children with cerebral palsy at the age of 10-12, the main group (MG) was 10 boys involved in SKFU for futsal. In the comparison group (CG) 10 boys, was engaged in futsal according to the usual school curriculum. Results. The article provides an experimental justification for the use of SKFU in futsal for the development of coordination abilities in children with cerebral palsy 10-12 years old. It was shown that at the ascertaining (initial) stage of the pedagogical experiment, the psychophysiological and motor indices in the exhaust gas and HS did not differ significantly. After formative exercises using SKFU in the exhaust gas, they received a significant improvement in spatio-temporal indicators and coordination abilities in comparison with the comparison group. Conclusion The use of SKFU when playing futsal contributes to the development of coordination abilities, spatio-temporal orientation, reduction of spastic disorders, and improvement of motor abilities.

Keywords: Central nervous system, cerebral palsy, futsal, spastic form of cerebral palsy, spatial-temporal orientation.

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1. Introduction

In the world and in the Russian Federation, the contingent of children with disabilities (HIA) is growing due to persistent structural and functional changes in the body (Bartlett & Palisano, 2000; Boop et al., 2001; Fennell & Dikel, 2001; Macdonald, 1995; Palisano, 2000; Sadovsky, 1997; Shevell et al., 2011; Sobrado et al., 1999; Stepanova et al., 2018; Stepanova et al., 2019). The total number of children suffering from various nosological groups of degenerative-dysfunctional pathologies is more than 100 million in the world (Agarwal & Indreshwar, 2012; Bagatell et al., 2017; El-Sobky et al., 2017; Hauer & Houtrow, 2017; Leviton et al., 2007; Makhov & Medvedev, 2018; Mathewson & Lieber, 2015; Osika et al., 2018; Oskoui et al., 2013; Panteliadis et al., 2013; Rosenbaum et al., 2007; Smith & Kurian, 2016). One of the common diseases that is accompanied by motor disorders is cerebral palsy (Abasov & Aleksyutina, 2016; Kachesov, 2005; Khamitov & Shmeleva, 2016; Osika et al., 2018).

According to the World Health Organization (WHO), in 2019, the incidence rate of cerebral palsy in the world was 8 children per 1000 births, in the Russian Federation these figures are higher and reach 10-12 children / 1000 births. It is believed that sports games in the form of futsal are an important component of rehabilitation therapy for a certain part of children with cerebral palsy, who do not have medical contraindications for these activities (Alimov & Mishchenko, 2018; Korkishko, 2018). Futsal is a dynamic, “live” game (Koroleva, 2008; Naumets & Zaloylo, 2010; Osika et al., 2018).

The use of all these motor actions (contact interactions by players in the fight for the ball, the dynamism of game situations, the start and constant change of direction of movement during running, targeted hits on the ball) are based on coordination abilities (CS), which should have a certain level of development for players (Jalbe & Jalbe, 2018; Kalyuzhin & Golubeva, 2016; Lelekova, 2016).

The main components of the coordination abilitiesare spatial-temporal orientation, balance skills to maintain vertical stability of the body, coordination of movements (Kalyuzhin & Golubeva, 2016; Korkishko, 2018; Lyakh, 2009).They are based on the interaction of the central (parts of the central nervous system) and peripheral (neuromuscular apparatus) links of the motor analyzer (MA), a certain level of development of which at a certain level is necessary for those involved in this type of adaptive physical culture (APC) (Botyaev & Zagrevskiy, 2009; Jalbe & Jalbe, 2018).

To assess the spatial-temporal orientation, a computer program “Researcher of temporal and spatial properties of a person version 2.1” (IVPS) was used (manufacturer: Scientific-Methodological Center Analyst LLC, Omsk) (Koryagina, 2006; Koryagina & Nopin, 2004). This computer program is based on the registration of a variant of the sensorimotor reaction of the subject, for which extrapolation is necessary - spatio-temporal foresight.

2. Problem Statement

Research by Botyaev and Zagrevskiy (2009), showed that the ability to visual and spatial-temporal orientation is important in various sports. It allows you to determine and timely change the position of the body for movement in the right direction based on processing in the central nervous system of spatio-temporal information (Malygina & Vorzheva, 2016; Makhov & Medvedev, 2018). In children with

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cerebral palsy due to neurophysiological disorders of the central nervous system, these processes have injuries of varying severity and need rehabilitation and correction (Makhov & Medvedev, 2018).

3. Research Questions

Research Objectives:

1) to evaluate the initial level of the processes of excitation and inhibition in the central nervous system in children with a spastic form of cerebral palsy at the age of 10-12 years at an ascertaining stage of the pedagogical experiment;
2) experimentally determine the effectiveness of SKFU in futsal, for the development of CS at the formative stage of pedagogical experiment;
3) to analyse the resulting results in children with cerebral palsy at the control stage of the pedagogical experiment using the program "Researcher of temporal and spatial properties of a person version 2.1" (IVPS).

4. Purpose of the Study

The purpose of the study was to study the influence of SKFU on the indicators of spatial and temporal orientation and coordination abilities in children with cerebral palsy during indoor football.

5. Research Methods

The study involved 20 children aged 10 to 12 years with a diagnosis of cerebral palsy with spastic forms of impaired motor function, which were admitted to systematic mini-football classes for medical reasons. The main group (OH) and the comparison group (HS) included 10 boys with cerebral palsy. The study was conducted for 9 months (from September 2018 to May 2019) based on the SBEI "Boarding School No. 5", Samara Region, Togliatti.

Lessons were held 3 times a week for 40 minutes in the exhaustive group, while at one lesson, they used SKFU, and in the CG they also practiced 3 times in futsal, but according to the standard educational program. The physical characteristics of the children in the exhaust gas and gas were similar.

For the diagnosis of spatio-temporal indicators in children with cerebral palsy, 4 tests were used from the program "Researcher of temporal and spatial properties of a person version 2.1" (IVPS)": which included:

1. Determination of the time of a simple sensorimotor reaction (SMR)

The technique consists in delivering a light or sound stimulus, upon presentation of which, the subject presses a button on the computer keyboard. Reaction time is measured using a system timer.

2. Determination of the reaction time to a moving object (RMO)

The measurement of RMO consists in monitoring the test subject for a red circle moving to the centre of the monitor indicated by a cross; the end of the movement is an incentive to determine the time of the motor reaction. To obtain a reliable estimate of the time of the RMO, which allows us to draw a

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conclusion about the relationship between the processes of excitation and inhibition in the central nervous system; we calculated the sum of delay errors and the amount of lead errors.

3. Determination of the reaction time of choice (RTC)

The reaction time of choice is one of the options for a complex sensorimotor reaction; when performing it, it is necessary to differentiate the signal according to the scheme: "reaction - no reaction." The selection reaction consists in pressing a key to the appearance of a small circle of two stimuli of a large and small red circle, appearing in a random order in the centre of the monitor screen.

4. Determination of the duration of an individual minute

When examining the assessment of the duration of an individual minute, the test subject must measure the 60-second interval by pressing a key at the beginning and end. The time estimate for the duration of an individual minute is measured using a system timer by calculating the difference between the start and end time of the measurement (Koryagina, 2006; Koryagina & Nopin, 2004).

5. Methods of mathematical statistics

Data processing was carried out using the software package SPSS for Windows version 17.0. To compare empirical distributions with normative indices in the exhaust gas and HS, the t-student parametric criterion for paired samples was used. The statistical significance of the presence of differences was determined at the level of $p \leq 0.05$.

6. Findings

The study included three stages:

Stage 1 - ascertaining - (September 2018 - November 2018) - groups of children of the exhaust gas and gas were selected, the initial indicators of coordination abilities, temporal and spatial properties in children with cerebral palsy of 10-12 years were measured.

Stage 2 - formative - (December 2018 - May 2019) - classes were conducted on SKFU (Table 1), which was aimed at the development of CS and spatio-temporal indicators in children with cerebral palsy at the age of 10-12 years.

Stage 3 - control (June 2019 - July 2019). The final diagnosis of the parameters of coordination abilities and spatio-temporal parameters in children with cerebral palsy at the age of 10-12 years and their comparison with the indicators of the ascertaining stage of the study were carried out in the exhaust gas and gas.

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Table 01. Special Complex of Physical Exercises (SKFU) for the development of spatial and temporal orientation and coordination abilities of children with cerebral palsy

Exercise Name	Execution Terms
1. The development of coordination of movement and a sense of ball.	It is necessary to complete the task of the stroke on the coordination ladder, then run to the ball and bring the ball to the rack, which is located at a distance of 8 meters.
2. Performing exercises at three stations.	Chips are arranged in a triangle, each player has a chip. Moving players by the whistle of the coach with the ball to each chip.
3. A mobile catch-up game with a soccer ball	It is necessary for the players to pass the ball between themselves and touch the ball with other players who are without the ball and run away from them.
4. Performing the ball, in a fraudulent movement with the ball into the free space between the defenders	Players must feel the distance and move in time
5. Dribbling in a confined space	Players become in one column and 6 chips are located in front of them. Each player takes turns dribbling the ball between the chips, the inside of the foot and the outside (right, left foot).

Results. The study used physical training tools for the progression of spatial and temporal orientation and coordination abilities in children with spastic forms of cerebral palsy.

When conducting pedagogical experiment MG and CG, we studied the indicators characterizing the spatial functions and coordination abilities of the students. Insignificant differences were obtained in the initial indices in the compared groups of MG and CG in children with cerebral palsy during indoor football. The test results for the three stages of pedagogical experiment we presented in table 2-3.

Table 02. The results of testing the spatio-temporal properties of children with cerebral palsy of 10-12 years in the exhaustive and sporting classes during an indoor football

Tests	At the beginning of the study		At the end of the study		Tests norm
	MG	CG	MG	CG	
Determination of SMR time	0,34± 0,01	0,34± 0,03	0,28± 0,3*	0,34± 0,11	0,26-0,33 (c.)
Reaction to a moving object (RMO)	0,34± 0,01	0,33± 0,13	0,25± 0,01*	0,31± 0,23.	0,14-0,30 (c.)
Determination of the reaction time of choice (RTC)	0,51± 0,12	0,50± 0,17	0,38± 0,08*	0,47± 0,14	0,34-0,45 (c.)
Determination of the duration of an individual minute (DIM)	56,1± 0,02	55,4± 0,03	49,8± 0,12*	54,7± 0,14	48-53,67-71

Note: * - $p < 0.05$

Testing data of children with cerebral palsy in the CG did not show significant changes after classes according to the traditional program of adaptive physical education of children with cerebral palsy.

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According to the results of the ascertaining stage of the pedagogical experiment in the exhaust gas presented in Table 2, it can be concluded that classes with the use of the developed SKFU for children diagnosed with cerebral palsy led to a significant acceleration in the response of children to the presented stimuli. This reflects the optimization of the neurophysiological state of the central nervous system and its interaction with the executive apparatus of the muscle complex. In the cortical structures of motor analyzer(MA), the processes of excitation and inhibition are stabilized (RMO test), the number of leading or delayed reactions of children with cerebral palsy to the presented stimuli decreases, and the number of precise reactions increases. There is also an increase in the number of students accurately determining the time range of an individual minute, which confirms the balance of the central nervous system of children with cerebral palsy in the exhaustive.

The data obtained indicate that after special exercises in the exhaustive group the state of sensorimotor interaction improves, motor performance and the level of training of young football players with cerebral palsy increase. This allows players with cerebral palsy to more co-ordinatedly and coherently perform motor actions in the process of playing futsal in the MG, in contrast to the CG. It should be specially noted that the indicators of SMR, RMO, DIM, the response time of the choice, approached the normal values recorded in healthy children.

Therefore, the use of SKFU for the development of motor capabilities of children with cerebral palsy has received experimental confirmation.

The influence of the traditional occupations of APC and SKFU on coordination opportunities for improving the technical preparedness of children with cerebral palsy for playing futsal activities we show in table 3.

Table 03. Testing results for children with cerebral palsy 10-12 years old in the exhaust gas and sports while playing mini-football

Tests	**at the beginning of the study**		**at the end of the study**	
	MG	**CG**	**MG**	**CG**
Running with fitting racks (5 racks, distance 2 m.) Sec/	11,47± 0,15 c.	10,99± 0,17	8,04± 0,01* c	. 9,98± 2,19
Slalom dribbling with a shot on goal (5 chips, distance 2 m.) Sec.	13,22± 0,08	13,01± 0,9	11,35± 0,01*	12,05± 1,08
Dribbling the ball with his back forward sec.	14,88± 0,14	14,67± 0,15	12,28± 0,12*	13,99± 2,14
Kick the ball at the target from 8 meters (number of accurate hits)	3± 0,03	3± 0,04	8± 0,12*	4± 0,18
Slalom with two balls (5 racks, distance 2 meters) sec.	18,01± 0,18	18,03± 0,16	15,01± 0,11*	17,87± 2,15

Note: * - $p < 0.05$

As we can see from table 3, there were no significant differences when testing the coordination abilities of children with cerebral palsy of 10-12 years old in the civil society after conducting classes according to the traditional APC-program during mini-football classes. While the application of the developed SKFU allowed obtaining an improvement in the physical fitness of children with cerebral palsy for indoor football. So, the running time with running around the racks decreased by 25%, dribbling

by 13%. Important is the improvement of such an indicator as hitting the target, which has increased 4 times.

Accuracy indicator, according to Golomazov, is the most important criterion for assessing the effectiveness of motor actions (as cited in Golomazov & Chirva, 2001). This allows us to recommend this type of training to improve the coordination abilities and psychomotor performance of children with cerebral palsy, engaged in futsal.

1. Classes of young football players with cerebral palsy of 10-12 years using special exercises aimed at developing CS, led to an improvement in the spatio-temporal orientation indicators, which are based on an increase in the balance of neurophysiological processes in the central nervous system. The indicators of SMR, RMO, DIM, the reaction time of the choice approached the indicators of healthy children.
2. The performance of motor tests characterizing coordination abilities, especially the accuracy of hitting the target, significantly improved. Therefore, the running time with running around the racks decreased by 25%, while dribbling the ball by 13%, the accuracy of hitting the target increased 4 times.
3. The results obtained improve the indicators of spatial and temporal orientation and coordination abilities to recommend the training developed by SKFU for training young football players with a diagnosis of cerebral palsy.

7. Conclusion

The modern world lives by the laws of society, often ignoring the laws of nature, on which the natural biological needs of the body are based. Therefore, Ya. A. Comenius (1592-1670) was justified as the main principle of didactics, the law of nature learning, that is, as much as possible full consideration in the educational process of the qualities and abilities of the child, as well as their development.

At present, non-optimal social and environmental conditions, demographic problems, intensification of the educational load in the field of education, difficulties in organizing medical care for the population have led to the growth of all types of diseases. The most negative impact of socio-environmental factors is affected by the children's population of all ages, reacting with deteriorating health indicators and increased disability, which is manifested in an increase in the number of children with severe neurological disease of cerebral palsy.

Rehabilitation requires a deep scientific study of the causes and mechanisms of the disease, as well as the development of new effective methods of rehabilitation of sick children to improve the quality of life and adaptation in society. Classes of children with cerebral palsy with such a popular sport as futsal help to develop their coordination abilities with the help of a set of special exercises, which was experimentally confirmed in the study.

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